RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College affiliated to University of Calcutta)
B.A./B.Sc. FOURTH SEMESTER EXAMINATION, MAY 2019
SECOND YEAR (BATCH 2017-20)

Date   : 25/05/2019

Time   : 11 am – 1 pm

PHYSICS (General)

Paper : IV

Full Marks : 50

[Use a separate Answer Book for each group]

Group – A

(*Answer <u>any four</u> questions*) [4×5]

1. a) What is depletion region of a p-n junction diode? How the thickness of depletion region changes when the junction is forward and reverse biased? (1+1+1)
    b) Draw a bridge rectifier circuit and explain its operation. (2)

2. a) Discuss about the input and output resistances of the transistor in CE mode. (1)
    b) Derive the relation $I_c = \beta I_B + I_{CEO}$ for a transistor in CE mode (Symbols have their usual meaning). (4)

3. a) Subtract the following binary numbers using 1's complement method.
        i) $16 - 11$ ii) $11 - 16$ (3)
    b) Simplify the Boolean expressions:
        i) $A.\left(B + C . \overline{(AB + AC)}\right)$
        ii) $\overline{\overline{\overline{A + \overline{\overline{B}}} + \overline{A + B}}}$ (2)

4. a) What is Full-adder? (1)
    b) Given the truth table of sum bit and carry bit of a Full-adder. Then write down the Boolean expression of sum bit and carry bit. (2+2)

5. Calculate $I_{d.c}$, I_{rms} and ripple factor(r) of a half wave rectifier. (2+2+1)

6. Given the logical expression $Y = (A + BC)(B + A\overline{C})$
    a) Design a circuit using gates to realize Y.
    b) Design a circuit using NAND gates only to realize the same function Y. (2+3)

Group – B

(*Answer <u>any six</u> questions*) [6×5]

7. a) What are the postulates of special theory of relativity? (2)
    b) Write down the transformation equations from S-frame to S' frame and prove $x'^2 + y'^2 + z'^2 - c^2 t'^2$ is equal to $x^2 + y^2 + z^2 - c^2 t^2$ (2+1)

8. a) Establish Einstein's mass-energy relationship. (3)
    b) With what velocity should a bullet travel so that its total energy becomes exactly twice its rest mass energy? (2)

9. Give the law of decay of radioactive nuclei. Define mean life and show its relationship with half-life. (2+1.5+1.5)

10. What is radioactive equilibrium? Distinguish between temporary and secular equilibrium. (2+3)

11. a) What is Q value of nuclear reaction? (1)
    b) Obtain the expression for Q value and explain exothermic and endothermic reactions. (2+1+1)

12. a) Explain Miller indices. (2)
    b) A mineral salt has density $2.17 \times 10^3 \, \text{kgm}^{-3}$ and molecular mass 58.5. If the glancing angle for first order reflection is 6^0 with a crystal of the salt, calculate the wave length of x-rays. Avogrado number $N = 6.023 \times 10^{23}$. (3)

13. In Bohr's atomic model, show that energy of the nth state is proportional to $\frac{1}{n^2}$. (5)

14. a) An election in hydrogen atom jumps from exited state 'n' to the ground state. The wave length illuminates a photo sensitive material having work function 2.75 eV. The stopping potential of the photoelectron is 10 V , then find the value of n. (3)
    b) If electron is accelerated in a potential 'v', then show that the de Broglie wave length associated is $\lambda = \frac{1.22}{\sqrt{v}}$ nm. (2)

15. Prove Schrodinger's equation starting from the complex wave function $\psi(x,t) = Ae^{i(kx-\omega t)}$. (5)

16. Find the energy eigen values for a particle in infinite potential well. Comment on the energy levels. (5)

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