d) A grating is able to resolve two closely spaced wavelengths of 560 nm and 560.5 nm of a spectrum in its second order spectrum. How many lines (grooves) of the grating must have been illuminated?

6. a) Describe the theoretical framework of diffraction of light from a single slit. **(35)**

b) A monochromatic beam of light impinges on a 0.3 mm wide single slit. The diffraction pattern is observed on a screen 1.5 m from the slit. What is the width of the central maximum? **(25)**

7. a) State planck's law of black body radiations. Deduce Wien's displacement law from it. **(35)**

b) Determine the irradiance of a blackbody maintained at temparature of 2000 °k and radiating in the wavelength interval 0.81μm and 0.79μm. **(25)**

8. a) A beam of linearly polarized light is changed into circularly polarized light by passing it through a slice of a crystal 3×10^{-3} cm thick. Find the difference between the refractive indices of the two types of rays in the crystal, assuming that the crystal has the minimum thickness that will produce the effect for wavelength of light 6000 Å. Deduce the formula used. **(35)**

b) A plane transmision grating has 2000 lines (rulings) in 4 cm and another has 1000 rulings in 2 cm. Compare their angular dispersions and resolving powers in the third order. **(25)**

[Total No. of Printed Pages-4 **Roll No. _____**

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PHYSICS - I

[18]

Time Allowed -3 Hours *Maximum Marks-300*

INSTRUCTIONS

i) Answer must be written in English.

ii) The number of marks carried by each question is indicated at the end of the question.

iii) The answer to each question or part there of should begin on a fresh page.

iv) Your answer should be precise and coherent

v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

vi) Candidates should attempt question Nos. 1 and 5 which are compulsory and any three more out of the remaining questions selecting at least one question from each Section

vii) If you encounter any typographical error, please read it as it appears in the textbook.

viii) Candidates are in their own interest advised to go through the general instructions on the back side of the title page of the answer script for strict adherence.

ix) *No continuation sheets shall be provided to any candidate under any circumstances.*

x) *Candidates shall put a cross(X) on blank pages of answer script.*

xi) *No blank page be left in between answer to various questions.*

xii) *No programmable calculator is allowed.*

xiii) *No stencil(With different markings) is allowed.*

Section - A

1. Question **1** is compulsory : **(4×15=60)**

a) A relativistic beam of electrons has energy of 2 MeV. What is the velocity of the electrons and their mass as observed in our frame of reference.

b) A horizontal 5.0 cm diameter pipe is joined to a second pipe of diameter 4 cm. Thue is a pressure difference of 6 kPa between the two pipes. Determine the volume of water which flows through the tubes per minute.

c) A combination of beaker of inner radius = 3 cm mounted on a turn table has moment of inertia $I = 5 \times 10^{-4}$ kg. m^2. Water is allowed to be dropped along its axis of rotation. If the empty beaker was rotating at 2.0 rpm, calculate the rotational speed of beaker when it contains 0.2 kg of water.

d) 10 gm of water is converted into steam of density 0.5 kg/m^3 at 1 atomospheric pressure and 100 °C. If the latent heat of vapourisation is 540 cal/gm' determine the change is its internal energy in the process.

2. a) Obtain an equation relating the acceleration in a rotating system to the acceleration in an inertial system. **(30)**

b) Determine the deflection for a mass in dropped from a height H at the equator. **(30)**

3. a) Write down the equation of motion for a rocket fired vertically upwords from the earth's surface. Obtain and expression for the final velocity of the rocket if Mo is the initial mass of the rocket, C is the fuel ejection velocity, R is the rate of exhaust mass and α is the ratio of the fuel mass to total mass of the rocket. **(35)**

b) An α-pacticle with kinetic energy of 0.5 MeV is scattered through an angle of 90° by a stationary $235_{92}U$ nucleus. Calculate the impact parameter. **(25)**

4. a) Describe the method of production of low temperatures using adiabatic demagnetization. **(35)**

b) Define Joule's kelvin Co-efficient and show that its expression is

$$\mu = \frac{1}{Cp}\left[T\left(\frac{\partial V}{\partial T}\right)_P - V\right]$$

Where the symbols have their usual meanings. **(25)**

Section - B

5. Question 5 is compulsory : **(4×15=60)**

a) Assuming Maxwellian distribution for velocities of a gas of molecular weight 28, find the probability that the molecules have speeds between 48 m/s and 52 m/s at 0 °C.

b) A damped harmonic oscillator cousisting of mass-spring system has m = 0.1 kg and w = 10 rad/s. It is subjected to a driving force of F = 0.5 cos wt (N). At resonance, its amplitude is 100 cm. What is the Q factor of the oscillator

c) A laser pulse of 10 picosecond duration has mean wavelength of $\lambda = 1.18$ μm. What is the spectral width of the pulse?