Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Waves & OpticsSemester: II
Program: BSc Physics (H) **Time 03 hrs.**
Course Code: PHYS 1014 **Max. Marks: 100**
No. of Pages:2
Instructions: All the questions are compulsory. Q6 and Q11 have internal choice

SECTION A

S. No.		Marks	CO
Q 1	Two beams having amplitude ratio 4:1 interfere. Calculate ratio of $I_{R\text{-}min}/I_{R\text{-}max}$.	**4**	**CO1**
Q2	Illustrate open-end and closed-end organ pipes, and write down the relation between the organ length (L) and wavelength (λ).	**4**	**CO1**
Q3	A plane wave, $X = 5\sin(2x - t)$ travels with a phase velocity, v_p = 2.5 m/s. Calculate the frequency of the given wave.	**4**	**CO2**
Q4	Discuss Laplace's correction to the velocity (v) of sound wave in air medium that results in correct velocity value, equal to 330 m/s.	**4**	**CO3**
Q5	Show that the minimum thickness of a parallel thin film that will appear as bright or dark follows the condition $2 \times t_{min-bright} = t_{min-dark}$	**4**	**CO2**

SECTION B

Q6	In Newton's ring interference show that mth order dark ring diameter $D_m \propto \sqrt{m}$, *where, m is natural number* **OR** Discuss Fresnel's half period zone with diagram. Show that radius of mth order zone, $r_m \propto \sqrt{m}$ *where, m is natural number*	**10**	**CO1**
Q7	Discuss interference of light in wedge shaped thin film. Find the condition for bright and dark fringe. Show the fringe width ¿ $\frac{\square}{2\sin}$, *where = refractive index, = wedge angle*	**10**	**CO2**
Q8	Derive the expression for Kinetic Energy (T) of a vibrating string in the form	**10**	**CO3**

	$T=\frac{M}{8}\sum_n \omega_n^2 c_n^2$ where, M = total mass of the string, ω_n = frequency (n^{th} mode) and c_n = amplitude (n^{th} mode), n is mode number.		
Q9	In Melde's experiment, transverse vibration of a stretched string shows 5 loops when 0.5 Kg is applied. When the load is replaced by another load M the longitudinal vibration shows 3 loops. Calculate the unknown load M.	**10**	**CO4**
	SECTION-C		
Q10	(a) Write a short note on Michelson interferometer. (b) A plane transmission grating gives 3rd order diffraction maximum of He-Ne-laser (λ = 632.5 nm) at 30 degree on a screen placed 50 cm away from grating. Calculate grating element and separation between central spot and 3rd spot on the screen.	**10** **10**	**CO2** **CO3**
Q11	(a) Tabulate the differences between Fresnel and Fraunhofer diffraction of light **OR** Tabulate the differences between interference and diffraction of light	**5**	**CO1**
	(b) Derive the expression for intensity profile of single slit Fraunhofer diffraction. Write the condition for diffraction maxima and minima. **OR** Discuss qualitatively the Fresnel diffraction at a circular aperture with suitable diagram.	**10**	**CO3**
	(c) When the movable mirror is shifted by 0.003 cm a shift of 100 fringes is observed. Calculate the working wavelength. Consider the experiment is performed in air. **OR** Calculate resolving power (R) of a grating at 2nd order when sodium light (589 nm) gets diffracted resolving 0.6 nm fine lines ($\Delta\lambda$).	**5**	**CO4**
	END		

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SECTION A

S. No.		Marks	CO
Q 1	In Young's double slit experiment (sodium light, λ = 590 nm) one measures fringe width, β = 0.5 mm on a screen placed 25 mm away from the slits. Calculate slits separation d.	**4**	**CO1**
Q2	Illustrate open-end and closed-end organ pipes, and write down the relation between the organ length (L) and wavelength (λ).	**4**	**CO1**
Q3	5 different plane waves with same amplitude of 2 unit and constant phase difference of δ = 60 degrees superpose to result resultant wave of the form, $X = A\sin$ ¿. Calculate resultant amplitude A.	**4**	**CO2**
Q4	Discuss Laplace's correction to the velocity (v) of sound wave in air medium that results in correct velocity value, equal to 330 m/s.	**4**	**CO3**
Q5	Show that minimum thickness of a parallel thin film that may appear as dark will be $t_{min-dark} =$ ¿2	**4**	**CO2**

SECTION B

Q6	Discuss interference of light waves using a biprism. Show that for two positions of lens the virtual sources (separated by d) will be observed with the condition, $d = \sqrt{d_1 d_2}$ where, d_1, d_2 are magnifications for the respective positions. **OR** Show that Fresnel's half period zone of m^{th} order follows the following relation, $r_m \propto \sqrt{m}$ *where* r_m *is the radius of respective zone*	**10**	**CO1**
Q7	With neat diagram, describe wedge shaped thin film interference, and prove that for small angle fringe width ¿ $\frac{\square}{2}$, *where* = *refractive index*, = *wedge angle*	**10**	**CO2**

Q8	A 5 Newton tension produces 5 loops in the transverse vibration of a stretched string. How many loops one can observe if the wire undergoes longitudinal vibration with the same load?	**10**	**CO4**
Q9	Deduce Kinetic Energy (T) of a vibrating string in the form $T=\frac{M}{8}\sum_{n}\omega_n^2 c_n^2$ where, M = total mass of the string, ω_n and c_n are the frequency amplitude of n^{th} order vibrational mode, respectively.	**10**	**CO3**
	SECTION-C		
Q10	(a) Write a short note on Fabri-Perot interferometer. (b) A diffraction pattern is obtained using two slits. The 3rd order diffraction maximum of Ruby laser (λ = 694.3 nm) is observed at 30 degree on a screen placed 50 cm away from grating. Calculate slits separation.	**10** **10**	**CO2** **CO3**
Q11	(a) Write down major differences between Fresnel and Fraunhofer diffraction **OR** Discuss briefly, the interference by division of wavefront and amplitude. Give examples of each.	**5**	**CO1**
	(b) Derive the expression for intensity of single slit Fraunhofer diffraction pattern. Obtain the conditions for max and min. **OR** Discuss qualitatively the Fresnel diffraction at a straight edge with suitable diagram.	**10**	**CO3**
	(c) In Michelson interferometer 0.0025 cm mirror shift results in a shift of 90 fringes. If the working wavelength is 780 nm calculate refractive index (μ) of the medium. **OR** A plane diffraction grating resolves 6 Å fine lines ($\Delta\lambda$) of sodium light (5890 Å) at 2nd order. Calculate resolving power (R) of the grating.	**5**	**CO4**
	END		