C 2226 (Pages : 3) Name.....

Reg. No.....

# FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
# APRIL 2021

Physics/Applied Physics

PHY 4B 04/APY 4B 04—ELECTRODYNAMICS—I

Time : Three Hours Maximum : 80 Marks

## Section A

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

1. $\nabla X B =$ ————————.
2. The Curl of vector field is ————————.
3. A particle is released from rest in to a region in which E is perpendicular B. The particle will undergo ———————— motion.
4. The electric field inside a charged spherical shell is————————.
5. For paramagnetic material, the value of $\chi$ is————————.

*Questions 6 to 10 write True* **or** *False.*

6. Electrostatic energy obeys superposition principle.
7. No work is done in moving a charge from one point to another point on the surface of a conductor.
8. Continuity equation gives the local conservation of charges.
9. Surface current density is the current per unit area.
10. Polarization is the dipole moment per unit volume.

(10 × 1 = 10 marks)

## Section B

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

11. Show that electricfield is the negative gradient of potential
12. State first uniqueness theorem.

**Turn over**

13. Show that the energy of an ideal dipole in an electric field is-**p.E.**

14. What is a polarizability tensor ?

15. Find the expression relating dielectric constant and electric susceptibility.

16. What is a linear magnetic material ?

17. State Ampere's law in magnetostatics.

(7 × 2 = 14 marks)

## Section C

*(Answer in* **a paragraph** *of about* **half a page** *to* **one page.**
*Answer any* **five** *questions.*
*Each question carries 4 marks.*

18. Derive the boundary conditions for electric displacement D.

19. Differentiate between paramagnetism and diamagnetism.

20. What do you mean by method of images ? Explain.

21. Find the electric field due to an infinite plane carrying a uniform surface charge σ and comment on the result.

22. Find the work needed to form an assembly of four point charges.

23. Show that the normal derivative of vector potential is discontinuous across a boundary.

24. What is the effect of magnetic field on atomic orbits ?

(5 × 4 = 20 marks)

## Section D

*Problems-write all relevant formulas.*
*All important steps carry separate marks.*
*Answer any* **four** *questions.*
*Each question carries 4 marks.*

25. Find the capacitance per unit length of two coaxial metal cylindrical tube of radii '*a*' and '*b*'.

26. A spherical conductor of radius '*a*' carries a charge Q. It is surrounded by a linear dielectric material of susceptibility $\chi_e$, out to radius '*b*'. Find the energy of this configuration.

27. Find the electric field due to a uniformly polarized sphere ?

28. At the interface between two linear dielectrics the electric field lines bend. Show that $\frac{\tan\theta_2}{\tan\theta_1} = \frac{\varepsilon_2}{\varepsilon_1}$, where $\theta_1$ and $\theta_2$ are the angle made by the electric field of the two media with the normal. There is no free charge at the boundary.

29. A long copper rod of radius R carries a uniformly distributed free current I. Find auxiliary field **H** inside and outside the rod.

30. Find the vector potential of an infinite solenoid with '*n*' turns per unit length, radius R and current I.

31. Find the capacitance of a parallel plate capacitor containing two dielectrics with $K_1 = 1.5$ and $K_2 = 3.5$, each occupying one half of the space between the plates with interface parallel to the plates. Given area of the plates equal to 2 $m^2$ and distance between the plates is equal to $10^{-3}$ m.

(4 × 4 = 16 marks)

## Section E (Essays)

*Answer in about* **two pages.**
*Answer any* **two** *questions.*
*Each question carries* 10 *marks.*

32. State Biot-Savart law. Find the magnetic field due to a circular coil carrying a current I.

33. State and prove Gauss's law in electrostatics. Find the electric field due to a uniformly charged solid sphere. Represent the variation of electric field with distance graphically.

34. What do you mean by ferromagnetism ? Explain the hysteresis curve.

35. What are dielectrics ? Find the expression for force experienced by a dielectric system placed between the plates of a parallel plate capacitor.

(2 × 10 = 20 marks)

C 2227 (Pages : 2) Name.....

Reg. No.....

# FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, APRIL 2021

Physics/Applied Physics

PHY 4C 04—ELECTRICITY MAGNETISM AND NUCLEAR PHYSICS

Time : Three Hours Maximum : 80 Marks

## Section A

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

1. Betatron is used to accelerate ———— particle.
2. The particle emitted in β decay together with electron is ————.
3. Superconductivity was discovered by ————.
4. The combination of one u quark and two d quarks is called ————.
5. Range of nuclear force in the order of ————.
6. An example for paramagnetic substance is ————.
7. Nuclear fission can be explained by ————.
8. The susceptibility of paramagnetic material is ————.
9. Charge of u quark is ————.
10. The principle of ———— 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. State Coulomb's theorem.
12. State Gauss Law.
13. Explain nuclear fission.
14. Explain critical temperature in superconductivity.
15. Explain the properties of electric lines of force.

(5 × 2 = 10 marks)

**Turn over**

## Section C

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

16. Differentiate between nuclear fission and fusion with example.
17. Explain the terms : binding energy of the nucleu, packing fraction mass defect.
18. Distinguish between Para, Dia and ferromagnetic materials.
19. Explain the terms, decay constant, half life and average life as applied to a radioactive substance. Find the relation between them.
20. Discuss with the neat diagram the working of a semiconductor detector.
21. Explain latitude effect in cosmic rays

(4 × 5 = 20 marks)

## Section D

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

22. A horizontal overhead power line caries a current of 50A from the south to north. Calculate the magnitude and direction of the magnetic field due to the current at a point 2m above the line.
23. Given the following isotopic masses $_3Li^7 = 7.016004$, $_3Li^6 = 6.015125$ and $_0n^1 = 1.008665$. Calculate the binding energy of neutron in $_3Li^7$ nucleus. Express the result in u, MeV and Joules.
24. A metallic wire 1 mm in diameter carries a charge of 100C in one hour. The metal contains $6 \times 10^{22}$ free electrons per cubic centimetre. Calculate the current in the wire and the drift velocity of electrons.
25. Calculate the force and acceleration of an $\alpha$ particle when it is at a distance of $6.9 \times 10^{-15}$ from the surface of the gold nucleus. Nuclear radius = $6.9 \times 10^{-15}$m Mass of the $\alpha$ particle = $6.7 \times 10^{-27}$Kg Charge of the electron = $1.6 \times 10^{-19}$C Atomic No. of gold = 79.
26. How many kilowatt energy will be released by complete fission of one kg of $U^{235}$. Given that the energy released per fission is 200 MeV ?

(2 × 5 = 10 marks)

## Section E

*Answer any* **two** *questions.*
*Each question carries* 15 *marks.*

27. Explain nuclear fission and fusion and also explain the working of hydrogen bomb.
28. Write an essay on Elementary Particles.
29. With the help of neat diagram and necessary theory, explain how the temperature coefficient of the material of a resistor can be determined using Carey Foster's Bridge.

(2 × 15 = 30 marks)

C 2228 (Pages : 3) Name.....

Reg. No.....

# FOURTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
# APRIL 2021

Physics/Applied Physics

APY 4C 04—DIGITAL INTEGRATED CIRCUITS

Time : Three Hours Maximum : 64 Marks

## Section A

*Answer* **all** *questions.*
*Each question carries* 1 *mark.*

1. The AND gate performs which of the following operations.

   (a) Multiplication. (b) Inversion.

   (c) Addition. (d) Subtraction.

2. A + AB is equal to :

   (a) 0. (b) 1.

   (c) A. (d) A + B.

3. TTL technology uses ——— transistors for the input devices.

   (a) Multiple emitter. (b) Single emitter.

   (c) Multiple collector. (d) Multiple base.

4. A TTL inverter is with :

   (a) Open emitter. (b) Open collector.

   (c) Open base. (d) None of these.

5. In an edge triggered SR flip flop the invalid condition is :

   (a) S high, R low. (b) S low, R high.

   (c) Both low. (d) Both high.

6. The difference between a latch and a flip-flop is :

   (a) Method used for changing state.

   (b) Method of giving input.

   (c) Method of giving output.

   (d) All the above.

7. If $n$ is the number of flip-flops in a counter then the maximum possible number of states is :

   (a) $n$. (b) $2n$.

   (c) $2^n$. (d) None of the above.

8. A register is used for :

   (a) Storing data. (b) Shifting data.

   (c) Both. (d) Either.

9. Sum output of a half adder is generated by ——— gate

   (a) AND. (b) OR.

   (c) Exclusive OR. (d) NOR.

10. The bit for detecting error is called ——— bit.

   (a) Parity. (b) Encoder.

   (c) Decoder. (d) None of the above.

(10 × 1 = 10 marks)

## Section B

*Answer* **all** *questions.*
*Each question carries* 2 *marks.*

11. Give the basic idea of analog to digital conversion.

12. Discuss the basic function of a decoder.

13. Explain serial in parallel out shift register.

14. Explain the term edge triggered in the case of flip-flop.

15. Explain about ECL circuits.

16. Discuss logical operation of OR gate

17. Explain commutative law of Boolean algebra.

(7 × 2 = 14 marks)

## Section C

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

18. Discuss the operation of CMOS NAND gate.

19. Explain the operation of SR latch.

20. Distinguish between synchronous and asynchronous counters.

21. Explain the basic function of a multiplexer.

22. Discuss the binary weighted input DA converter.

(3 × 4 = 12 marks)

## Section D

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

23. Explain the binary to BCD conversion.

24. Explain why asynchronous counters are called ripple counters.

25. Explain the method of edge triggering in a SR flip flop.

26. Explain the working of a TTL inverter.

27. Explain SOP and POS forms of logic function.

(3 × 4 = 12 marks)

## Section E

*Answer any* **two** *questions.*
*Each question carries* 8 *marks.*

28. Discuss the simplification of Boolean expression using a Karnaugh map.

29. Explain the basic binary decoder and discuss four bit binary decoder and BCD to decimal decoder.

30. Explain the types of shift registers.

31. List out the specification of TTL logic family. Compare the features of TTL & CMOS logic families.

(2 × 8 = 16 marks)

C 3561 (Pages : 3) Name.....

Reg. No.....

# FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2021

Physics/Applied Physics

PHY 4B 04/APH 4B 04—ELECTRODYNAMICS—II

Time : Two Hours Maximum : 60 Marks

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

## Section A (Short Answer Type)

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

1. Explain Joule heating law.
2. Comment on the statement "nature abhors a change in flux".
3. Illustrate the symmetry in Maxwell's equations for E and B in free space.
4. Write down the general wave equation. Give its solution.
5. Draw a monochromatic plane wave travelling in the $z$ direction indicating the E and B vectors.
6. Give expressions for the electric and magnetic field vectors E and B in terms of the potentials.
7. Show that the Coulomb gauge leads to Poisson's equation.
8. List the origin of transient currents in circuits.
9. Write down an expression for the DC transient current in a series R-L circuit. Explain the terms involved.
10. Plot the growth and decay of DC transient currents in an RC series circuit.
11. Compare series and parallel resonant circuits.
12. Write down the Kirchhoff's voltage law.

(8 × 3 = 24 marks)

**Turn over**

## Section B (Paragraph/Problem Type)

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

13. Explain the boundary conditions for the electric and magnetic vectors E and B at an interface separating two linear media of permittivities $\varepsilon_1$ and $\varepsilon_1$ and permeabilities $\mu_1$ and $\mu_2$.

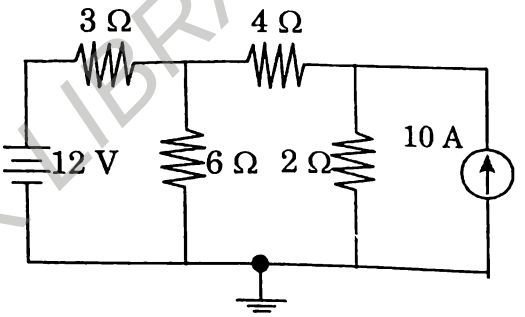
14. Show that, for a plane monochromatic wave, the momentum density stored in the field is the energy density divided by the velocity of the wave.

15. A ballistic galvanometer has a free period of 10 seconds and gives a steady deflection of 200 divisions with a steady current of 0.1 milli-amperes. A charge of 121 micro-coulombs is instantaneously discharged through the galvanometer giving rise to a first maximum deflection of 100 divisions. Calculate the decrement of the resulting oscillations.

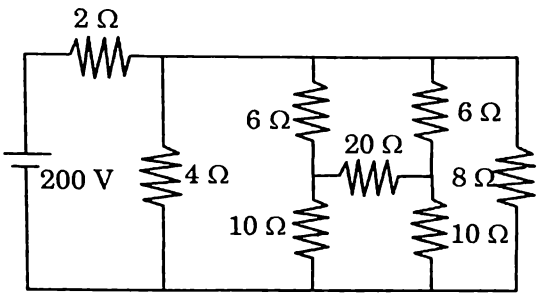
16. A coil having an inductance of 50 mH and resistance 10 Ω is connected in series with a 25 μF capacitor across a 200 V AC supply. Determine : (i) The resonance frequency of the circuit ; (ii) Current flowing at resonance ; and (iii) Q-factor.

17. Obtain an expression for the power consumed in a series LCR circuit.

18. Use Thevenin's theorem to determine the current flowing through the 4 Ω resistance of the following circuit.



19. Find the current through the 8 Ω resistor of the following circuit using Norton's theorem.




(5 × 5 = 25 marks)

## Section C (Essay Type)

*Answer any* **one** *question.*

*The question carries* 11 *marks.*

20. Obtain Maxwell's equations in matter.

21. Obtain the wave equation for the electric and magnetic field vectors E and B in free space. Explain the term polarization and show that electromagnetic waves are transverse in behavior.

(1 × 11 = 11 marks)

C 3562 (Pages : 2) Name.....

Reg. No.....

# FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION
# APRIL 2021

Physics/Applied Physics

PHY 4C 04—ELECTRICITY MAGNETISM AND NUCLEAR PHYSICS

Time : Two Hours Maximum : 60 Marks

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

## Section A (Short Answers)

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

1. Give the differential form of Gauss's law in electrostatics. What are the terms involved in the expression ?
2. What are the properties of equipotential surfaces ?
3. What do you mean by the capacitance of a capacitor ? Give the basic expression for the same.
4. Give the vector statement of Ohm's law. What are the terms involved ?
5. Give the value of the angle of dip at the magnetic pole and magnetic equator.
6. Give any *four* properties of ferromagnetic materials.
7. What is the use of a deflection magnetometer ? How will you arrange a deflection magnetometer in tan C position ?
8. What is nuclear fusion ? Give an example.
9. What are cosmic ray showers ?
10. What are the fundamental interactions in nature ?
11. What do you mean by hypercharge ? What is the hypercharge of $\pi^+$ particle ?
12. Name the different leptons.

(8 × 3 = 24 marks)

**Turn over**

## Section B (Paragraph/Problem Type)

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

13. How much electric flux will come out through a surface S = 10 $j$ kept in an electrostatic field E = $2i + 4j + 7k$ ?

14. Determine the capacitance of a sphere of 20 cm diameter inside which there is an earth-connected sphere of 10 cm diameter, the medium between the spheres being air.

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 is the origin for a hysteresis loop in ferromagnetic materials ? Use a typical hysteresis loop indicating retentivity and coercivity.

17. Discuss the working principle of a tangent galvanometer. What do you mean by the reduction factor of a tangent galvanometer ?

18. How long will it take for 60 % of a sample of radon to decay ? Given, the half-life of radon = 3.82 days.

19. Explain the distinction between particles and antiparticles. Illustrate using two examples.

(5 × 5 = 25 marks)

## Section C (Essay Type)

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

20. Explain the working principle of a potentiometer. How will you determine the resistance of a wire using a potentiometer ?

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

(1 × 11 = 11 marks)

C 3563 (Pages : 2) Name.....

Reg. No.....

# FOURTH SEMESTER (CBCSS—UG) DEGREE EXAMINATION
# APRIL 2021

Physics/Applied Physics

APH 4C 04—OP-AMP AND APPLICATIONS

Time : Two Hours Maximum : 60 Marks

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

## Section A (Short Answer Type)

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

1. Why an op-amp is considered as a versatile device ?
2. Define slew rate of an op-amp.
3. What is gain-bandwidth product ?
4. What are the features of an ideal op-amp ?
5. Explain the principle of an open loop differential amplifier.
6. How can you construct a summing amplifier in non-inverting configuration ?
7. With a schematic, compare the frequency responses of a basic and practical integrator using op-amp.
8. Mention two applications of differentiators.
9. What are the two basic criteria to be fulfilled while designing an oscillator ?
10. What is meant by frequency stability of an oscillator ? How is it related to the figure of merit Q of the circuit ?
11. What are the limitations of an op-amp zero-crossing detector ?
12. What is meant by hysterisis of a comparator ?

(8 × 3 = 24 marks)

**Turn over**

## Section B (Paragraph/Problem Type)

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

13. Draw the equivalent circuit of an op-amp and explain the features.

14. An open loop differential amplifier circuit with op-amp IC 741 has the following specifications.

    A = 2,00,000 $R_i$ = 2MΩ, $R_o$ = 75Ω, + $V_{CC}$ = +15V, – $V_{EE}$ = – 15 V

    Output voltage swing – ± 14 V

    Determine the output voltage in each of the following cases for the open loop differential amplifier.

    (i) $v_{in\,1}$ = 5μV dc, $v_{in\,2}$ = – 7μV dc

    (ii) $v_{in\,1}$ = 10 mV r.m.s. $v_{in\,2}$ = 20 m V r.m.s.

15. Explain the principle of an op-amp voltage follower.

16. An IC 741 op-amp having following parameters is connected as a non-inverting amplifier with $R_1$ = 1 KΩ, $R_F$ = 10 KΩ. Open loop voltage gain, A = 2,00,000. Supply voltages = + 15V. Compute the values of gain of the feedback circuit (B) and closed loop voltage gain($A_F$).

17. Design a first order low pass filter with cut-off frequency of 1 kHz with pass band gain of 2. Give the circuit diagram.

18. How shall you construct a zero crossing detector from an inverting comparator ? Give the circuit and waveforms.

19. Describe the principle of a square wave generator using an op-amp based circuit.

(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 shunt feedback amplifier using op-amp. Explain the concept of virtual ground.

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

(1 × 11 = 11 marks)