FEDERAL PUBLIC SERVICE COMMISSION
COMPETITIVE EXAMINATION-2021
FOR RECRUITMENT TO POSTS IN BS-17
UNDER THE FEDERAL GOVERNMENT

Roll Number

PHYSICS, PAPER-I

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: (i) **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.
(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** Describe Einstein postulates of special theory of Relativity. Express the difference between the special and the general theories of Relativity. (10)

(b) Establish the energy-mass relationship and give its significance. (10) **(20)**

Q. 3. **(a)** Differentiate between Fermi-Dirac, Bose-Einstein and Maxwell Statistics. Give application of each. (10)

(b) Draw a labelled diagram of a nuclear reactor and give significance of each part. (10) **(20)**

Q. 4. **(a)** Distinguish between the linear and angular momentum. Express Newton's second law in terms of the linear and angular motion. (10)

(b) Discuss the acceptor and rejecter electronic circuits. (10) **(20)**

Q. 5. **(a)** Describe and explain the Miller indices. Recognize the symbols <111>, [010], (111). (10)

(b) Discuss the closest packed crystal structures. (10) **(20)**

Q. 6. **(a)** Can you imagine a three dimensional diffraction grating? Describe in detail. (10)

(b) Justify the dual nature of light with elaborative examples. (10) **(20)**

Q. 7. **(a)** State and explain the three laws of Thermodynamics. (10)

(b) What is a heat engine? Determine the efficiency of the engine if it takes 10,000 J of heat and delivers 2000 J of work per cycle. (10) **(20)**

Q. 8. Write notes on any **TWO** of the following: **(10 each)** **(20)**

(a) Mickelson-Morley experiment and its latest usage in a recent Nobel award.

(b) Unification of forces and Abdus Salam contribution.

(c) An essay on Large Hadron Partical Accelerator.

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Roll Number

PHYSICS, PAPER-II

TIME ALLOWED: THREE HOURS	**PART-I (MCQS) MAXIMUM MARKS = 20**
PART-I(MCQS): MAXIMUM 30 MINUTES	**PART-II MAXIMUM MARKS = 80**

NOTE: **(i)** **Part-II** is to be attempted on the separate **Answer Book.**
(ii) Attempt **ONLY FOUR** questions from **PART-II**. **ALL** questions carry **EQUAL** marks.
(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.
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(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.
(vi) Extra attempt of any question or any part of the question will not be considered.
(vii) **Use of Calculator is allowed.**

PART – II

Q. 2. **(a)** Consider an infinitely long cylindrical insulating shell of inner radius a, and outer radius b, and has a uniform volume charge density ρ. If a line of charge density λ is placed along the axis of the shell then determine the electric field intensity at a point r such that (i) $a < r < b$ and (ii) $r > b$. (8)

(b) Determine the energy density for a capacitor. (6)

(c) Discuss the Lorentz force. (6) **(20)**

Q. 3. **(a)** Find the magnetic energy density for the magnetic field of the inductor. (10)

(b) Sate and explain the Lenz's law. (6)

(c) Why is the work done by a magnetic field on a charged particle always zero? (4) **(20)**

Q. 4. **(a)** Describe the properties of each of, an electron and the light, that show their dual nature. (8)

(b) State and explain the de Broglie hypothesis? (6)

(c) Metals A, B and C have work functions 2.2eV, 3.6eV and 4.8eV. If a light of wavelength 320nm is incident on these, then find (6) **(20)**
(i) Which metals exhibit photoelectric effect?
(ii) Maximum kinetic energy of photoelectron in each case?

Q. 5. **(a)** Determine the transmission co-efficient for a particle having energy E incident on a rectangular barrier, so that $E < V_0$, the barrier is given by (14)

$$V(x) = \begin{cases} +V_0 & for\ -a < x < a \\ 0 & for\ |x| > a \end{cases}$$

(b) For an operator $\hat{A}$, we know $[\hat{H}, \hat{A}] = 0$, where $\hat{H}$ is the Hamiltonian operator, what can we conclude about the eigen states of $\hat{A}$ and the $\langle \hat{A} \rangle$? (4)

(c) Give two examples for the operator $\hat{A}$, given in part (b) above. (2) **(20)**

Q. 6. **(a)** Describe the electrical conduction in different types of solids in terms of band theory. (8)

(b) Explain the crystal structure of diamond. (6)

(c) Find the carrier concentration of electrons in Silicon at a temperature of $25^{o}C$. (6) **(20)**

Q. 7. **(a)** What factors contribute to the stability of a nucleus? Draw and explain the plot of neutron number N versus atomic number Z for stable nuclei. (10)

(b) Explain the use of chain reaction in relation to a nuclear reactor. (6)

(c) The stable isotope of potassium is ^{19}K, what kind of radioactivity do you expect from ^{18}K? Give reasons. (4) **(20)**

Q. 8. Write notes on any **TWO** of the following: **(10 marks each)** **(20)**

(a) Poynting Vector

(b) Fusion in stars

(c) MOSFET

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