

2022

(February)

PHYSICS

(Honours)

(Electrodynamics, Electronics—II)

[PHY-06 (T)]

Marks : 56

Time : 3 hours

The figures in the margin indicate full marks
for the questions

Answer Question No. **1** which is compulsory
and *any four* from the rest

1. (a) The data sheet of a JFET gives the following information :

$$I_{DSS} = 3 \text{ mA}; V_{GS(\text{off})} = 6 \text{ V}; \\ g_{m(\text{max})} = 5000 \text{ S}$$

Determine the (i) transconductance for $V_{GS} = 4 \text{ V}$ and (ii) drain current I_D at this point. 2+2=4

- (b) Using Boolean techniques, simplify the following expression : 3

$$Y = AB + A(B + C) + B(B + C)$$

- (c) Calculate the magnitude of Poynting vector on the surface of the sun. Given that the power radiated by sun 3.8×10^{26} watts and the radius of the sun $= 7 \times 10^8 \text{ m}$. 3

- (d) Write the FORTRAN expression corresponding to the following arithmetic expression : 2

$$\frac{(a-b)(c-d)}{(a+b)(c-d)}$$

2. (a) Derive Clausius-Mossotti equation. 5

- (b) Discuss the boundary conditions satisfied by \vec{E} at the interface between two homogeneous dielectrics. 3

- (c) Show that $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$, where symbols have their usual meanings. 3

3. (a) State and prove uniqueness theorem. 7

- (b) Write down the Maxwell's equations for time-dependent electromagnetic fields in a material medium at rest and discuss the empirical basis of these equations. 4

4. (a) What are gauge transformations? Discuss the significance and utility of Coulomb's gauge in dealing with inhomogeneous wave equations. 2+5=7

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- (b) Considering normal incidence of electromagnetic waves at the boundary between two dielectric media, derive the expression for transmittance and reflectance. $2+2=4$
5. (a) Using a circuit diagram, explain the working of an OP-AMP as an integrator. 4
- (b) What is meant by CMRR of an OP-AMP? 2
- (c) What are FETs? Explain static and transfer characteristic of a JFET with the help of supporting diagrams. $1+4=5$
6. (a) With the help of a neat circuit diagram, explain the working of a Hartley's oscillator. Draw an AC equivalent circuit of a Hartley's oscillator. Obtain an approximate expression for its frequency of oscillation. $3+1+3=7$
- (b) Convert $(32\ 812)_{10}$ to binary. 2
- (c) What is a digital comparator? Draw a 1-bit digital comparator. 2
7. (a) What are optical fibres? Mention its types and explain how light is guided in an optical fibre. $1+1+2=4$

(4)

- (b) Using 2's complement scheme, perform the following binary subtraction : $1\frac{1}{2}$
- $$101\cdot1101 - 101\cdot0111$$
- (c) Draw a flowchart to solve the roots of a quadratic equation. Develop the algorithm for the same and hence write the code/program in FORTRAN to solve the quadratic equation. $1\frac{1}{2}+1\frac{1}{2}+2\frac{1}{2}=5\frac{1}{2}$
8. (a) Explain the following non-executable statements with at least one example : $1\frac{1}{2}\times4=6$
- (i) FORMAT statement
- (ii) DIMENSION statement
- (iii) OPEN FILE statement
- (iv) COMMON statement
- (b) Explain the usage of the following control statements in FORTRAN : $1\frac{1}{2}\times2=3$
- (i) GO TO statement
- (ii) IF THEN, ELSE, ENDIF
- (c) List the types of FORTRAN variables and explain any one of them. 2

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