LECTURE 26 questions

21	TWO-SLIT INTERFERENCE
	LONSIDSE THE POINT (x)
· · · · · ·	B SLITS MIDWAY BETWEEN THE TWO SLITS
a) w	HAT is THE PATH - LENGTH DIFFERENCE OF FOR THE TWO
· · · · · · · · · · · ·	SSIBLE PATHS A 4 B THAT LIGHT CAN TAKE TO REACH (\times)
· · · · · ·	
b) 5-1 101	PPOSE WE BLOCK THE DER SLI7, ELIMINATING PATH B:
A~ (x)	D MEASURE THE INTENSITY AT B 7. BZ IX BLOCKED
	WHAT INTENSITY I AND WE
	WABLOCK THE SLIT?
	$\left[\begin{array}{c} H_{1} \times 7 \\ \end{array}\right] \xrightarrow{\text{AMPLITAB23}} \xrightarrow{\text{APD}} \left(\begin{array}{c} H_{1} \times 7 \\ \end{array}\right)$
r ٦ (^C) /هن	$\frac{1}{2} p_{0} \cup \frac{1}{2} R \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 1 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \\ 1 & 2 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times) & 1 \end{array} \right) \xrightarrow{\text{MODOROSD}} \left(\begin{array}{c} (\times$
-74E	(PT.(b))

A) NOW Suppose WE MOVE OUR	point Source Down, AS (LLSTRATED :
	· 15 AT STILL ZERO?
point source	
B A A A A A A A A A A A A A A A A A A A	() WHERE TO US N220 70 MONE (*) 70
<> ^{20,13} .	50 7HAT AT IS ZEED AGAIN?
L L	Suppose For Simplicity THAT. THE SUTS
	ARE HALFWAY BETWEEN THE SCREEN 1
	THE POINT SALECE
	IN GENERAL, WHAT DOES SHIFTING THE
	point Source Do To THE INTERERINCE
	PATTSEN C THE SCREEN?

DIFFRACTION RZ (a) RADIO TRANSMITTER RADIO BAND SHOULD WHA7 THE TRANSMITTER BROADCAST To optimite RECOPTION on · @ THE RADIO RECEIVER THE OTHER SIDE OF THE HILL : • FM (f = 100 MHz] or · AM [f= |MH2]? (HINT : WASES DIFFERACT PAST EDGES IN A MANNER SIMILAR To Differenceion pasa shirs] incomme WAVE EDGE "SHADOW" DIFF RACTION

b)
Pidnerser Pinnerser
PDINT SOURCE
· IN RAY OPTICS, THE SPOT FORMED BY A POINT SOURCE ON THE
SCREEN of A PINHOLE CAMERA 6275 SMALLER AS THE PINHOLE
DIAMETER DECREASES SINCE FEWER RAYS ARE ABLE TO
MAKE 17 INTO THE CAMERA
· WAVE OPTICS, HOWEVER, WARNS us THAT WHEN THE PINHOLE
GETS TOO SMALL, DIFFEACTION WILL ACT TO INCREASE
742 Spo7 Size.
(Roughly) How LARGE SHOULD you MAKE THE
PINHERE G27 THE SMALLEST Spot SIZE ON THE
CAMERA SCREEN?
1.2. WHEN DO THE RAY & WAVE THEORIES PREDICT
742 SAM2 5007 5122?
+ I.E. USE THE EQUATION FOR THE DIFFERENCION SPOT SIZE, EVEN THOUGH,
STRICTUR SPEARING, THIS ER- APPLIES FOR SLIT-SIMPSO APSRTURES, NOT CIRCULAR

points separates by an set division of the Suit WIDT $\left(\int \frac{1}{2} \frac{\omega}{2}\right)$ RESULTED IN TOTAL DESTRUCTIVE INTERPRETATION $\left(\int \frac{1}{2} \frac{\omega}{2}\right)$ 26. $d = \frac{\omega}{4}$. ω_{1} 10° and of points $U_{10^{\circ}}$ and $U_{10^{\circ}}$ $U_{10^{\circ}}$ and of points $U_{10^{\circ}}$ and $U_{10^{\circ}}$ $U_{10^{\circ}}$ and $U_{10^{\circ}}$	IN THE NO	5725 WE AR	0020 7HA7 DESTE	werve write 2290 2	~IS-7.7.J
PSSULTED IN TOTAL DESTRUCTIVE INTERPRETARY (2) THE SCREEN $E(C, d) = \frac{1}{2}$ (1) $($	points sep	ARATED BY A	J. SUEN Division	ge THE SUT WIDTH	$=\frac{\omega}{2}$,
$z_{16} = \frac{\omega}{4} \qquad \omega_{1}$ $z_{16} = \frac{\omega}{1} \qquad \omega_{1}$ w_{1}	RESULTED in	N TOTAL DE	structive inter	ERENCE @ 142 SCREEN	ป: .
$\sum_{i=1}^{2} G_{i} = \frac{1}{2} \qquad \qquad$			· · · · · · · · ·	ZERD INTENSITY	
$ \begin{split} & \omega_{HY} \forall o \omega \in Not OBS ZRUE ZEES INTENSITY () \\ & AN ANGLE \Theta \omega_{HERE} \omega \in Haute Destruction of the initial o$		2.6. ∂= 4	ωl		• •
$ \begin{array}{c} & \label{eq:construction} & c$					
• WHY TO WE NOT DESTRUE ZERO INTENSITY AN ANGLE O WHERE WE HAVE DESTRUCTIVE INTEGERATION BETWEEN POINTS SEPARATED BY AN ODD DIVISION OF THE SLIT WIDTH $\left(J = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \cdots \right)^{7}$ WHY NOT E.G. $J = \frac{\omega}{3}$: ω_{13} ω_{1					
$ \begin{array}{c} \omega_{Hy} \Rightarrow_{o} \omega_{E} \text{ Not Obstrue Zero Intensity } \\ AN ANGLE & where we have destructive integers. \\ Between points separated by AN obd Division of The SLIT width \left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)^{2} \\ The SLIT width \left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)^{2} \\ \omega_{Hy} \text{ Not } \\ E.G. d = \frac{\omega}{3} \\ \vdots \\ \omega_{J_{3}} \\ 1 \\ 0 \\ 0$			180" 047 05	= pHASE	
• WHY TO WE NOT DESTRUE ZERO INTENSITY (AN ANGLE O WHERE WE HAVE DESTRUCTIVE INTEREED BETWEEN POINTS SEPARATED BY AN ODD DIVISION OF THE SLIT WIDTH $\left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)^{7}$ WHY NOT E.G. $d = \frac{\omega}{3}$ ω_{13} 10					
$ \begin{array}{c} & \ensuremath{\omega} H \psi \ \ensuremath{\overline{D}} \ \ensuremath{\omega} \ \ensur$					
AN ANGLE O WHERE WE HAVE DESTRUCTIVE INTERESSAN BETWEEN POINTS SEPARATED BY AN DDD DIVISION OF THE SLIT WIDTH $\left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)^{?}$ WHY NOT E.G. $d = \frac{\omega}{3}$ ω_{13} $1 \frac{\omega}{10}$ $1 \frac{\omega}{10}$	· WHY D	o we no	TOBSERVE	ZERO INTENSITY	Ø
BETWEELD WHERE WE HAVE DESTELETIVE INTEREER BETWEEN POINTS SEPARATED BY AN ODD DIVISION OF THE SLIT WIDTH $\left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)$? Why NOT E.G. $d = \frac{\omega}{3}$: $\omega_{/3}$ 10					
BETWEEN POINTS SEPARATED BY AN ODD DIVISION QF THE SLIT WIDTH $\left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)$? WHY NOT E.G. $d = \frac{\omega}{3}$ $\frac{\omega}{3}$ 10^{-1}	ANI ANILI	S A LOUGA	5		. .
THE SLIT WIDTH $\left(d = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{5}, \dots \right)^{?}$ WHY NOT E.G. $d = \frac{\omega}{3}$ $\omega/_{3}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$ $\int \frac{\omega}{10}$	AN ANGU	E O WHER	E WE HAVE	DESTRUCTIVE INTEF	2 R 9NC
$\sum_{i=1}^{n} (i - \frac{1}{3}) = \frac{1}{3}$	AN ANGU BETWEE	E O WHER	E WE HAVE SEPARATED BY	AN ODD Division	ERSNI OF
E.G. $J = \frac{\omega}{3}$: ω_{13} 10^{10}	ΑΝ ΑΝΟ	E O WHER	E WE HAVE SEPARATED BY	AN ODD Division	ersni of
$\Sigma \cdot G \cdot d = \frac{\omega}{3} \qquad \qquad$	AN ANGU BETWEE THE SLI	Е Ө ШНЕР Л РОМТS Т ШІР7н	$E WE HAVE$ $SEPARATED By$ $\left(\begin{array}{c} d = \frac{W}{1}, \frac{W}{3}, \end{array}\right)$	DESTELCTIVE INTER AN ODD Division	ERSNI 07
$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i$	AN ANGU BETWEE THE SLI	ε Θ ωнее J роімтs τ ωι D7н	$\sum \bigcup \sum HAJE$ $\sum Eprential By$ $\left(\begin{array}{c} J = \\ J = \\ 1 \end{array}, \frac{\omega}{3}, \frac{\omega}{3} \end{array}\right)$	DESTRUCTIVE INTER	5R.9 N
$ \begin{array}{c} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ $	AN ANGO BETWEE THE SU	ε Θ ωμεκ η ροιωτς τ ωιδτη	$\Sigma \omega \Sigma HAJE$ $SEPARATED By$ $\left(\begin{array}{c} J = \frac{\omega}{1}, \frac{\omega}{3}, \end{array}\right)$	DESTRUCTIVE INTER AN DDD Division Division Division Division Division Division Division Division Division Division Division	5259 of
	AN ANGU BETWEE 748 SLI 2.6. J	ε Θ ωμεκ	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	DESTRUCTIVE INTER AN ODD Division Why Not ZERD INTENSITY IN THIS DIRECTION	225 M
	AN ANGU BETWEE THE SLI E.G. J	ε Θ ωμεκ λ ροι∾τs τ ωιδ-7μ = ω 3	$\Sigma = \omega \Sigma + HAJE$ $S \in parameter D = By$ $\left(\begin{array}{c} J = \frac{\omega}{1}, \frac{\omega}{3}, \frac{\omega}{3} \end{array}\right)$	DESTELCTIVE INTER AN ODD DIVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION DiVISION	225 NO 07 7
1 1	AN ANGU BETWEE THE SU	ε Θ ωμεκ	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	DESTELCTIVE INTER AN ODD Division S S WHY NOT ZERD INTENSITY IN THIS Direction	229 NO 95
. .	ΑΝ ΑΝΟΟ Βετωεε 7με Sli 2.6.	ε Θ ωμεκ	$\sum \qquad \qquad$	DESTRUCTIVE INTER AN ODD Division Di Division Division Division Division Division Division Di	2R5~10 9F 7
	AN ANGU BETWEE THE SU	ε Θ ωμεκ	$\sum \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_$	DESTELCTIVE INTER AN ODD DIVISION S,]? WHY NOT ZERD INTENSITY IN THIS DIRECTION	2229 N
· · · · · · · · · · · · · · · · · · ·	AN ANGU BETWEE THE SLI	ε θ ωμεκ	$\sum \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_$	DESTELCTIVE INTER AN ODD Division Division S.J. J. J. Division S.J. J. ZERD INTENSITY IN THIS DIE ECTIC	2251
	AN ANGU BETWEE 742 SU	$\mathcal{E} \Theta \cup \mathcal{H} \mathcal{E} \mathcal{R}$ $\mathcal{A} P^{0} \mathcal{M}^{TS}$ $\mathcal{T} \cup \mathcal{D} \mathcal{T} \mathcal{H}$ $= \frac{\mathcal{U}}{3}$	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	DESTRUCTIVE INTER AN ODD DIVISION S,]? WHY NOT ZERD INTENSITY IN THIS DIRECTION	225.00
-	AN ANGU BETWEE 749 SU	$\mathcal{E} \ \Theta \ \omega \ HER$ $\sqrt{\frac{1}{2}} \ \mathbf{P}^{0 \omega TS}$ $\mathcal{T} \ \omega \ I \mathbf{D} \ \mathcal{T} \mathbf{H}$ $= \frac{\omega}{3}$	$E = WE + HAJE$ $SEPARATED = By$ $\left(\begin{array}{c} J = \frac{W}{1}, \frac{W}{3}, \frac{W}{3} \right)$	DESTELCTIVE INTER AN ODD DIVISION S,]? UNY NOT ZERD INTENSITY IN THIS DIRECTION	22500
	AN ANGU BETWEE THE SU	ε θ ωμεκ	$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i$	DESTRUCTIVE INTER AN ODD DIVISION S,]? WHY NOT ZERD INTENSITY IN THIS DEECTION	

ANSWERS
R1
PATH B is B Suits
JUST A REFLECTION
OF PATHA DISTANCES
TRAVELED ARE EQUAL SO DE = 0
WE EXPECT CONSTRUCTIVE INTERFERENCE
HEEE
b) THE AMPLITUDES WILL ADD, DOUBLING
THE AMPLIZUDE @ (x) SINCE THEY
ADD "IN PHASE" $(\Delta \Gamma = 0)$
$A^{*}_{A}(t) \qquad \qquad$
$= \left(A_{A}^{\times} + A_{B}^{\times} \right)^{2}$
$= \left(2 \Delta^{\times} \right)^{2}$
$A_{A_{A_{a_{a_{a_{a_{a_{a_{a_{a_{a_{a_{a_{a_{a_$
$\circ + $
= 4 I, V



Q2 a) F.M. WAJES A.M. WAVES RADIO TRANSMITTER \$ \$ SIMAL STEML Sic RADIO 00 WEAK STRONG DIFFERENCION BIG/SMAL SHADOW DIFFPACTION EFFECTS STRONGER Ce Lowb WAVELENG7HS Low R 28 m f = cRECEPTION @ A.M. (~ IMHZ) BETTER VS F.M [- 100 MHz]

(\mathbf{p},\mathbf{p})	
	sport start start start
POINT SOURCE	
sp	07 SIZE (RAY OPZIZS)
· · · · · · · · · · · · · · · · · · ·	SIMILAR 70:ANGLES]
· · · · · · · · · · · · · · · · · · ·	$\frac{S_{RAY}}{L_1 + L_2} = \frac{\omega}{L_1} \longrightarrow S_{RAY} = \frac{L_1 + L_2}{\omega}$ $L_1 + L_2 = L_1 \qquad L_1$
Se	07 SIZE (WAVE aprics):
s,	$\sum_{nve} \simeq 2 L_2 \lambda \sim \mathcal{V} \text{ From No723}$
MIN 5007 5122	WHEN Sery = Swaje
· · · · · · · · · · · · · · · · · ·	$L_1 + L_2 = \frac{2L_2 \lambda}{\omega}$
	$\rightarrow \omega^2 = \frac{2L_1L_2\lambda}{2}$
	L,+L ₂
	$\omega = \left(\frac{2L_1L_2\lambda}{L_1+L_2}\right)^2$
	E.G. FOR $L_1 = L_2 = 1 + \lambda = I_{MM}$
	→ w = Imm = Human EyE pupic Diameter

c)	•
· PAIRS · JOINED BY	•
CANCEL SACH 5THER, W/3	•
But Bottom Third of	
SUT HAS NO POINTS TO	•
$\sum_{\substack{180^{\circ}\\0x^{1} \text{ of }}} ni e^{-\frac{\lambda}{2}}$	•
DESTRUCTIVE INTERFERENCE PUT	•
is THRESFORZ NOT TOTAL,	
1.2. INTENSITY IS NON-ZERO	•
· FOR LARGE ODD Divisions	•
$\left(\Sigma G, J = \frac{\omega}{101}, \frac{\omega}{1001}\right), \text{ only}$	•
Timy FRACTION OF SLIT WIDTH	
15 UNCANCELLED $\left(\frac{1}{101}, \frac{1}{1001}\right)$	•
So INTENSITY, WHILE STRICTLY	
SPEAKING is NON-ZERD, is VERY LOW	•
· 7415 IMPLIES 71197 INTENSITY OF SITUR	•
SLIT DIFFEACTION DATTSEN IS USEY DIM @	
HIGH ANGLES, SINCE ANY ANGLE IS CLOSE TO	•
AN ANGLE WHERE $\Delta T = \pm \frac{\lambda}{2}$ for some large	
Division [ZUZN OR ODD]] =F W	•