

**BANKIM SARDAR COLLEGE**

**Part – I (1+1+1) Examination 2020**

**B.Sc. (Honours)**

**Subject: Physics.....**

**Paper: I+II**

**Group: (1+2)**

**Time: 2 Hours**

**Full Marks: 25+25 = 50**

**(Answer each group in separate Answer-Sheets)**

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**Group: 1**

**Paper -I (F.M-25)**

**Paper: IA (F.M-12.5)**

**(Answer in separate Answer-Sheets)**

**Answer any TWO Questions from Question 1 to 4. Question 5 is compulsory.**

5x2=10

1. Write down the Taylor series expansion of a function  $f(x,y)$  about the values  $x_0, y_0$ . Prove the series  $x + \frac{x^2}{2} + \frac{x^3}{3} + \dots$  is convergent for  $0 < x < 1$  2+3
2. (a) Evaluate  $\iint xy dx dy$  around the quadrant of the circle with  $x \geq 0, y \geq 0$ .  
(b) For a force defined by defined by,  $F = \frac{(-x\hat{i}+y\hat{j})}{x^2+y^2}$ , evaluate the line integral along the semi circular path connecting the points  $(-1,0)$  and  $(1,0)$  with the origin at the center. 2+3
3. (a) By stokes theorem prove that  $\vec{\nabla} \times \vec{\nabla} \varphi = 0$   
(b) A particle moves along the curve  $x=2t^2, y=4t^2-1$  and  $z=5t-3$ , where  $t$  denotes time. Find the component of acceleration at  $t=1$  in the direction  $(\hat{i} - 2\hat{j} + 2\hat{k})$ . 2+3
4. Find the eigen values and the normalized eigen vector of the matrix  $\begin{pmatrix} 1 & 1 \\ 4 & 1 \end{pmatrix}$ . 2+3

**5. Compulsory Question**

**2.5 × 1 = 2.5**

(I) Show that infinite series  $\sum \frac{1}{n^p}$  is convergent if  $p > 1$ .

**OR**

(II) Show that Hermitian matrix remain Hermitian under unitary transformation.

**Paper: IB (F.M-12.5)**

**(Answer in separate Answer-Sheets)**

**Answer any TWO Questions from Question 6 to 9. Question 10 is compulsory.**

5x2=10

6. (a) Define bandwidth and the quality factor with respect to the resonance.  
(b) Use it to establish conjugate foci relation for refraction at a spherical surface. Define principal points and nodal points. 2+3
7. Draw a two input positive logic diode AND circuit. Design a two input XOR gate using NOR gates exclusively 2+3
8. (a) What is 'depletion region'?  
(b) Explain the behavior of P-N junction diode under reverse bias 2+3
9. (a) Define Group velocity and the phase velocity.  
(b) Establish Relation between them. 2+3
10. **Compulsory Question**  $2.5 \times 1 = 2.5$   
(I) Prove the Boolean Relation  $(A+B)(A+C)=A+BC$   
**OR**  
(III) State and explain Fermat's Principle

**Group: 2**

**Paper-II (F.M-25)**

**Paper: IIA (F.M-12.5)**

**(Answer in separate Answer-Sheets)**

**Answer any TWO Questions from Question 11 to 14. Question 15 is compulsory.**

5x2=10

11. (a) What do you mean by pseudo force?  
(b) How pseudo forces appear in a rotating frame of reference? 2+3
12. (a) What is center of mass of a body?  
(b) Prove that position of centre of mass is unique for a system of particles 2+3
13. (a) What do you understand by degrees of freedom?  
(b) State and explain the principle of 'Equipartition of Energy' among degrees of freedom. 2+3
14. (a) What is 'mean free path'?  
(b) Find Boyle's temperature of a van der waal's gas? 2+3
15. **Compulsory Question**  $2.5 \times 1 = 2.5$   
(I) Estimate the average speed of molecules of a gas in terms of velocity of sound in the gas.

**OR**

- (II) Find the center of mass of a thin homogeneous semi circular disc of radius  $r$  and surface mass density  $\sigma$ .

**Paper: IIB (F.M-12.5)**

**(Answer in separate Answer-Sheets)**

16. (a) Draw the circuit diagram of a Zener diode to study the reverse characteristics curve.  
(b) Write the formula of percentage of load regulation of a Zener diode.  
(c) What is difference between a Zener diode and an ordinary P-N junction diode?  
(d) Write three differences between Zener Breakdown and the avalanche breakdown?

4+3+3+2.5