C 21553 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS–UG) DEGREE EXAMINATION, APRIL 2022

Physics/Applied Physics

APH 4C 04—OP-AMP AND APPLICATIONS

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

The symbols used in this question paper have their usual meanings.

Section A

Answer at least **eight** *questions.*
Each question carries 3 *marks.*
All questions can be attended.
Overall Ceiling 24.

1. Why an operational amplifier is called so ?
2. What is input offset voltage ?
3. Why open loop op-amp configurations are not used in linear applications ?
4. What is the function of pin land 5 of an IC741 op-amp ? Explain.
5. Mention the features of negative feedback.
6. How can you construct a summing amplifier in inverting configuration ?
7. Distinguish between active and passive filters.
8. What is the use of an all pass filter ?
9. Mention the classification of oscillators based on various criteria.
10. Why crystal oscillators are more stable than RC and LC oscillators ?
11. Give the circuit diagram and waveforms of a basic op-amp comparator with positive and negative output voltage limiting.
12. Define upper threshold voltage and lower threshold voltage of a Schmitt trigger.

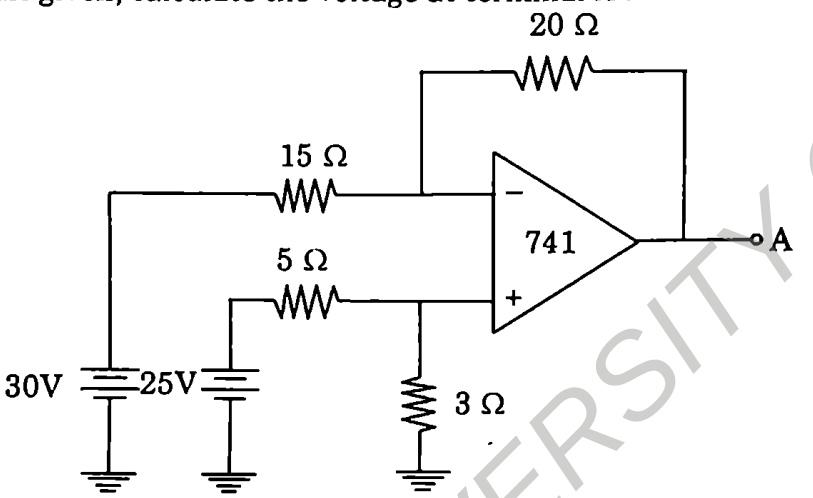
(8 × 3 = 24 marks)

Section B

Answer at least **five** *questions.*
Each question carries 5 *marks.*
All questions can be attended.
Overall Ceiling 25.

13. Define Common Mode Rejection Ratio (CMRR) of an op-amp. What is its significance?

14. For the circuit given, calculate the voltage at terminal A :



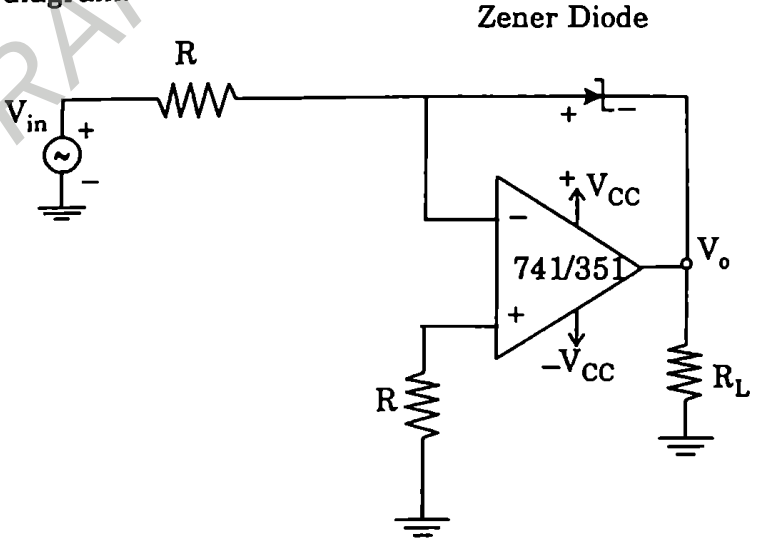
15. An op-amp voltage follower in non-inverting configuration has the following parameters.

    $A = 200.000$ $R_i = 2M\,\Omega$ $f_0 = 5Hz$ Output voltage swing $V_{sat} = \pm 13$ V

    Compute the values of A_F, R_{iF},R_{oF}, f_F and V_{ooT}.

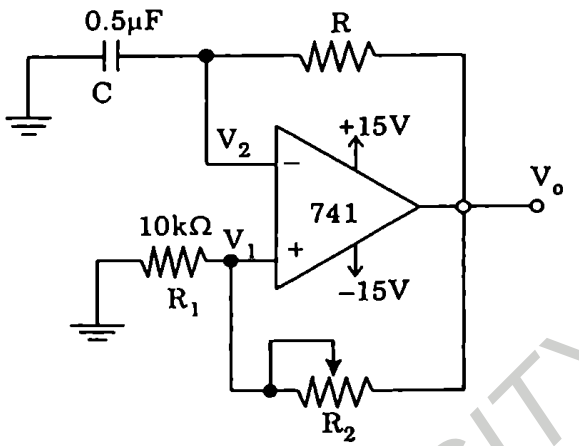
16. Obtain the equation for closed loop gain of an inverting amplifier using virtual ground concept.

17. Design a first order low-pass filter with cut-off frequency of 2 kHz with pass band gain of 2. Give the circuit diagram.



18. In the given circuit, V_{in} = 500 mV peak 60 Hz sine wave, R = 100 ohm, Zener Voltage V_z = 5.1 V, supply voltages ±15V. Determine the output voltage swing. Assume that the voltage drop across the forward biased zener is 0.7 V.

19. Fig. shows a square wave generator. Calculate the values of R and R_2.



(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*
The question carries 11 *marks.*

20. With a schematic, illustrate the principle of a voltage series feedback amplifier using op-amp. Derive expressions for its closed loop voltage gain, input and output resistances with feedback.

21. What are active filters ? Explain the principle and working of a narrow band- pass filter.

(1 × 11 = 11 marks)

C 21552 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2022

Physics/Applied Physics

PHY 4C 04—ELECTRICITY MAGNETISM AND NUCLEAR PHYSICS

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

Section A

Answer at least **eight** *questions.*

Each question carries 3 *marks.*

All questions can be attended.

Overall Ceiling 24.

1. Explain Gauss's law in electrostatics.
2. How will you define the potential difference between two points in an electric field ? What is its unit ?
3. What do you mean by a capacitor ? What are the factors on which the capacity of a capacitor depends on ?
4. Write down the expression connecting current density and drift velocity. What are the terms involved ?
5. What do you mean by angle of dip ? What is the angle of dip at the magnetic equator ?
6. Give any *four* properties of paramagnetic materials.
7. What is the use of a deflection magnetometer ? How will you arrange a deflection magnetometer in tan B position ?
8. What is the working principle of a tangent galvanometer ?
9. What do you mean by nuclear fission ? Give an example.
10. What are secondary cosmic rays ? What is its content ?
11. Give the quark composition of a proton and a neutron.
12. What is the purpose of large hadron collider ?

Section B

Answer at least **five** *questions.*

Each question carries 5 *marks.*

All questions can be attended.

Overall Ceiling 25.

13. If 1 coulomb charge is placed at the centre of a cube of side 10 cm, estimate the flux coming out of any face of the cube.

14. A sphere of 10 cm. diameter is suspended within a hollow sphere of 12 cm. diameter. If the inner sphere be charged to a potential of 15,000 volt and the outer sphere be earthed, determine the charge on the inner sphere.

15. A galvanometer of resistance 15 ohms gives full scale deflection for a current of 2 milli ampere. Calculate the shunt resistance needed to convert it to an ammeter of range 5 A.

16. What do you mean by a hysteresis loop ? Plot a typical hysteresis loop and indicate retentivity and coercivity.

17. Discuss the arrangement of a Searle's vibration magnetometer using a suitable figure. Give an application of a Searle's vibration magnetometer.

18. The half life of a radioactive substance is 15 years. Calculate the period in which 2.5 % of the initial quantity will be left over.

19. Discuss the lepton and baryon number conservation laws giving an example for each.

(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*

The question carries 11 *marks.*

20. Using a suitable figure, discuss the working principle of a Carey Foster bridge. How will you determine the temperature co-efficient of resistance of a material using a Carey Foster bridge.

21. Using a suitable figure, explain the working principle of a cyclotron.

(1 × 11 = 11 marks)

C 21551 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2022

Physics/Applied Physics

PHY4B04/APH4B04—ELECTRODYNAMICS—II

(2019 Admission onwards)

Time : Two Hours Maximum : 60 Marks

Section A

Answer at least **eight** *questions.*

Each question carries 3 *marks.*

All questions can be attended.

Overall Ceiling 24.

1. Explain Ohm's law. Discuss the terms involved.
2. What do you mean by the term displacement current ? Give an expression for the same.
3. Illustrate the symmetry of Maxwell's equations for E and B in the absence of the charge and current density terms.
4. What is Poynting vector ? Give an expression for the same.
5. Give the wave equation for the magnetic field vector B in free space and explain the terms involved. Write down the expression for the speed of the wave.
6. What do you mean by a monochromatic plane wave ? Give its general form.
7. Write down the boundary conditions for the magnetic field vector B at an interface separating two linear media of permittivities ε_1 and ε_2 and permeabilities μ_1 and μ_2.
8. Distinguish between initiation and transition transient currents.
9. What do you mean by wattles current ?
10. Give Kirchhof's mesh law.
11. What are the features of an ideal constant voltage source ?
12. What is reciprocity theorem ?

(8 × 3 = 24 marks)

Section B

Answer at least **five** *questions.*

Each question carries 5 *marks.*

All questions can be attended.

Overall Ceiling 25.

13. Obtain an expression for the energy stored in a magnetic field due to a current.

14. Write down the integral forms of Maxwell's equations and explain the terms involved.

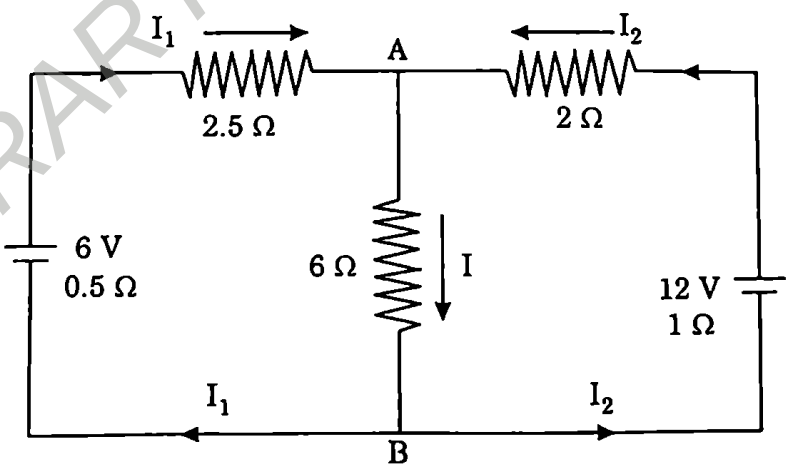
15. Prove that for a plane monochromatic wave, the Poynting vector is the energy density times the velocity of the wave.

16. Give the fundamental laws of geometrical optics considering the reflection and transmission of electromagnetic waves at a boundary separating two linear media.

17. A circuit consists of a non-inductive resistance of 50 Ω, an inductance of 0.3 H and a resistance of 2 Ω and a capacitor of 40 μF in series and is supplied with 200 V at 50 Hz. Find the impedance of the circuit.

18. An alternating voltage of 10 V at 100 Hz is applied to a choke of inductance 5 H and resistance 200 Ω. Determine the power factor of the coil.

19. For the circuit shown below, find the currents flowing in all branches and the voltage across the 6 Q resistor using superposition theorem.



(5 × 5 = 25 marks)

Section C

Answer any **one** *question.*

The question carries 11 *marks.*

20. Obtain the wave equation for the E and B vectors in free space. Using a plane wave solution show that the electromagnetic waves are transverse in nature and the E and B vectors are in phase and mutually perpendicular.

21. Explain the construction and working principle of a ballistic galvanometer. Obtain the relation connecting the charge flowing and the ballistic throw of the galvanometer.

(1 × 11 = 11 marks)

C 21307 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION APRIL 2022

Physics/Applied Physics

PHY 4C 04—ELECTRICITY MAGNETISM AND NUCLEAR PHYSICS

(2014—2018 Admissions)

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*
Answer in a word **or** *phrase.*

1. Nuclear forces are appreciably bonly when the distance between nucleons is of the order of ————.
2. The particle emitted in β-decay together with electron is ————.
3. The ionization power is maximum for ————.
4. The principle used in cyclotron is ————.
5. An example for paramagnetic substance is ————.
6. Energy of cosmic rays is of the order of ————.
7. Value of electric charge and strangeness of d quark is ————.
8. The susceptibility of paramagnetic material is ————.
9. The colours of quarks are ————.
10. The principle is ———— used in the construction of atom bomb.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions.*
Each question carries 2 *marks.*
Answer in two **or** *three sentences.*

11. Explain critical magnetic field Hc in superconductivity. How it is related to T_c ?
12. Give two examples for ferromagnetic materials.

13. State Gauss Law.

14. List out the properties of electric lines of force.

15. Distinguish between primary and secondary cosmic rays.

(5 × 2 = 10 marks)

Section C

Answer any **four** *questions.*
Each question carries 5 *marks.*
Answer in one paragraph.

16. Distinguish between Para, Dia and ferromagnetic materials with examples.

17. Differentiate between nuclear fission and fusion with example.

18. Explain latitude and longitude effect in cosmic rays.

19. Explain the terms, decay constant, half life and average life as applied to a radioactive substance. Find the relation between them.

20. Give the construction, theory and limitations of cyclotron.

21. Write the fundamental laws of radioactivity.

(4 × 5 = 20 marks)

Section D

Answer any **two** *questions.*
Each question carries 5 *marks.*

22. A metallic wire 2 mm. in diameter carries a charge of 200 C in one hour.The metal contains 6×10^{22} free electrons per cubic centimetre .Calculate the current in the wire and the drift velocity of electrons.

23. A cyclotron in which the flux density is 1.4 weber/m^2 is employed to accelerate protons. How rapidly should the electric field between the Dees be reversed ? Mass of the proton = 1.67×10^{-27} kg. and charge 1.67×10^{-19}.

24. The radius of Ho^{165} is 7.731 fermi. Deduce the radius of He^4 .

25. A reactor is developing energy at the rate of 3000 kW. How many atoms of U^{235} undergo fission per second ? How many kilograms of U^{235} would be used in 1000 hours of operation assuming that on an average energy of 200 MeV is released per fission ?

26. Complete the reaction :

$\Pi^+ \longrightarrow$ .....

$\Pi^- \longrightarrow$ .....

$\Pi^0 \longrightarrow$ .....

$\mu^+ \longrightarrow$ .....

$\mu^- \longrightarrow$ .....

(2 × 5 = 10 marks)

Section E

Answer any **two** *questions.*

Each question carries 15 *marks.*

27. With the help of neat diagram and necessary theory,explain how the temperature co-efficient of the material of a resistor can be determined using Carey Foster's Bridge.

28. State and Prove Gauss Law. Find the electric field due to similarly and oppositely charged two infinite plane parallel sheets. Deduce the expression of a parallel plate capacitor, when the dielectric slab is inserted between the plates. Assume the slab thickness is less than the plate separation.

29. What are cosmic rays ? State the main features of these rays. Discuss the effect of earth's magnetic field, latitude and longitude on them. What is the possible origin of these rays ?

(2 × 15 = 30 marks)

C 21306 (Pages : 3) Name.....

Reg. No.....

FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION APRIL 2022

Physics/Applied Physics

PHY 4B 04/APY 4B 04—ELECTRODYNAMICS—I

(2014—2018 Admissions)

Time : Three Hours Maximum : 80 Marks

Section A

Answer **all** *questions.*
Each question carries 1 *mark.*
Answer in a word **or** *phrase.*

1. Write the relationship between electric displacement vector and electric field vector.
2. State Faraday's law of electromagnetic induction. Explain the symbols used.
3. State Coulomb's law in electrostatics.
4. What is the nature of force between two parallel conductors carrying currents ?
5. State Gauss's law for magnetic fields.

State whether the statement is True *or* False

6. For static charge, the curl of E is zero.
7. Below the Curie temperature, a ferromagnetic material would become paramagnetic.
8. H_2O is an example of a polar molecule.
9. For paramagnetic materials, the susceptibility is negative and small.
10. $\nabla^2 V = -\rho/\epsilon_0$ is called Poisson's equation.

(10 × 1 = 10 marks)

Section B

Answer **all** *questions in two* **or** *three sentences.*
Each question carries 2 *marks.*

11. Write down the expression for the work done to assemble a collection of point charges.
12. Write Ampere's law in differential and integral form.

Turn over

13. Derive the relation between electric field and electric potential.

14. Differentiate between susceptibility and permeability.

15. State ampere's force law.

16. Draw a diagram to show the variation of electric field of a charged metallic sphere with distance.

17. Explain scalar potential and vector potential.

(7 × 2 = 14 marks)

Section C

Answer any **five** *questions.*
Each question carries 4 *marks.*

18. Derive the equation $E = -\nabla V$

19. Derive the relation connecting dielectric constant and electric susceptibility.

20. Show that the energy of a magnetic dipole in a magnetic field B is given by $U = -m.B$

21. Derive an expression for the potential of a localized charge distribution.

22. State and explain Gauss's law in the presence of dielectrics.

23. Compare magnetostatics and electrostatics.

24. Explain the magnetostatic boundary conditions.

(5 × 4 = 20 marks)

Section D

Answer any **four** *questions.*
Each question carries 4 *marks*

25. The electric field in some region of space is found to be $E = kr^3 \hat{r}$ in spherical coordinates, where k is some constant and $\hat{r}$ is the unit vector. Find the charge density.

26. A conductor 4m. in length lies along the y axis with a current of 10A in the $\hat{y}$ direction. Find the force on the conductor if the field in the region is B = 0.05 tesla in the x direction.

27. A charge 1×10^{-6} C is at the centre of a cubical Gaussian surface of 0.5 mm. edge. What is the electric flux for this surface ?

28. Find the magnetic induction at the centre of a square loop of wire of side 'a' carrying a current I.

29. A metallic sphere of radius 10 cm. has a surface charge density of 10 nC/m^2. Calculate the energy stored in the system.

30. An all metal aeroplane dives down vertically at 300 km/s where $B_H = 0.4 \times 10^{-4}$T. If the wing span is 30 m, what will be the resulting potential difference between the tips ?

31. A current distribution gives rise to the magnetic vector potential $\mathbf{A} = x^2y\ \hat{x} + y^2x\ \hat{y} - 4xyz\ \hat{z}$. Calculate **B** at (– 1, 2, 5).

(4 × 4 = 16 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

32. Obtain the Gauss's law in differential form. Using Gauss's law, find the electric field inside and outside a spherical shell of radius R that carries a uniform surface charge density σ.

33. (a) State and explain Biot Savart's law.

    (b) Derive an expression for the magnetic field due to a circular loop of current at a point on the axis of the coil.

34. (a) Explain atomic polarizability and polarisation vector.

    (b) Derive the expression for the torque experienced by a polar molecule (dipole) in a non-uniform field.

35. (a) Derive the expression showing the effect of magnetic field on atomic orbit.

    (b) Derive the relation connecting magnetic susceptibility and permeability.

(2 × 10 = 20 marks)