



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

Roll Number

**PHYSICS, PAPER-II**

<b>TIME ALLOWED: THREE HOURS</b>	<b>PART-I (MCQS)</b>	<b>MAXIMUM MARKS = 20</b>
<b>PART-I(MCQS): MAXIMUM 30 MINUTES</b>	<b>PART-II</b>	<b>MAXIMUM MARKS = 80</b>
<b>NOTE: (i) Part-II is to be attempted on the separate Answer Book.</b>		
<b>(ii) Attempt ONLY FOUR questions from PART-II. ALL questions carry EQUAL marks.</b>		
<b>(iii) All the parts (if any) of each Question must be attempted at one place instead of at different places.</b>		
<b>(iv) Write Q. No. in the Answer Book in accordance with Q. No. in the Q.Paper.</b>		
<b>(v) No Page/Space be left blank between the answers. All the blank pages of Answer Book must be crossed.</b>		
<b>(vi) Extra attempt of any question or any part of the question will not be considered.</b>		
<b>(vii) Use of Calculator is allowed.</b>		

**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  $\rho$ . If a line of charge density  $\lambda$  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) State 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)

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

- (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)

## **PHYSICS, PAPER-II**

- 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°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  $^{39}\text{K}$ , what kind of radioactivity do you expect from  $^{40}\text{K}$ ? 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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