



Nagarjuna Degree College  
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Reg. No.

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V Semester B.Sc. Degree Examination, March/April - 2022

**PHYSICS**

**Astrophysics, Solid State Physics and Semiconductor Physics**

*(CBCS-Freshers+Repeaters 2018-19 & Onwards Scheme)*

**Paper : VI**

**Time : 3 Hours**

**Maximum Marks : 70**

**Instructions to Candidates:**

1. Answer any **five** questions from each part.
2. Non - programmable scientific calculators is allowed.

**PART - A**

Answer any **five** questions. Each question carries **Eight** marks. (5×8=40)

1. Obtain the expression for core pressure of a star on the basis of Linear density model. (8)
2. Obtain an expression for gravitational potential energy of a star on the basis of Linear density model. (8)
3. a) What is Chandrasekhar's mass limit?  
b) Obtain an expression for core temperature of a star. (2+6)
4. Derive the expression for electrical conductivity of a metal based on free electron theory. Hence arrive at ohms law. (8)
5. a) What is Hall effect? Arrive at the expression for Hall co-efficient.  
b) Distinguish between continuous and characteristic X-ray spectra. (4+4)
6. With relevant circuit diagram, explain the characteristics of n-p-n transistor in common emitter mode. (8)
7. a) What is a solar cell?  
b) Obtain an expression for the concentration of free electrons in an intrinsic semiconductor. (1+7)
8. a) What are hybrid parameters?  
b) Using hybrid equivalent circuit, derive the expression for current gain and voltage gain of CE amplifier. (2+6)

**[P.T.O.]**



## PART - B

Solve any **five** problems. Each problem carries **four** marks.

(5×4=20)

9. The apparent and absolute magnitude of a star are +0.87 and -0.63 respectively. Calculate its distance from the earth.
10. If the luminosity and surface temperature of a star are  $26 L_{\text{sun}}$  and  $1.12 \times 10^4 \text{ K}$  respectively, calculate its radius. Given  $L_{\text{sun}} = 4 \times 10^{26} \text{ W}$ ,  $R_{\text{sun}} = 7 \times 10^8 \text{ m}$ ,  $T_{\text{sun}} = 6000 \text{ K}$ .
11. Find the interplanar spacing for the lattice planes of Miller indices (3 2 1), (2 1 0) for cubic lattice with  $a = 5.26 \text{ \AA}$ .
12. In an experiment on Compton scattering X - rays of wavelength  $1.5 \times 10^{-10} \text{ m}$  are used. Calculate the wavelength of X-rays scattered at an angle  $60^\circ$ . Given  $h = 6.625 \times 10^{-34} \text{ Js}$ ,  $m_e = 9.1 \times 10^{-31} \text{ kg}$  and  $c = 3 \times 10^8 \text{ ms}^{-1}$ .
13. Assuming one free electron per atom, estimate the Fermi energy for copper. Given the density of copper  $= 8.95 \times 10^3 \text{ kg m}^{-3}$  and atomic mass  $= 0.0635 \text{ kg mol}^{-1}$ .
14. Calculate the conductivity of silicon material if mobility of electrons and holes are  $0.32 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$  and  $0.18 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$  respectively and intrinsic carrier concentration  $n_i$  is  $18 \times 10^{22} \text{ m}^{-3}$ . Given  $e = 1.6 \times 10^{-19} \text{ C}$ .
15. A 24 V - 600 mW Zener diode is to be used for providing 24V stabilized supply to a variable load. If the input voltage is 32V calculate the value of series resistance.
16. Calculate the values of  $\beta_{dc}$ ,  $I_C$  and  $I_E$  for transistor that has  $\alpha_{dc} = 0.96$  and  $I_B = 120 \mu\text{A}$ .

## PART - C

Answer any **Five** questions. Each question carries **Two** marks.

(5×2=10)

17.
    - a) Is the brightness of star a good indicator of its distance? Explain.
    - b) Can Black holes be seen? Explain.
    - c) Do white dwarfs attain stability? Explain.
    - d) Is an unit cell of fcc structure a primitive cell? Explain.
    - e) Why ordinary light cannot be used for crystal diffraction? Explain.
    - f) Is p-type semiconductor electrically neutral? Explain.
    - g) Can emitter and collector regions of transistor be inter changed? Justify.
    - h) Superconductor is an ideal diamagnetic material. Justify.
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