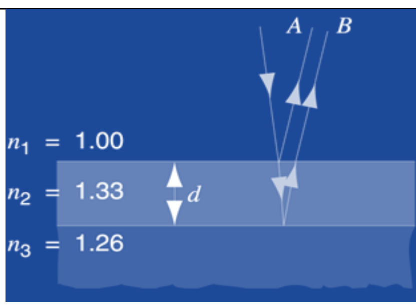
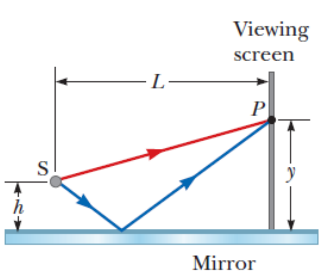
MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

II SEMESTER B. TECH (PHYSICS)
IN SEMESTER EXAMINATION – II, JUNE 2020 (Re Test 1)
SUBJECT: ENGINEERING PHYSICS (PHY 1051)
REVISED CREDIT SYSTEM

Time: 90 Minutes **MAX. MARKS: 15**

Note: Answer ALL the questions.

1.	What are coherent waves? How do you produce them? Explain the formation of fringes in Michelson interferometer.	**03**
2.	How to produce linearly polarized light by (a) selective absorption, (b) reflection, (c) double refraction? Explain.	**03**
3.	 In the given diagram, if the two reflected rays are out of phase by 1.50 λ. If the wavelength of the incident light is 572 nm, find the thickness d of the film.	**02**
4.	Consider a single slit of width 25.2 μm. The distance from the slit to a screen is 3.48m. Consider a point on the screen 1.13 cm from the central maximum. If a monochromatic light with wavelength 538 nm falls on a slit, calculate the ratio of the intensity at this point to the intensity at the central maximum.	**03**
5.	 Interference fringes are produced using Lloyd's mirror and a source S of wavelength λ= 606 nm as shown in the Figure. Fringes separated by Δy=1.20 mm are formed on a screen a distance L = 2.00 m from the source. Find the vertical distance *h* of the source above the reflecting surface.	**02**

6.	A beam of bright red light of wavelength 654 nm passes through a diffraction grating. Enclosing the space beyond the grating is a large semi-cylindrical screen centered on the grating, with its axis parallel to the slits in the grating. Fifteen bright spots appear on the screen. Assuming that there are 2183 grooves/cm, calculate the angular position of the highest order.	**02**

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HAND BOOK FOR STUDENTS

<table>
<tr><th colspan="3">Interference of light waves</th></tr>
<tr><td>Young's double slit expt.: Condition for constructive and destructive interference</td><td>$d\sin\ \theta_{\text{bright}} = m\lambda$; $(m = 0,\ \pm1,\ \pm2,\ \ldots)$
$d\sin\ \theta_{\text{dark}} = \left(m + \frac{1}{2}\right)\lambda$
$(m = 0,\ \pm1,\ \pm2,\ \ldots)$</td><td rowspan="7">$d$: distance between the two slits
λ : wavelength of light used
θ : angular position on the screen
m : order number
φ : phase difference
δ : path difference
y : linear position on the screen
L : distance between the slit and the screen
I_{max}: the maximum intensity on the screen
n : refractive index
t : thickness of the film
R : radius of curvature of lens</td></tr>
<tr><td>Relation between phase difference and path difference</td><td>$\varphi = \frac{2\pi}{\lambda}\delta$</td></tr>
<tr><td>Linear positions of bright and dark fringes</td><td>$y_{\text{bright}} = L\frac{m\lambda}{d}$ (small angle approximation)
$y_{dark} = L\frac{\left(m + \frac{1}{2}\right)\lambda}{d}$
$(m = 0,\ \pm1,\ \pm2,\ \ldots)$</td></tr>
<tr><td>Average light intensity at a point on the screen</td><td>$I = I_{max}\cos^2\left(\frac{\varphi}{2}\right)$
$I = I_{max}\cos^2\left(\frac{\pi d\sin\ \theta}{\lambda}\right)$
$I = I_{max}\cos^2\left(\frac{\pi d}{\lambda L}y\right)$</td></tr>
<tr><td rowspan="2">Condition for interference in thin films in air (reflective system)</td><td>Constructive interference:
$2nt = \left(m + \frac{1}{2}\right)\lambda \quad (m = 0,\ 1,\ 2,\ \ldots)$</td></tr>
<tr><td>Destructive interference:
$2nt = m\lambda \quad (m = 0,\ 1,\ 2,\ \ldots)$</td></tr>
<tr><td>Radius of mth order Newton's ring</td><td>$r_{dark} \approx \sqrt{mR\lambda} \quad (m = 0,\ 1,\ 2,\ \ldots)$
$r_{bright} \approx \sqrt{\frac{\left(m + \frac{1}{2}\right)R\lambda}{n_{film}}} \ (m = 0,\ 1,\ 2,\ \ldots)$</td></tr>
</table>

Diffraction patterns and Polarization		
Single slit diffraction: condition for minima	$sin\ \ \theta_{\text{dark}} = m\frac{\lambda}{a} \qquad m = \pm 1,\ \pm 2,\ \pm 3,\ \ldots$	*A* : width of single slit I_{max}: the maximum intensity[Central maxima] *d* : distance between the two slits *D* : diameter of the aperture
Intensity due to single slit diffraction	$I = I_{max}\left[\frac{sin\ \ (\pi a\ \ sin\ \ \theta/\lambda)}{(\pi a\ \ sin\ \ \theta)/\lambda}\right]^2$	
Intensity of two slit diffraction pattern [combined effect]	$I = I_{max}\, cos^2\left(\frac{\pi d\ \ sin\ \ \theta}{\lambda}\right)\left[\frac{sin\ \ (\pi a\ \ sin\ \ \theta/\lambda)}{(\pi a\ \ sin\ \ \theta)/\lambda}\right]^2$	
Rayleigh's criterion: limiting angle of resolution	$\theta_{min} = 1.22\,\frac{\lambda}{D}$ [for circular aperture] $\theta_{min} = \frac{\lambda}{a}$ [for rectangular aperture]	
Grating equation for maxima	$d\,sin\ \ \theta_{\text{bright}} = m\lambda\,;\ \ m = 0,\ \pm 1,\ \pm 2,\ \pm 3,\ \ldots$	
X-ray diffraction: Bragg's law	$2d\ \ sin\ \ \theta = m\lambda \qquad m = 1,\ 2,\ 3,\ \ldots$	*d* : Inter-planar spacing in the crystal
Malus's law	$I = I_{max}\, cos^2\,\theta$	I_{max} : the intensity of the polarized beam incident on the analyzer θ : angle made by the analyzer transmission axis with the polarizer axis
Brewster's law	$\tan\theta_p = \frac{n_2}{n_1}$	θ_p : polarizing or Brewster's angle n_1, n_2 : refractive indices of first and second medium