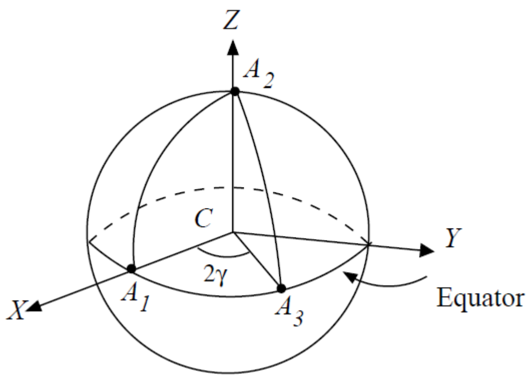
QN	Solution	Marks
III.1	Step 1: Superposition $$\delta = \omega\Delta t = \frac{\omega d\sin\theta}{c}$$ $$\left\lvert\mathbf{E}_1+\mathbf{E}_2\right\rvert^2 = E_0^2\left[\cos^2(\omega t)\left(1+2\cos\delta+\cos^2\delta\right)+\sin^2(\omega t)\sin^2\delta - 2\cos(\omega t)\left(1+\cos\delta\right)\sin(\omega t)\sin\delta\right]$$	0.4 0.2
	Step 2: Time averaging: $\overline{\cos^2\omega t} = \overline{\sin^2\omega t} = 1/2$ and $\overline{\sin(\omega t)\cos(\omega t)} = 0$,	0.3
	Step 3: Intensity $$I(\theta) = \beta\overline{\left\lvert\mathbf{E}_1+\mathbf{E}_2\right\rvert^2} = \beta E_0^2\left(1+\cos\delta\right)$$	0.1
III.2	The beam 1 has travelled extra optical path $= (\mu-1)\,w$.	0.4
	Thus the net phase difference between two beams when they emerge at the angle θ, $$\delta = \frac{\omega}{c}\left(d\sin\theta - (\mu-1)\,w\right)$$	0.2
	and $I(\theta) = \beta E_0^2\left(1+\cos\delta\right)$.	0.4
III.3	The two beams have travelled exactly same paths upto the slits. Thus when they emerge at an angle θ, they have a net phase difference of $\delta = \omega d\sin\theta/c$. Then, notice $$\left\lvert\mathbf{E}_1+\mathbf{E}_2\right\rvert^2 = \left\lvert\mathbf{i}\left[\frac{E_0}{\sqrt{2}}\cos(\omega t)+E_0\cos(\omega t+\delta)\right]+\mathbf{j}\left[\frac{E_0}{\sqrt{2}}\sin(\omega t)\right]\right\rvert^2$$	0.70 for x component and 0.3 for y component
	$$\left\lvert\mathbf{E}_1+\mathbf{E}_2\right\rvert^2 = E_0^2\left[\cos^2(\omega t)\left(\frac{1}{2}+\sqrt{2}\cos\delta+\cos^2\delta\right)+\sin^2(\omega t)\sin^2\delta + 2\cos(\omega t)\left(\frac{1}{\sqrt{2}}+\cos\delta\right)\sin(\omega t)\sin\delta\right]+\frac{E_0^2}{2}\cos^2(\omega t)$$	0.3
	Thus, after taking time averages, the intesity will be $$I(\theta) = \beta E_0^2\left[1+\frac{1}{\sqrt{2}}\cos\left(\frac{\omega d\sin\theta}{c}\right)\right]$$	0.3

QN	Solution	Marks
	The minimum value of the intensity is $\beta E_0^2\left[1-\frac{1}{\sqrt{2}}\right]$. Maximum value is $\beta E_0^2\left[1+\frac{1}{\sqrt{2}}\right]$	0.2+0.2
III.4	The electric field at $z=b$ is given b $\mathbf{E}_1(z=b) = \frac{1}{\sqrt{2}}\left[E_0\cos\left(\omega t-kb-\gamma\right)\right]\mathbf{i}'$	magnitude 0.8 , direction 0.2
	The electric field at $z=b$ is given by $\mathbf{E}_1(z=c) = \frac{1}{\sqrt{2}}\cos\gamma E_0\cos\left(\omega t-kc-\gamma\right)\mathbf{i}$	magnitude 0.3, direction 0.2
	Phase difference $\alpha=\gamma$.	0.5
III.5	At equator $e=0$. Then $\mathbf{E}=\mathbf{E}_{\mathrm{Eq}}=\mathbf{i}'E_0\cos\left(\omega t\right).$ Clearly the beam is linearly polarised along $\mathbf{i}'$.	$\mathbf{E}$: 0.2 Linear Polarization: 0.3
III.6	At north pole $e=\pi/4$ and γ can be taken to be 0. Then $\mathbf{i}'=\mathbf{i}$ and $\mathbf{j}'=\mathbf{j}$. The electric field $\mathbf{E} = \mathbf{i}\frac{E_0}{\sqrt{2}}\cos\left(\omega t\right)+\mathbf{j}\frac{E_0}{\sqrt{2}}\sin\left(\omega t\right)$ or $= \mathbf{i}\frac{E_0}{\sqrt{2}}\cos\left(\omega t+\gamma\right)+\mathbf{j}\frac{E_0}{\sqrt{2}}\sin\left(\omega t+\gamma\right)$ which represents circular polarisation.	$\mathbf{E}$: 0.2 Circular Polarization: 0.3
III.7	Figure  	A1 on x axis 0.3, A2 on the north pole 0.5, A3 on equator 0.4, angle of 2γ 0.3
III.8	From figure it is clear that the area of the spherical triangle $A_1A_2A_3$ is $2\pi\times\left(\frac{2\gamma}{2\pi}\right)=2\gamma$	0.7
	Thus the phase difference α is half the area S of the spherical triangle $A_1A_2A_3$ on Poincare sphere i.e. $S=2\alpha$.	0.8