PUNJAB PUBLIC SERVICE COMMISSION

COMBINED COMPETITIVE EXAMINATION FOR RECRUITMENT TO THE POSTS OF PROVINCIAL MANAGEMENT SERVICE, ETC -2022 CASE NO. 2C2023

SUBJECT: PHYSICS (PAPER-I)

TIME ALLOWED: THREE HOURS **MAXIMUM MARKS: 100**

NOTE:

i. All the parts (if any) of each Question must be attempted at one place instead of at different places.
ii. Write Q. No. in the Answer Book in accordance with Q. No. in the Q. Paper.
iii. No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
iv. Extra attempt of any question or any part of the question will not be considered.

NOTE: **Attempt any FIVE Questions in All. Attempt in Urdu or English.**

Q. No.1 **a)** What are spherical polar coordinates? Define these coordinates. How these are related with Cartesian coordinates (x, y, z)? Explain direction cosines of a vector. **(4+4+4=12 Marks)**

b) Explain vector triple product? Show that

$$\vec{A} \times (\vec{B} \times \vec{C}) = (\vec{A} \cdot \vec{C})\vec{B} - (\vec{A} \cdot \vec{B})\vec{C}$$

(8 Marks)

Q. No.2 (a) Derive the Stokes' theorem from the fundamental theorem of calculus and the definition of line and surface integrals. Discuss the assumptions and conditions under which Stokes' theorem holds, and give counterexamples to illustrate when the theorem fails.

(b) How is the curl related to the rotation and divergence of a vector field? What are some common properties and identities of the curl. **(10+10=20 Marks)**

Q. No.3 **a)** Define pressure of a fluid. Derive an expression for the pressure gradient between a point inside a fluid and a point at the surface. Determine variation in pressure in the atmosphere. **(14 Marks)**

b) A bowler swings a ball while bowling to a cricketer. Explain this swing using Bernoulli's equation. **(6 Marks)**

Q. No.4 **a)** What are stationary waves? How these waves are formed? Describe their characteristics and mathematical treatment.

b) Calculate formula for power and intensity in wave motion. **(10+10=20 Marks)**

Q. No.5 (a) Explain the phenomenon of interference of waves. What is the difference between constructive and destructive interference? Give an example of each and discuss their applications.

(b) Explain the working principle of a spectrometer. How does it measure the spectral distribution of light? **(10+10=20 Marks)**

Q. No.6 (a) What is coherence and why is it important in the study of wave phenomena? Explain the difference between spatial coherence and temporal coherence.

(b) What is the resolving power of a diffraction grating? Derive the equation for the resolving power of a diffraction grating and explain the factors affecting it. **(10+10=20 Marks)**

Q. No.7 (a) What is the difference between reversible and irreversible processes in thermodynamics? How do reversible processes relate to entropy and energy conservation? **(10 Marks)**

(b) What is enthalpy and how is it related to internal energy and work? **(5 Marks)**

(c) What is Brownian motion and how does it occur? **(5 Marks)**

Q. No.8 **a)** What is an ideal gas? Calculate pressure of an ideal gas on the basis of kinetic theory of gases. Prove that pressure exerted by ideal gas molecules is directly proportional to the average translational kinetic energy of gas molecules.

b) Considering thermodynamic potentials discuss Maxwell's relations. **(12+8=20 Marks)**

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SUBJECT: PHYSICS (PAPER-II)

TIME ALLOWED: THREE HOURS **MAXIMUM MARKS: 100**

NOTE:
i. All the parts (if any) of each Question must be attempted at one place instead of at different places.
ii. Write Q. No. in the Answer Book in accordance with Q. No. in the Q. Paper.
iii. No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
iv. Extra attempt of any question or any part of the question will not be considered.

NOTE: **Attempt Five Questions in All. Calculator is allowed (Non-Programmable). Attempt in Urdu or English.**

Q. No. 1:
a) State and explain Ampere's Law of magnetic field on considering a straight current carrying conductor.
b) How you can determine the value of magnetic field inside a current carrying Solenoid by employing Ampere's Law? **(10+10=20 Marks)**

Q. No. 2:
a) What is Transient current? Derive its expression for an LR circuit.
b) What is Time Constant of an LR circuit?
c) How much percent of maximum current will appear in LR circuit after 5 Time Constants? **(10+4+6=20 Marks)**

Q. No. 3:
a) Differentiate between the mechanism of current flow through npn and pnp transistors.

b) What is an amplifier? Describe in detail the transistor as an amplifier using a common-emitter configuration. **(6+14 =20 Marks)**

Q. No. 4:
a) What is a NAND gate? Write its truth table, logic equation and logic operation. Draw and explain its switch equivalent. Why NAND and NOR gates are called universal gates? Explain with appropriate example.

b) What is De Morgan's theorem? Explain its significance. Describe briefly how De Morgan's theorem is applied in the simplification of a Boolean expression. **(12+8=20 Marks)**

Q. No. 5:
a) What is Photoelectric Effect? Explain the experimental results of Photoelectric set-up.
b) Describe the followings:
i) Threshold frequency
ii) Work Function of a metal
iii) Einstein's equation of Photoelectric Effect
iv) Stopping Potential

(12+8=20 Marks)

Q. No. 6:
a) Derive Time dependent and Time Independent Schrodinger's wave equations. What is the importance a wave function?
b) Solve Schrodinger's wave equation for a particle trapped in one dimensional box.
(10+10=20 Marks)

Q. No. 7:
a) What do you mean by mass defect and binding energy of a nucleus? How does binding energy per nucleon vary as a function of mass number?

b) State radioactive law. How will you find the mean life time of a radioactive element? Prove that mean life time of a radioactive element is always greater than its half-life.
(10+10=20 Marks)

Q. No. 8:
a) What do you mean by radioactive decay? Discuss theory of alpha-decay in detail.

b) Define half-life of a radioactive element. Derive an expression to find the half-life of a radioactive element.

c) Explain the reason that nuclei with high mass numbers tend to accommodate more neutrons than protons. **(8+8+4=20 Marks)**