KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Mark Scored:

Level : B. Sc.
Year : IV

Course : PHYS 402
Semester: I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : FEB 2 1 2019

SECTION "A"
[20 Q. × 1 = 20 marks]

Choose and tick the most appropriate answer.

1. For collision between electrons and gas molecules of Nitrogen, the energy transfer coefficient is about
[a] 1% [b] 0.01% [c] 10% [d] 100%

2. Light of wavelength 50 nm falls on atomic hydrogen. The maximum velocity of the ejected electron would be
[a] 2×10^6 m/s [b] 1×10^5 m/s [c] 2×10^6 cm/s [d] 2×10^4 m/s

3. A partially ionized medium has electron density 10^{16} m^{-3} and electron temperature KT_e= 2eV. This could possibly be
[a] glow discharge [b] thermonuclear fusion
[c] Earth's ionosphere [d] inter stellar space

4. The Debye length (λD) in a plasma with n= 108 /m3 and Te = 105 K is equal to
[a] 10 m [b] 1m [c] 10^2 m [d] 10^3 m

5. Which one of the following does NOT represent the criterion for plasma?
[a] $\lambda_D << L$ [b] $\lambda_D >> L$ [c] $\omega\tau > 1$ [d] $N_D >>> 1$

6. An electron of energy 10 keV is subjected to a magnetic field of 5×10^{-5}T. The Larmor for the electron is equal to
[a] 6.8cm [b] 3.4 m [c] 6.75m [d] 13.5 m

7. The magnitude of acceleration due to gravity 'g' such that the gravitational drift of an electron would equalize its electric drift due to an electric field if 10 volts/m would be
[a] 1.8×10^{12} m s^{-2} [b] 1.8×10^{10} m s^{-2} [c] 9.8 m s^{-2} [d] 3.6×10^{10} m s^{-2}

8. Townsend's first ionization coefficient is defined as the number of
[a] ions produced by an electrons per cm in the direction of electric field
[b] ions produced by electrons per cm^2 in the direction of electric field
[c] ions produced by electrons per unit volume in the inter-electrode space
[d] electrons produced by an incident ions on the cathode

9. The diffusion of electrons in a plasma in presence of magnetic field is
[a] directly proportional to collision frequency
[b] inversely proportional to collision frequency
[c] inversely proportional to square of collision frequency
[d] independent of collision frequency

10. The cyclotron frequency will be approximately equal to the plasma frequency for electrons if n= 10^{18} /m^3 and magnetic field B equal to
[a] 0.16 T [b] 0.32 T [c] zero [d] 8 T

11 Helium has ionization potential of 24.66 eV. For helium atom to get ionized by multiphoton ionization process when irradiated by a beam of neodymium laser (λ=1064 nm), the number of photons necessary to absorb is

[a] 1 [b] 22 [c] 18 [d] 12

12. The first assumption that Townsend made for the ionization of a gas by electron collision is that the energy gained by the electron in traversing a distance l must be equal to the ionization energy of the gas of ionization potential V_i. If E be the electric field, then

[a] $l = \frac{V_i}{E}$ [b] $l = \frac{E}{V_i}$ [c] $l = \frac{4E}{V_i}$ [d] $l = \frac{V_i}{4E}$

13. The second ionization potential of an Ar atom is the energy necessary for the process

[a] $Ar \rightarrow Ar^{+} + e$ [b] $Ar \rightarrow Ar^{++} + e$ [c] $Ar^{+} \rightarrow Ar^{++} + e$ [d] $Ar \rightarrow Ar^{+} + 2e$

14. Bremsstrahlung radiation is emitted due to

[a] accelerated charged particles
[b] recombination of charged particles
[c] gyration of charged particles around the magnetic field lines
[d] collision of electron with neutrals

15. Consider the following two statements regarding single Langmuir probe used for plasma diagnostics

A. At the floating potential electron current to the probe is equal to the ion current
B. In the ion current saturation, the probe repels ions and attracts electrons

[a] A is wrong but B is correct [b] B is wrong but A is correct
[c] both A and B are correct [d] both A and B are wrong

16. The emission of spectrum is a function the electron temperature of the plasma. When the electron temperature T_e=10,000K, the frequency of the emitted radiation lie in the,

[a] UV- range [b] visible range [c] IR range [d] X-ray range

17. The Bohm –Gross dispersion relation is expressed as

[a] $\omega^2 = \omega_p^2 + \frac{3}{2} k v_{th}^2$ [b] $\omega^2 = \omega_p^2 + \frac{3}{2} k^2 v_{th}^2$ [c] $\omega^2 = \omega_p^2 + v_{th}^2$ [d] $\omega^2 = \omega_p + \frac{3}{2} k v_{th}^2$

18. Which one of the following is NOT the source of error in the plasma diagnostics by electrical probe method?

[a] photo emission may occur from the surface of the probe
[b] secondary electron may be emitted from the probe surface due to impact of incident electrons
[c] if the electron velocity distribution is non - Maxwellian the theory of probe becomes invalid
[d] if the pressure is low the probe theory may not be valid

19. Ion acoustic waves are basically

[a] constant frequency waves but turn into constant velocity wave at short wavelength.
[b] constant frequency waves but turn into constant velocity wave at long wavelength.
[c] constant velocity waves but turn into constant frequency wave at short wavelength.
[d] constant velocity waves but turn into constant frequency wave at long wavelength.

20. In gaseous discharge system, the trapping effect charge particle of mobility μ caused by the high frequency alternating field E of frequency ω and amplitude A applied between two electrodes separated by a distance d is specified by ,

[a] $\frac{2\mu E}{\omega d}$ [b] $\frac{2E}{\omega \mu d}$ [c] $\frac{2E}{\mu \omega d^2}$ [d] $\frac{\omega d}{2\mu E}$

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

FEB 2 1 2019

Level : B. Sc.
Year : IV
Time : 2 hrs. 30 mins.

Course : PHYS 402
Semester: I
F. M. : 55

SECTION "B"
[5 Q. × 4 = 20 marks]

1. What is a plasma? Describe the three criteria for an ionized gas to be a plasma.

2. Calculate λ_D for the following plasmas and verify that these plasmas satisfy the condition $N_D >> 1$.

Plasma	n_e (m^{-3})	T_e (K)
Light hot plasma	10^{18}	10^6
Ionosphere	10^{12}	10^3

3. Give a qualitative explanation of the minimum in Paschen curve.

4. What is meant by diffusion of charged particles in a plasma? Deduce the expression for the diffusion of an electron in the presence of uniform electric field B.

OR

Write a short note on ionization of a gas by exploding wire method.

5. Describe the motion of electron and ion in a region of uniform electric and magnetic field perpendicular to each other. Also trace the trajectories of the particles.

SECTION "C"
[5 Q. × 7 = 35 marks]

6. Deduce the dispersion relation for ion-acoustic wave in plasma and discuss the validity of plasma approximation.

OR

Describe the phenomena of plasma oscillation. Show that plasma frequency is given by

$$\omega_p = \left(\frac{n_0 e^2}{\varepsilon_0 m} \right)^{\frac{1}{2}}$$

7. Explain Townsend theory of ionization by collision and also explain the criterion for breakdown. What are the limitations of this theory?

8. Explain the principle of optical emission spectroscopy (OES). Explain how it can be used for the measurement of plasma parameters.

9. Describe the theory of Langmuir single probe and explain the current-voltage characteristics of a typical plasma using the probe. Explain how it is used to determine the electron temperature (T_e) and density (n_e) in a plasma.

10. Write short notes on the following:
(i) magnetic property of plasma
(ii) photo ionization of a gas

OR

Deduce the expression for Bremsstrahlung process of energy loss from a plasma. Compare it with that of cyclotron radiation.