2019

B.Sc.

3rd Semester Examination

PHYSICS (Honours)

Paper - C 5-T

Full Marks : 40   Time : 2 Hours

The figures in the margin indicate full marks.
Candidates are required to give their answers
in their own words as far as practicable.

Answer *five* questions from Group - A,
four from Group - B and *one* from Group - C.

Group - A

Answer any *five* questions of the following :

$$2\times5=10$$

1. State the type (parabolic, elliptic or hyperbolic) of the following partial differential equation.

   (i) $\dfrac{\partial^2 u}{\partial t^2} = c^2 \dfrac{\partial^2 u}{\partial x^2}$

[Turn Over]

(ii) $9\dfrac{\partial^2 u}{\partial x^2} + 6\dfrac{\partial u}{\partial x}\dfrac{\partial u}{\partial y} + \dfrac{\partial^2 u}{\partial y^2} = 3x + 4y + 1$ 2

2. Show that complex Fourier coefficient of odd function is purely imaginary.   2

3. What is the nature of singularity of the following differential equation ?

$$y'' - \dfrac{6}{x^2}y = 0$$ 2

4. A Lagrangian $L(q, q, t) = \dfrac{1}{2}mq^2 - \dfrac{1}{2}k(q - vt)^2$ 2

Find the generalised momentum and Hamiltonian of the system.

5. Prove that $erf(x) + erf_c(x) = 1$ 2

6. Fourier expansion of $f(x)$ in the interval $0 < x < l$

is : $f(x) = \dfrac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos\dfrac{n\pi x}{l}$ show that

$$\int_0^l \left[f(x)^2 \right] dx = \dfrac{1}{4}a_0^2 + \dfrac{1}{2}\sum_{n=1}^{\infty} a_n^2$$ 2

7. If L is the Lagrangian of a system, then show that

$L_1 = L \pm \dfrac{dF}{dt'}$ where F is a function of the generalized

coordinates, momenta and time; will also satisfy
Lagranege's equations. 2

8. Potential energy of a particle are given by :

$$V = \dfrac{A}{\sqrt{\left(x^2 + y^2 + z^2\right)}} - Bz^2 \ln\left(x^2 + y^2\right).$$

Find its generalised momenta p_x and p_z. 2

Group - B

Answer any *four* questions of the following :

4×5=20

9. Prove that $\displaystyle\int_0^1 x^m \left(\log x\right)^n \, dx = \dfrac{(-1)^n \, n!}{(m+n)^{m+1}}$, when n

is a positive interfer and $m > -1$. 5

10. A differential equation is given by :

$$\left(1 - x^2\right) y'' - 2xy' + ny = 0.$$ 2

[Turn Over]

(a) Find the singular points.

(b) Check whether the singular points are essential or non-essential. Comment whether series solution of this equation is possible or not.

$$2+1$$

11. Prove $\int\limits_{0}^{\infty} e^{-(x+a)^2} dx = \dfrac{\sqrt{\pi}}{2}\left[1-\text{erf}\,(a)\right]$ 5

12. Write the integral $\int_{0}^{1} \dfrac{x^3}{\sqrt{1-x^2}} dx$ in the form of Beta function and hence evaluate it. 5

13. Calculate the Legendre transform of (i) $F(x) = x^2$

(ii) $F(x) = \ln x$. State the geomtrically meaning of Legendre transform. 5

14. Derive Euler's equation of motion for couple oscillators. 5

Group - C

Answer any *one* question of the following :

$$10\times1=10$$

15. (a) Solve the following boundary value problem by the method of separation of vaiaboles "

$$\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}; \text{ Given } u(0, y) = 8e^{-3y}.$$ 4

(b) (i) Obtain the expression of kinetic energy of a particle in terms of generalized coordinates. 2

(ii) Show that in the absence of rheonomic constraints the Hamiltonian of a system is equal to the sum of kinetic and potential energies of the system. 2

(iii) Show that if the Lagrangian of a system does not depend on time explicitly then the Hamiltonian of this system remains conserved. 2

16. (a) Define error function $erf(x)$. Find $erf(0)$ and $erf(\infty)$. Draw the graph ofo error function.

1+2+1

(b) Find the solution of the following differential equation by the method of Frobenius :

$$y'' - 2xy' + 2ny = 0; \text{ where } n \text{ is the non-negative integer.}$$ 6—

$$a_0(1-nx^2) + a_1x\left(1-\frac{2n-1}{3}x^2\right)$$

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PHYSICS (Honours)

Paper - C 6-T

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in their own words as far as practicable.

1. Answer any *five* questions of the following :

$$5×2=10$$

(a) What is meant by 'thermodynamic equilibrium'. State 'Zeroth Law' of Thermodynamics.   1+1

(b) Distinguish between adiabatic cooling and Joule Thomson colling.   2

(c) Certain mass of gas at NTP is expanded to three times of its volume abiabatically. Calculate the resulting temperature $(\gamma = 1.40)$.   2

(d) The equation of state of an ideal gas is $PV = nRT$. Show that (i) the volume

[Turn Over]

expansivity β is equal to $\dfrac{1}{T}$. and (ii) isothermal compressibility k is equal to $\dfrac{1}{P}$.   1+1

(e) How is the atomicity of a gas molecules related with the ratio of two speitic heats ?   2

(f) $dn_c = 4\pi na^3 e^{-bc^2} c^2 dc$ is the number of molecules having lying between c and $c+dc$, where $a = \sqrt{m/2\pi kT}$ and $b = m/2kT$. Plot dn_c vs c for two different temperatures T_1 and $T_2 (T_2 > T_1)$. What is the significance of the total area under curve and the c-axis ?   2

(g) Distinguish between first order and second order phase transition.   2

(h) State the law of corresponding states for real gases.   2

2. Answer any *four* questions :   4×5

(a) Using Kinetic theory of gases, find an expression for the coefficient of self-diffusion for an ideal gas where concentration gradient exists only along one direction.

(b) Show how would you determine

(i) Enthalpy H from a knowledge of Gibb's free energy G and

(ii) Gibb's free energy G from a knowledge of Helmholtz free energy F.   2½+2½

(c) (i) Derive an expression for change in entropy when ice changes into steam.   3

(ii) Find the change of entropy when 10 gm of ice melt at 0°C to 100°C.   2

(d) Derive clausius clapeyron's Latent heat equation

$$\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$$

from Maxwell's thermodynamic relations.   5

(e) Show that the porbability of a gas molecule traversing a distance x without suffering a collision is $\exp(-x/\lambda)$, where λ is the mean free path of the gas.

Calculate the fraction of molecules which will be travelling undeflected after traversing 0.693 times the mean free path.   3+2

[Turn Over]

(f) State both the Kelvin-Planck and the Clausius statements of second law of thermodynamics. Show that they are equivalent. 2+3

3. Answer any *one* question : 1×10

(a) Prove that

$$C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$$

Hence find the value of $\left(C_p - C_v\right)$ for an

(i) Ideal gas and

(ii) Van der Waal's gas. The symbols have usual meaning. 2+2+4

(iii) Prove that for any substance

$$Tds = C_p dT - T\left(\frac{\partial V}{\partial T}\right)_P dp$$ 2

(b) What do you mean by 'degrees of freedom' of a dynamical system ? State and establish the equipartition theorem. What specific heats are predicted for diatomic and triatomic molecules by the theory ? What is significance of Boyle temperature ? What is the concept of work in Thermodynamics ? 1+(1+2)+2+2+1+1

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3rd Semester Examination

PHYSICS (Honours)

Paper - C 7-T

(Digital System and Applications)

Full Marks : 40   Time : 2 Hours

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in their own words as far as practicable.

1. Answer any *five* questions of the following :

$$5 \times 2 = 10$$

(a) Write down advantages of Integrated Circuits.

(b) What do you mean by positive logic and negative logic.

(c) Convert hexadecimal number $(2F9A)_{16}$ to equivalent binary number.

[Turn Over]

(d) Prove that negative logic OR gate is equivalent to positive logic AND gate.

(e) Write down SOP expression for the Boolean function

$$f(A, B, C, D) = \sum m(0, 3, 6, 7, 10, 12, 15).$$

(f) What is Race-around condition in J-k Flip-Flop.

(g) Draw half adder circuuit using NAND gates only.

2. Answer any *four* qustions :   4×5=20

(a) (i) Design a positive logic NOT circuit using transistor.

   (ii) How OR gate can be constructed using transistors only ?   3+2

(b) Minimize the Boolean function $f(A, B, C, D)$.

$$= \sum m(0, 1, 2, 3, 11, 12, 14, 15) \text{ by karnaugh}$$
map.   5

(c) Explain why NAND gate is called Universal Gate. Construct $EX - OR$ Gate using NAND Gates only.   3+2

(d) Add the binary numbers 1111, 0111, 1011 and 1001. Perform the binary subtract 1000–1001 using 2's complement method.   2+3

(e) Construct a 4-bit full adder circuit using half adders only.   5

3. Answer any *one* question.   1×10=10

(a)   (i) Implement the Boolean expression

$$f(A, B, C, D) = \sum m(0, 2, 3, 6, 8, 9, 12, 14)$$

(ii) Design a 1 : 4 demultiplexer.   6+4

(b)   (i) Draw the circuit diagram of a Master-Slave J-K Flip-Flop and explain its operation.

(ii) Design a monostable multivibrator using IC 555.   5+5

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2019

B.Sc.

3rd Semester Examination

PHYSICS (Honours)

Paper - SEC-1T

Full Marks : 40　　　　　　　Time : 2 Hours

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(Physics Workshop Skill)

1. Answer any *five* questions of the following :

$$5 \times 2 = 10$$

(a) Convert 1 atmosphere pressure into CGS unit.

(b) Define least count.

(c) Define screw pitch of a screw gauge.

(d) Write down the use of sextant.

(e) Write down the types of welding defects.

[Turn Over]

(f) How galvanometer used as voltmeter.

(g) Why base region of transistor is thin.

(h) Write down unit of resistivity and conductivity.

2. Answer any *four* questions :   4×5=20

(a) Write a short note one-Turbine.

(b) Explain backlash error.

(c) Define welding and and explain various types of welding.

(d) Point difference between iron & steel. Which types materials are better for steel.

(e) Explain briefly Common machine tools.

(f) Explain multimeter and its different uses.

3. Answer any *one* question :   1×10

(a) Define cathode ray oscillodcope (CRO). Explain briefly its different parts.   2+8

(b)   (i) Write down differences between soldering and welding.

        (ii) What is integrated circuit (IC)

(iii) Why discrete circuits are replaced by IC.

(iv) What is classification of IC.

(v) Where do we use linear and digital IC.
                    2+2+3+1+2

(Electrical Circuit and Network Skills)

1. Answer any *five* questions of the following :
                    5×2=10

(a) What is choke ? And its use.

(b) Define Eddy current and discuss its use.

(c) Why core of a transformer is laminated ?

(d) Explain rotating magnetic field.

(e) Define form factor.

(f) Write Limitation of Ohm's Law.

(g) Which type materials is used for Fuse element ?

[Turn Over]

(4)

(h) What are the main difference between Ammeter and Voltmeter

2. Answer any *four* questions : 4×5

(a) Write down the differences between star and delta conection.

(b) Describe Lap and wave winding.

(c) Write down the relation between current and emf at primary & secondary coil.

(d) Calculate instantaneous power in a ac circuit.

(e) Discuss different types of Loss in a transformer.

3. Answer any *one* question : 1×10

(a) What is principle of a A/C motor ? Discuss its different parts. Which meter is best A/C or D/C. 4+3+3=10

(b) Derive the equation of emf produced in a DC generator. Define slipring and commutator. 6+4=10

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