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JKPSC Exam

Mains Previous Paper

Simplifying
Government Exams

 SSC CHSL	 IAS EXAM	 RRB NTPC	 NTSE	 CDS
 SSC CGL	 CBSE UGC NET	 IBPS PO	 NDA	
 SBI PO	 IBPS CLERK	 AFCAT	 SSC JE	 CTET
 CSIR UGC NET	 CAPF	 IBPS RRB		

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PHYSICS-II

[18]

Time Allowed -3 Hours

Maximum Marks-300

INSTRUCTIONS

- i) Answers 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 **four** out of the the remaining questions, selecting **two** questions from each section.
- vii) If you encounter any typographical error, please read it as it appears in the text book.
- viii) Candidates are in their own interest are 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.
- xiv) In no circumstances help of scribe will be allowed.

SECTION-A

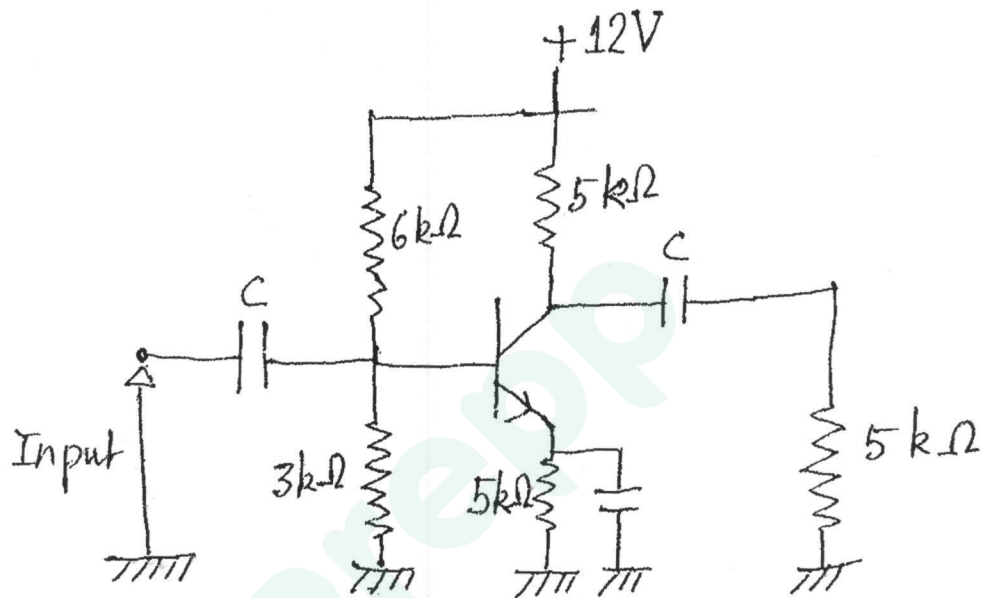
1. a) A square loop of conducting wire of side 10.0 cm carries a current of 1.5 A. Find the magnitude of magnetic field $|\vec{B}|$ at the centre of the loop. (4×12.5=50)
- b) A 10.0 Watt laser beam has a diameter 0.5 cm. Determine the time averaged poynting vector and the amplitude of electric field of the laser beam.

- c) A series RLC circuit has $R=2.0 \Omega$, $L=10.0 \text{ mH}$ and $C=1.0 \mu\text{F}$. A variable frequency voltage source of 9.0 V is connected across the circuit. At resonance, find the voltage across L,C and R. What is the Q-value of the resonant circuit?
- d) An uncharged square plate [$20.0 \text{ cm} \times 20.0 \text{ cm}$] of a conductor is placed in a region of uniform electric field of 8000 N/C . The direction of the field is perpendicular to the surface of the plate. Find the total charge on each face of the plate.
2. a) Consider a thick insulating cylindrical shell with inner and outer radii a and b . It has uniform volume charge density ρ . Find the electric field in the regions (i) $r \leq a$, (ii) $r \geq b$ and (iii) $a \leq r \leq b$ (30)
- b) A long solenoid of radius 5.0 cm has 10 turns per cm. A ring of wire of radius 2.0 cm is placed within the solenoid perpendicular to the axis of the solenoid. What is the value of mutual inductance? (20)
3. a) Write down Maxwell's equations in integral forms. What does each of these equations signify? (25)
- b) An atom makes a transition from an excited state to the ground state with emission of photons of wavelength $\lambda = 600 \text{ nm}$. If the life time of the excited state is 10^{-8} s , What is the spectral width of the transition line? (25)
4. a) Write down the Schrodinger equation for hydrogen atom in spherical coordinate system. Solve it to obtain expressions for its ground state energy and wave function. (35)
- b) Consider the emission of radiation of wavelength $\lambda = 500 \text{ nm}$ due to transition from p-state to s-state of an electron in an atom. Estimate the wavelength separation between two components of radiations from the split p-states to the s-state due to Zeeman effect, if the atom is placed in a magnetic field of 1.0 T . (15)

SECTION-B

5. a) A photon of energy 2.0 KeV makes a collision with a free electron and is deflected by 90° . How much energy is gained by the electron as a result of the collision with the photon? ($4 \times 12.5 = 50$)
- b) A cyclotron operates with magnetic field $B = 5.2 \text{ T}$ and produces accelerated protons of energies 30 MeV . What is the radius of the cyclotron?

- c) An electron is confined to move in a 1- dimensional box. Its energy in the ground state ($n=1$) is 2.0 eV. How much energy will be needed to excite it to its first excited state?
- d) A 6.0 V Zener diode is connected across a voltage source of 24.0 V through a series resistor R. If a load resistor of $3.0 \text{ K}\Omega$ is connected across the Zener diode. What is the maximum value of R which would give a constant voltage of 6.0 V across the load?
6. a) Find the concentration of holes and electrons in a p-silicon semiconductor of resistivity $100 \Omega \text{ cm}$. The hole and electron mobilities are $500 \text{ cm}^2/\text{v}\cdot\text{sec}$ and $1500 \text{ cm}^2/\text{v}\cdot\text{sec}$, respectively and the intrinsic carrier concentration is $1.5 \times 10^3 \text{ cm}^{-3}$. (25)
- b) Find the voltage gain of the amplifier represented by the circuit given below



(25)

7. a) What is Raman effect? Obtain expressions for wave numbers corresponding to spectral lines in a pure rotational spectra of a linear molecule. (30)
- b) Write down nuclear fusion reaction involving deuterium (D) and tritium (T) What are the essential conditions to be met for nuclear fusion of D and T to occur? (20)
8. a) Explain the fine structure of hydrogen atom arising due to l-s coupling. (20)
- b) List elementary particles along with their classification. Explain strong and weak electromagnetic interactions. (20)
- c) What are various types of modulations employed in radio frequency communication? Discuss their relative merits. (10)

Physical Constants

Velocity of light in vacuum $C = 3 \times 10^8$ m/s

Mass of electron $m_e = 9.11 \times 10^{-31}$ Kg.

Charge of electron $e = 1.602 \times 10^{-19}$ C

Specific charge of electron $e/m_e = 1.76 \times 10^{11}$ C/kg

1 u = 1 amu = 1.660566×10^{-27} Kg = 931.5 MeV/c²

Rest mass energy of electron $m_e c^2 = 0.511$ MeV

Permittivity in free space $\epsilon_0 = 8.8542 \times 10^{-12}$ C²/N/m²

Permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ N/A²

Gas constant $R = 8.314$ J/mol/K

Boltzman constant $K_B = 1.381 \times 10^{-23}$ J/K

Planck constant $h = 6.626 \times 10^{-34}$ Js

$h = 1.0546 \times 10^{-34}$ J_s

Bohr magneton $\mu_B = 9.274 \times 10^{-24}$ J/T

Nuclear magneton $\mu_n = 5.051 \times 10^{-27}$ J/T

Fine structure constant $\alpha = 1/137.03599$

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