

## SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS-UG)

Physics/Applied Physics

APH 6B 14 (EL2)—MICROPROCESSOR AND MICRO COMPUTER SYSTEMS

(2019 Admissions)

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. How many address lines are required for a CPU with 256 bytes memory addressing capability ?
2. Find the decimal equivalent of the binary 110101.
3. What is Accumulator (ACC) ?
4. Write any four functions of ALU of 8085.
5. What are the functions of  $\overline{RD}$ ,  $\overline{WR}$  signals of 8085 ?
6. Give any two examples of two byte instruction of Intel 8085.
7. Discuss 'Fetch Operation'.
8. What do you mean by operation code and operands ?
9. What is a timing diagram ?
10. Discuss machine cycle.
11. Explain the use of temporary register.
12. Briefly explain the role of 'Sign Flag' (S)

(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. What is Central Processing Unit (CPU) of a computer ? Explain the major components of a CPU.
14. Convert the following binary numbers to decimal numbers :
  - (i) 1100.110.
  - (ii) 0.1110.
15. Convert the decimal number 10767 to a hexa-decimal number.
16. What are the various status flags of Intel 8085 ? Give a brief description.
17. What are Registers ? List the various registers associated with Intel 8085 and explain the use of general-purpose registers.
18. Discuss Pin Configuration of 8085. Give a brief description / role of at least five pins.
19. Discuss the various types of instruction groups used for Intel 8085 with suitable examples.

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one questions.*

*The question carries 11 marks.*

20. What are Buses? Discuss any two types of bus architecture.
21. Discuss different addressing techniques used in Intel 8085. Give examples for each addressing mode.

(1 × 11 = 11 marks)

**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS-UG)

Physics/Applied Physics

APH6B14 (EL1) OP—AMPS AND DIGITAL INTEGRATED CIRCUITS

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

**Section A***Answer atleast eight questions.**Each question carries 3 marks.**All questions can be attended.**Overall ceiling 24.*

1. Draw the equivalent circuit of an ideal op-amp.
2. Why is an op amp called a differential amplifier ?
3. With the help of a neat diagram explain the slope of an ideal voltage transfer curve.
4. How an op amp in an inverting configuration be used as a scaling amplifier ?
5. A resistor is connected across the feedback capacitor in a practical integrator. Why ?
6. Define an electric filter. Differentiate between active and passive filters.
7. Define a zero crossing detector and explain how the problem of slow switching between the saturation voltages can be rectified.
8. Write any *two* limitations of using op amps as comparators.
9. Explain the comparator characteristics.
10. Explain the propagation of time delay in CMOS gates.
11. What is the reason for the compatibility of CMOS devices ?
12. What is the static power dissipation of a CMOS gate ?

(8 × 3 = 24 marks)

**Turn over**

**Section B**

*Answer atleast five questions.*

*Each question carries 5 marks.*

*All questions can be attended.*

*Overall ceiling 25.*

13. Describe die working of a sawtooth wave generator using an op-amp.
14. An IC 741 op-amp having following parameters is connected as a non-inverting amplifier with  $R_1 = 1K \Omega$  and  $R_F = 10K \Omega$  Open loop voltage gain,  $A = 200000$ . Supply voltages =  $\pm 15V$ . Compute the values of gain of die feedback circuit (B) and closed loop voltage gain ( $A_F$ ).
15. With a neat diagram explain the working of an op-amp differentiator.
16. Discuss the case of a Schmitt trigger using an op amp.
17. Design a low pass filter at a cut off frequency of 1 kHz with a passband gain of 2.
18. With a neat diagram explain the working of a CMOS NAND gate.
19. With a neat diagram explain briefly how a TTL NOR gate functions.

(5 × 5 = 25 marks)

**Section C**

*Answer any one questions.*

*Each question carries 11 marks.*

20. Discuss the working of an instrumentation amplifier. Mention *two* applications of the same.
21. Describe the TTL parameters. Write a note on the propagation time delay and power consumption of different TTL variants.

(1 × 11 = 11 marks)

**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 14 (EL3)—MATERIALS SCIENCE

(2019 Admissions)

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 the basic components of the discipline materials science and engineering.
2. Why is it so that the properties of polycrystalline materials usually isotropic ?
3. Using a suitable figure, explain a self-interstitial.
4. What is Burgers vector ?
5. Give Fick's first law of diffusion and explain the terms involved.
6. Give expression indicating the temperature dependence of diffusion co-efficient and explain the terms involved.
7. Explain what you mean by macromolecules.
8. Distinguish between homopolymers and copolymers.
9. What are the prerequisites of abrasives ? Give an example.
10. Discuss the structures of any four types of repeating units in polymeric materials.
11. What are the applications of Laue's method ?
12. Explain the term optical microscopy.

(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. What are advanced materials? Discuss their applications.
14. Give a graph representing the variation of attractive, repulsive and the resultant force on the inter atomic separation for two isolated atoms.
15. Distinguish between edge and screw dislocation in solids.
16. Distinguish between steady state and non-steady state diffusion.
17. Discuss briefly the different molecular structures in polymers.
18. Obtain the Bragg's law of x-ray diffraction.
19. Write short note on scanning probe microscopy.

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Discuss the formation of (i) Covalent ; and (ii) Van der Waals bonding in solids.
21. Explain briefly the mechanical properties of ceramics.

(1 × 11 = 11 marks)

**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS-UG)

Physics/Applied Physics

PHY6B14 (EL2)—NANOSCIENCE AND TECHNOLOGY

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

**Section A***Answer atleast eight questions.**Each question carries 3 marks.**All questions can be attended.**Overall ceiling 24.*

1. Give the band structure of a semiconductor indicating valence and conduction bands and the energy gap.
2. Show a graph illustrating the variation of Fermi-Dirac function with temperature.
3. Plot the density of states versus energy curve of a quantum well.
4. Mention the limitations of Drude model of electrical conduction in metals.
5. What do you mean by quantum mechanical tunneling ?
6. What are the basic assumptions in the Bohr model of hydrogen atom ?
7. Give four examples of bottom-up approaches to nanomaterials synthesis.
8. Distinguish between resolution and magnification of microscopy tools.
9. What are piezoceramics ? Give an application of them.
10. Explain how STM is used for manipulation of atoms.
11. Mention *three* methods of deposition of carbon nanotubes.
12. Explain what do you mean by a molecular machine.

(8 × 3 = 24 marks)

**Turn over**

**Section B**

*Answer atleast five questions.*

*Each question carries 5 marks.*

*All questions can be attended.*

*Overall ceiling 25.*

13. Discuss the conduction mechanism in ionic crystals.
14. Discuss the quantum confinement effects in nanomaterials.
15. Using a suitable schematic, discuss the various processes involved in chemical vapour deposition.
16. Explain the principle of electro deposition process.
17. Using a suitable schematic, discuss the working principle of AFM.
18. Using suitable schematics, distinguish between constant height and constant current modes of operations of STM.
19. Write short note on the applications of nanomaterials in energy and medical field.

(5 × 5 = 25 marks)

**Section C**

*Answer any one questions.*

*Each question carries 11 marks.*

20. Discuss the different electron conduction mechanisms in thin solid films. Explain the Poole-Frenkel and Arrhenius types of conduction.
21. What do you mean by an infinite square well potential ? Obtain the eigen functions and eigen values of a particle confined to an infinite square well.

(1 × 11 = 11 marks)



**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 14 (EL1)—BIOMEDICAL PHYSICS

(2019 Admissions)

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. Give an expression for Helmholtz free energy. Discuss the terms involved.
2. What are the different valves of heart ?
3. Discuss the different parts of human brain.
4. Explain the basic components of a medical instrumentation system.
5. Discuss electroencephalogram.
6. Give a brief description of ultrasonic diagnosis.
7. Discuss the basic properties of beta rays.
8. Explain electron capture.
9. What is positron emission tomography ?
10. Mention the biological effects of NMR imaging.
11. Explain the term coherence of laser beams.
12. Discuss the application of lasers in neurosurgery.

(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. Briefly outline the Hodgkin-Huxley model for membrane transport.
14. Obtain the Einstein equation relating mobility to the diffusion coefficient.
15. List the different sources of biomedical signals.
16. Write short note on biosensors.
17. Discuss briefly the visualization techniques of X-rays.
18. Briefly discuss the image reconstruction techniques in NMR imaging.
19. Write short note on carbon dioxide laser.

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Discuss the diffusion phenomenon and explain the Fick's laws of diffusion.
21. Explain the principle of computed tomography (CT) illustrating the techniques for producing CT images.

(1 × 11 = 11 marks)

**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 13/APH 6B 13—RELATIVISTIC MECHANICS AND ASTROPHYSICS

(2019 Admissions)

Time : Two Hours

Maximum : 60 Marks

*The symbols used in 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. What is meant by transformation equations in relativity ?
2. Why did Einstein assume that the speed of light in vacuum is a universal constant ?
3. State the Cosmological principle.
4. Is the white dwarf a stable equilibrium state ? Explain why.
5. Give the postulates of special relativity.
6. Define luminosity of a star. Is the luminosity of a star related to its temperature ?
7. Sirius has a parallax of 0.379 arcseconds. How much parsec is its distance from the Earth ?
8. What is CMBR ?
9. Explain Hubble's law for the expansion of the universe.
10. Explore the features of AGN. Why are they called so ?
11. What are Binary stars ?
12. Mention the features of Population II stars ?

(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. Show that in the non-relativistic limit, Lorentz transformations reduces to Galilean transformations.
14. (a) If a star's brightness is increased by 45,000 times, how much is the change in its magnitude ?  
(b) Faint Brown dwarf stars have absolute magnitudes of around 17.5. How much fainter they are compared to Sun ?
15. Mention the important features of Cepheid variables. Why are they used as distance indicators ?
16. Discuss the standard big-bang theory for the origin of the universe.
17. A particle is traveling through the Earth's atmosphere at a speed of  $0.6c$ . To an Earth-bound observer, the distance it travels is 1.50 km. How far does the particle travel in the particle's frame of reference ?
18. Discuss the classification of galaxies.
19. What kinds of objects make up the dark matter ?

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Derive the law of addition of velocities using Lorentz transformation equations.
21. Explain the star formation and life cycle of stars.

(1 × 11 = 11 marks)

## SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 12/APH 6B 12—NUCLEAR PHYSICS AND PARTICLE PHYSICS

(2019 Admissions)

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. Discuss any *two* properties of nuclear forces.
2. Draw a typical binding energy per nucleon versus mass number plot indicating its features.
3. Explain the Gamma decay process.
4. Distinguish between prompt and delayed neutrons.
5. What are the basic requirements for a plasma state ?
6. What is the working principle of a proportional counter ?
7. What is the working principle of a Van de Graaff accelerator ?
8. Draw the schematic of a proton synchrotron.
9. What is the working principle of an intersecting beam accelerator ?
10. Give the list of leptons. Mention the charge of each particle.
11. What is the strange behavior of kaons and hyperons ?
12. What do you mean by quantum chromodynamics ?

(8 × 3 = 24 marks)

**Turn over**

**Section B (Paragraph/Problem Type)**

*Answer at least five questions.*

*Each question carries 5 marks.*

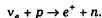
*All questions can be attended.*

*Overall Ceiling 25.*

13. Estimate the binding energy of the nucleus  $^{12}_6\text{C}$ . Also determine its density.
14. With the help of a neat diagram, explain the working principle of a Wilson cloud chamber.
15. Briefly explain the working principle of a proportional counter using a suitable figure.
16. Using a suitable figure, discuss the principle of a betatron accelerator.
17. Determine the energy released when three alpha particles combine to form  $^{12}\text{C}$ .
18. Find the Q value of the following decay.



19. Name the conservation law that would be violated in the following decay.



(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Explain the conservation laws in radioactive decays using suitable examples.
21. Discuss the stages involved in nuclear fission illustrating examples. Explain the basic features of fission reactions that make it useful as a means to generate electrical energy.

(1 × 11 = 11 marks)

## SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 11/APH 6B 11—STATISTICAL PHYSICS, SOLID STATE PHYSICS,  
SPECTROSCOPY AND PHOTONICS

(2019 Admissions)

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. What are Fermions ? Give an example. What do you mean by Pauli principle ?
2. Plot the specific heat versus temperature graph of liquid helium at low temperatures. What do you mean by lambda point ?
3. Using a suitable figure, discuss the lattice parameters of a unit cell.
4. What do you mean by a symmetry operation in a unit cell ? What are the point group symmetry operations ?
5. Draw an NaCl lattice structure.
6. Distinguish between microwave active and microwave inactive molecules. Give examples.
7. Distinguish between symmetric top and spherical top molecules.
8. Explain the term "zero point energy" of an IR active molecule.
9. What are hot bands ? Why are they called so ?
10. Explain population inversion.
11. Discuss the basic components of a laser.
12. Mention any four applications of lasers.

(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. Show that the most probable speed of the Maxwell speed distribution is  $(2kT/m)^{1/2}$ .
14. Using Fermi-Dirac distribution, obtain an expression for the Fermi energy at absolute zero.
15. Find the interplanar spacing for the lattice planes of Miller indices (3, 2, 1), (2, 1, 0) and (1, 1, 1) for a cubic lattice with  $a = 5.62\text{\AA}$ .
16. Discuss the various regions of the electromagnetic spectrum.
17. Draw the energy levels and the allowed transitions between them in the rotational spectrum of a rigid diatomic molecule. Give the corresponding spectrum.
18. Explain the processes spontaneous emission and stimulated emission.
19. Discuss the construction, energy levels involved in lasing action and emission wavelengths of a ruby laser.

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Discuss briefly the Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions. Plot the corresponding distribution functions.
21. Obtain Bragg's law of X-ray diffraction. Discuss the basic principle of powder method.

(1 × 11 = 11 marks)



**SIXTH SEMESTER U.G. DEGREE EXAMINATION, MARCH 2022**

(CBCSS—UG)

Physics/Applied Physics

PHY 6B 10/APH 6B 10—THERMODYNAMICS

(2019 Admissions)

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. Distinguish between reversible and irreversible processes.
2. Is it possible to get a Carnot's engine with 100 % efficiency ? Explain.
3. Plot the TS diagram for various reversible processes of a hydrostatic system.
4. State the mathematical form of entropy principle and explain it.
5. What is Joule- Thomson expansion ? What is its use ?
6. Distinguish between first and second order phase transitions.
7. Which are the macroscopic quantities, required to describe the materials in a cylinder of an automobile engine ?
8. State and explain the zeroth law of thermodynamics.
9. Explain thermal equilibrium.
10. What are the features of quasi-static process ?
11. Give the mathematical formulation of the first law of thermodynamics and its related ideas.
12. Comment on the molar heat capacities of ideal gases.

(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 isotherms of  $H_2O$ .
14. Write down the equations representing the hydrostatic properties of a pure substance and then express Maxwell's thermodynamic relations.
15. Find the change in entropy when a perfect gas expands isothermally and adiabatically.
16. The pressure of 10 g of copper is increased at ice point from 0 to 1000 times the atmospheric pressure. Calculate the work done. Given the density of copper  $8930 \text{ kgm}^{-3}$ , its isothermal compressibility  $7.16 \times 10^{-12} \text{ Pa}^{-1}$ .
17. What are virial coefficients? Give their significance.
18. Show that the adiabatic curve has a steeper negative slope than does an isothermal curve at the same point.
19. Explain the microscopic theories which help to give information about thermal properties of systems.

(5 × 5 = 25 marks)

**Section C (Essay Type)**

*Answer any one question.*

*The question carries 11 marks.*

20. Analyse the working of a Carnot's engine, calculating expression for its efficiency.
21. Discuss first order phase transition and derive the Clausius-Clapeyron equation.

(1 × 11 = 11 marks)

**SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

APY 6B 14 (E2)—MICROPROCESSOR AND MICRO COMPUTER SYSTEMS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

*Symbols used in this question paper have their usual meanings.***Section A***Answer in a word or phrase.**Answer all questions.**Each question carries 1 mark.*

1. Write an example of a two byte instruction in 8085.
  2. Write the 8085 ALP instruction to store the content of accumulator to the memory location 2050H.
  3. Expand EPROM.
  4. What is word length of a computer ?
  5. Name two expert systems.
- Write True or False :
6. Secondary memory holds data permanently.
  7. OR gates are easy to fabricate neither than NOR gates using IC technology.
  8. The parity flag is set when the result of an arithmetic or logical operation contains odd number of ones.
  9. HLT is an example of implicit addressing mode in 8085.
  10. ORACLE is an application package.

(10 × 1 = 10 marks)

**Section B***Answer in a short paragraph - three or four sentences.**Answer all questions.**Each question carries 2 marks.*

11. Explain the concept of virtual memory.
12. What is Binary Coded Decimal ?

- Write the truth table of logic AND gate.
- Explain the features of Dynamic RAM in computers.
- Give the difference between JMP and JNC instruction in 8085.
- Explain the register indirect addressing mode with suitable examples.
- Write a note on the address bus and data bus in 8085.

(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.*

- Explain the flag registers in 8085.
- Explain four instructions using different Op Codes from the Stack, I/O and Machine Control group of instructions in 8085.
- Discuss the functions of ALU and Timing and Control Unit in 8085.
- Discuss the various buses employed in computer architecture.
- Describe the working of any two magnetic memory devices.
- Explain what you mean by time shared operating system.
- Differentiate between array processors and vector processors.

(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.*

- Explain the operation done through the following instructions :
  - JP 2600H.
  - MVI D, 19H.
  - MOV M,B.
  - INR A.
- Comment on each instruction of the following program. Give the content of the accumulator after the execution of the whole instructions

MVI A, 20H

MOV B, A

MVI A, 12 H

ADD B

HLT

27. Write a set of instructions in 8085 to move the data in memory location 2500H to the accumulator, and then to complement it and then to store the result in register B.
28. Add  $-78$  and  $+45$  using 2's complement method. Verify the result using 1's complement method
29. Convert decimal 1231 into : (a) binary and (b) hexadecimal number.
30. Convert decimal 2345.89 into binary up to 5 decimal places.
31. Draw the circuit diagram of how to implement NAND gate using NOT and OR gates. Verify the result using truth table.

(4 × 4 = 16 marks)

### Section E

*Essays - Answer in about two pages.*

*Answer any two questions.*

*Each question carries 10 marks.*

32. Describe the various steps in the Instruction Cycle of 8085 with necessary diagram. Describe the flow of instruction word.
33. With the help of a schematic diagram explain the architecture of a microcomputer system. Enumerate the differences between Hardware, Software and Firmware.
34. Explain how the memory addressing capability of a CPU depends on the width of its address bus. With the help of a schematic diagram describe how the I/O and memory devices are interconnected through buses.
35. Draw and explain the timing diagram for I/O Write and memory Write operation.

(2 × 10 = 20 marks)

**SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

APY 6B 14 (E1) OP—AMP AND DIGITAL INTEGRATED CIRCUITS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

**Section A ( Answer in a word or phrase)***Answer all questions.**Each question carries 1 mark.*

1. ICs are used in \_\_\_\_\_ electronics circuits .
2. An OP-AMP circuit uses a feedback which is called a \_\_\_\_\_.
3. A differential amplifier has \_\_\_\_\_ inputs.
4. The last stage of an OP-AMP amplifier is the \_\_\_\_\_.
5. The tail current of a differential amplifier is \_\_\_\_\_.
6. \_\_\_\_\_ is an example for hex open drain buffer.
7. The word \_\_\_\_\_ refers to the way a driving device is connected to a loading device.
8. The common-mode voltage gain is \_\_\_\_\_ than differential voltage gain
9. The differential gain is \_\_\_\_\_.
10. The \_\_\_\_\_ can amplify both ac and dc signals

(10 × 1 = 10 marks )

**Section B (Answer in a short paragraph—three or four sentences)***Answer any all questions.**Each question carries 2 marks.*

11. Explain slew rate.
12. Draw the circuit diagram of a sawtooth generator.
13. List out the applications of comparators.

14. What are all pass filters ?
15. What is scaling amplifier ?
16. Explain CMOS.
17. Explain about ideal voltage transfer curve.

(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. Explain the working of a square wave generator.
19. Explain how instrumentation amplifiers work.
20. Explain working voltage limiters with circuit diagram.
21. Give a brief account on the applications of digital ICs.
22. Explain inverting and non-inverting terminals of Op-Amp.
23. Give a brief account on voltage controlled oscillator with diagram.
24. Write about the advantages and disadvantages of ICs.

(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. The output voltage of an OP-amp changes by 10V within 5 s. Calculate the slew rate.
26. An OP-amp is used as an inverting amplifier with a gain of 40. The voltage gain vs frequency response is flat upto 30kHz. What is the maximum peak to peak input signal that can be applied without disturbing the output voltage ?
27. Design an operational amplifier circuit with a gain of -20. Assume input resistance is equal to 5KΩ.
28. Design a high pass filter at a cutoff frequency of 1 kHz with a pass band gain of 2.
29. A differential amplifier has an output of 1V with a differential input of 5mV with a common mode input of 10mV. Find CMRR in dB.

30. Determine the output voltage for the summing amplifier having  $V_1 = 10V$ ,  $V_2 = 8V$ ,  $V_3 = 7V$ ,  $R_1 = R_2 = R_3 = 10k\Omega$ ,  $R_f = 1k\Omega$ .
31. A non-inverting amplifier has  $R_1 = 1k\Omega$ ,  $R_f = 100k\Omega$ . Determine feedback factor if  $V_{out} = 5V$ .

(4 × 4 = 16 marks)

**Section E (Essays–Answer in about two pages)**

*Answer any two questions.*

*Each question carries 10 marks.*

32. Draw a practical Schmitt trigger circuit and explain its operation with waveforms. What is the difference between a comparator and Schmitt trigger ?
33. Explain frequency counter, multiplexing displays and application of digital ICs.
34. Explain summing amplifier in *three* configurations.
35. Explain frequency response of first order and second order low pass butterworth filter with appropriate circuit diagram.

(2 × 10 = 20 marks)



**SIXTH SEMESTER (CUCBCSS-UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

PHY6B13 (E3)—MATERIALS SCIENCE

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

**Section A (Answer in a word or a phrase)***Answer all questions.**Each question carries 1 mark.*

1. \_\_\_\_\_ is defined as the number of atoms per unit length whose centers lie on the direction vector for a specific crystallographic direction.
2. A \_\_\_\_\_ Hydrocarbon, all bonds are single ones and no new atoms may be joined without the removal of others that already bonded.
3. Give an expression for Bragg's law.
4. Give an Expression for Force-potential energy relationship for two atoms.
5. Diffusion occurs for pure metals, but all atoms exchanging positions are of the same type ; this is termed \_\_\_\_\_.

Write True or False :

6. Cesium Chloride is a BCC structure.
7. In ionic bonding, stable electron configuration are attained by the sharing of electrons between adjacent atoms.
8. One mechanism involves the interchange of an atom from a normal lattice position to an adjacent vacant lattice site or vacancy is called vacancy diffusion.
9. For substitutional type, solute or impurity atoms replace or substitute for the host atoms.
10. Vacancies are linear defect that centers around the line that is defined along the end of the extra half plane of atoms.

(10 × 1 = 10 marks)

**Turn over**

**Section B (Answer in two or three sentences)**

*Answer all questions.*

*Each question carries 2 marks.*

11. Define planar density.
12. What you mean by vanderwaals bonding ?
13. Give an expression for evaluate grain size of the material.
14. Differences between screw and edge dislocations..
15. What is polymer molecules ?
16. Explain stress and strain in solids.
17. Define Smart materials.

(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. Briefly explain electron microscopy.
19. What is advanced materials and what are its classifications ?
20. Differentiate steady state diffusion and non-steady state diffusion.
21. Explain flexural strength and elastic behaviour.
22. What are the factors affecting in diffusion of solids ?
23. Differentiate thermosetting and thermoplastic polymers.
24. Explain different kind of volume defects.

(5 × 4 = 20 marks)

**Section D (Short essays, in a paragraph of about half a page to one page)**

*Answer any four questions.*

*Each question carries 4 marks.*

25. Explain glass ceramics and their properties.
26. Briefly explain the classification of materials.
27. Explain schottky and frenkel defect.

28. Derive atomic factor of FCC crystal with suitable diagram.
29. Briefly explain principle of X-ray diffraction.
30. Explain ionic bonding and covalent bonding.
31. Differentiate homopolymers and copolymers.

(4 × 4 = 16 marks)

**Section E (Essays-Answer in about two pages)**

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

32. Explain the different kind of imperfections occurred in the solids. Also explain the importance of imperfections in solids.
33. Explain principle and working of Transmission Electron microscopy and its advantages.
34. What is diffusion? Explain the different type of diffusion occurred in solids with suitable examples
35. Explain the importance of carbon structures and also explain the different kind of carbon structures.

(2 × 10 = 20 marks)

**SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

PHY 6B 13 (E2)—NANOSCIENCE AND TECHNOLOGY

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

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

1. \_\_\_\_\_ is to be a quasi particle composed of an electron along with its accompanying polarization field.
2. STM is the \_\_\_\_\_ between a metallic tip and a conducting substrate which are in very close proximity.
3. \_\_\_\_\_ is the emission of electrons or ions by highly heated substances, caused by thermal vibrational energy overcoming the electrostatic forces holding electrons to the surfaces.
4. The conductivity expression can be given by \_\_\_\_\_.
5. \_\_\_\_\_ is a method that uses chemical processes to create an image.

Write True or False :

6. AFM is the van der Waals force between the tip and the surface.
7. Pyrolysis is a process occurred in chemical vapour deposition.
8. Variable range hopping is a model describing high temperature conduction in strongly disordered systems with localized states.
9. Quantum particle will be fully reflected even if it has enough energy to propagate the step potential  $V_0$ .
10. Plasma arc discharge is an example of lithographic technique.

(10 × 1 = 10 marks)

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

11. What is Schottky effect ?
12. Explain tunnelling current.

13. Define zero dimensional nanostructures.
14. Explain single electron transistor.
15. Name two applications of Schrödinger equation.
16. Define Buckminster fullerene.
17. What is Top down synthesis in nanomaterials ?

(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. What is carbon nanotube and its applications ?
19. Describe the classification of nanomaterials according to their dimension.
20. Briefly explain the principle of SPM techniques.
21. Explain the process included in ball milling.
22. Explain quantum confinement effect in nanomaterials.
23. Describe Field enhanced thermionic emission.
24. What is the principle of sputtering ?

(5 × 4 = 20 marks)

### Section D

*Short essays, in a paragraph of about half a page to one page.*

*Answer any four questions.*

*Each question carries 4 marks.*

25. Explain polar conduction.
26. Explain the mechanism of conduction in ionic crystals.
27. What are the different modes of operations occurred in atomic force microscopy ?
28. Explain different type of chemical vapour deposition.
29. Explain the principle of electron microscopy.
30. Explain plasma arc discharge method.
31. Derive an energy expression for an electron which trapped in nanosheet.

(4 × 4 = 16 marks)

**Section E**

*Essays - Answer in about **two** pages.*

*Answer any **two** questions.*

*Each question carries 10 marks.*

32. Give detail description of principle behind the sol gel technique with suitable example and flow chart.
33. Explain classical and quantum mechanical theory of electron conduction in metals.
34. Explain principle and working of Scanning probe microscopy and their applications.
35. Describe electron transport in semiconductors and also derive and explain fermi level of intrinsic semiconductors.

(2 × 10 = 20 marks)

## SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022

Physics/Applied Physics

PHY 6B 13 (E1)—COMPUTATIONAL PHYSICS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

*The symbols used in the question paper have their usual meanings.***Section A***Answer in a word or a phrase.**Answer all questions.**Each question carries 1 mark.*

1. Name any *two* input/output functions in Python.
2. What are strings ?
3. What is meant by curve fitting ?
4. What do you mean by interpolation ?
5. What is the difference between the *two* statements  $i = i + 1$  and  $i == i + 1$  ?

Write True or False :

6. Curve fitting by graphical method depends on the choice of points on the line.
7. The process of finding the value of a function outside the given range of arguments is called interpolation.
8. The operators ' $\Delta$ ' and ' $\nabla$ ' are linear.
9. The logical NOT operator returns true if the operand is false.
10. Dictionary is atype of data structure.

(10 × 1 = 10 marks)

Turn over

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

11. What is tuple in Python ?
12. What do you mean by the principle of least squares ?
13. Discuss the fall of a body in a viscous medium.
14. What are the properties of dictionary keys in python ?
15. Distinguish between compilers and interpreters.
16. What are finite differences ?
17. What are the advantages of python in comparison with other programming languages ?

**(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. Write a note on operators and expressions in python.
19. Explain the principle of least squares.
20. Explain the Newton-Raphson method for solving algebraic equations.
21. What is the significance of indentation in python ?
22. How does a function return a value ?
23. Derive the Trapezoidal rule from the general quadrature formula.
24. How do you create a text file using python ?

**(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. By the method of least squares, find the straight line that best fits the following data :

<i>x</i>	1	2	3	4	5
<i>y</i>	14	27	40	55	68



26. Evaluate  $\int_0^{10} \frac{dx}{1+x^2}$  using Simpson's 3/8 rule.
27. Using Taylor's series method, solve  $\frac{dy}{dx} = x^2 - y$ ,  $y(0) = 1$ , at  $x = 0.1$ .
28. Write a program to find the factorial of a number, using python.
29. Using python, write a program to print the Fibonacci series.
30. Given  $y' = x^2 - y$ ,  $y(0) = 1$ . Find  $y(0.1)$  using Runge-Kutta method of second order.
31. Write a python program to add two numbers.

(4 × 4 = 16 marks)

#### Section E (Essays)

*Answer in about two pages each.*

*Answer any two questions.*

*Each question carries 10 marks.*

32. Explain the list functions and set functions in python.
33. Describe with examples, the conditional statements and iterative statements in python.
34. Derive Newton's forward difference interpolation formula.
35. Derive the general quadrature formula and from that, obtain Simpson's 1/3 rule.

(2 × 10 = 20 marks)

**SIXTH SEMESTER (CUCBCSS-UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

PHY 6B 12/APY 6B 13—NUCLEAR PHYSICS, PARTICLE PHYSICS AND ASTROPHYSICS

(2014—2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

**Section A (Answer in a word or phrase)***Answer all questions.**Each question carries 1 mark.*

1. Charge of u quark is \_\_\_\_\_.
2. The empirical formula for the nuclear radius is \_\_\_\_\_.
3. The total amount of energy radiated from a star from its surface per second is called \_\_\_\_\_.
4. The hydrogen isotope \_\_\_\_\_ is radioactive.
5. A particle and antiparticle possess the same \_\_\_\_\_.

Question 6 to 10 : Write True or false :

6. Neutrino possesses a mass.
7. Tokamak is used for the confinement of plasma.
8. The principle of a betatron is the use of cross electric and magnetic fields so as to accelerate charged particles.
9. A scintillation counter is very fast in response.
10. Ionisation chamber is used to accelerate charged particle.

(10 × 1 = 10 marks)

**Section B (Answer in two or three sentences)***Answer all questions.**Each question carries 2 marks :*

11. What are baryons and leptons ?
12. Mention some of the uses of a nuclear reactor.
13. Explain decay constant.

**Turn over**

14. List out the confinement methods.
15. Comment on the saturation property of nuclear forces.
16. State the properties of Beta rays.
17. Give the quark combination of a proton.

(7 × 2 = 14 marks)

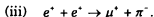
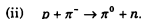
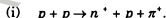
**Section C (Paragraph type)***Answer in a paragraph of about half a page to one page.**Answer any five questions.**Each question carries 4 marks.*

18. Discuss about radio-carbon dating and mention its application.
19. Write a short note on strangeness.
20. Discuss about meson theory of nuclear forces.
21. Give a brief account on nuclear fission and its important applications.
22. Explain the working principle of electron synchrotron.
23. Explain geomagnetic effect in cosmic rays.
24. Explain the term stellar parallax and the units of stellar distances.

(5 × 4 = 20 marks)

**Section D (Problems)***(Problems write all relevant formulas, all important steps carry separate marks.)**Answer any four questions.**Each question carries 4 marks.*

25. Consider a single helium nucleus formed by the fusion of two deuterium nuclei. Mass of  ${}^1_1\text{H}^2 = 2.014102\text{u}$  ; mass of  ${}^2_2\text{He}^4 = 4.002604\text{u}$ . Find out the energy released in fusion.
26. Explain Carbon-Nitrogen and proton-proton cycle in sun.
27. Determine whether the following reactions are allowed or forbidden :



28. The disintegration constant  $\lambda$  of a radioactive element is 0.00231 per day. Calculate its half-life and average life.
29. A reactor is developing energy at the rate of 3000 kW. How many atoms of  $U^{235}$  undergo fission per second ?
30. Briefly explain equatorial and ecliptic co-ordinate systems.
31. List the four fundamental interaction and their properties.

(4 × 4 = 16 marks)

**Section E (Essays–Answer in about two pages)**

*Answer any two questions.*

*Each question carries 10 marks.*

32. Give the principle of nuclear reactor. What are the roles of moderator and control rods in the reactor ? List the main parts and explain the working of the reactor.
33. Discuss the origin and nature of cosmic rays. Differentiate between primary and secondary cosmic rays. Explain properties of beta and gamma rays.
34. Explain liquid drop model of nucleus. How does it lead to the semi-empirical mass formula. Write any two application of Semi-empirical mass formula.
35. Explain the classification of elementary particles with examples.

(2 × 10 = 20 marks)

**SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

PHY 6B 11/APY 6B 12—SOLID STATE PHYSICS, SPECTROSCOPY AND LASER  
PHYSICS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

**Section A***Answer in word or a phrase each.**Answer all questions.**Each question carries 1 marks.*

1. The process of determination of crystal structure is called \_\_\_\_\_.
2. X-rays are produced when an element of high atomic weight is bombarded by high energy \_\_\_\_\_.
3. The vibrational energy of lowest energy state is called \_\_\_\_\_.
4. In Raman scattering, if the scattered photon have energy  $h(\nu_0 + \nu_m)$  that corresponds to \_\_\_\_\_ line.
5. If the number of atoms in the excited state is greater than that in the lower energy level, it is called

Questions 6 to 10 : Write True or False :

6. Crystalline solids are anisotropic.
7. In an asymmetric top molecule, all the three moment of inertia are distinct.
8. Soft superconductors show Meissner effect.
9. X-rays have electromagnetic wave nature as ordinary light.
10. In superconductors, the critical field depends on temperature.

(10 × 1 = 10 marks)

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

11. Define crystal lattice.
12. What is Meissner effect ?

**Turn over**

13. What is Doppler broadening ?
14. Write down Bragg's equation.
15. Why anti-stokes lines are less intense than stokes lines ?
16. Distinguish between stimulated emission and spontaneous emission.
17. Write any 4 medical applications of laser.

(7 × 2 = 14 marks)

### Section C

*Answer in a paragraph of about half a page to one page each.*

*Answer any five questions.*

*Each question carries 4 marks.*

18. Write a brief note on crystal systems.
19. Distinguish between Type I and Type II superconductors.
20. Write a note on Absorption instruments.
21. Outline the effect of isotopic substitution on the rotational spectra of molecules.
22. Write a note on vibrational Raman spectra.
23. Which are the factors that affect the intensity of spectral lines ?
24. What are Einstein's co-efficients ?

(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. A Raman line is observed at  $4768.5\text{\AA}$  when acetylene was radiated by  $4358.3\text{\AA}$  radiations. Calculate the vibrational frequency that causes this shift.
26. An atom has two atomic levels spaced by  $3\text{eV}$  in energy. Calculate the ratio of population in higher and lower energy at  $50^\circ\text{C}$ . Boltzmann's constant =  $1.38 \times 10^{-23}\text{J/K}$ .
27. What is the minimum voltage applied to an X-ray tube to produce X-rays of  $0.5\text{\AA}$  .
28. Electrons are accelerated to 728 volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is  $8^\circ$ . Determine the interplanar spacing of the crystal.
29. Copper has fcc structure with the lattice constant  $0.361\text{nm}$ . Calculate the interplanar spacing for (112) and (120) planes.

30. If the bond length of  $H_2$  is 0.07417nm, what would be the positions of the first three rotational Raman lines in the spectrum? What is the effect of nuclear spin on the spectrum ?  
 ${}^1H = 1.673 \times 10^{-27}$  kg.
31. The frequency of OH stretching vibration in  $CH_3OH$  is  $3300\text{cm}^{-1}$ . Estimate the frequency of OD stretching vibration in  $CH_3OD$ .

(4 × 4 = 16 marks)

### Section E

*Essays - answer in about two pages each.*

*Answer any two questions.*

*Each question carries 10 marks.*

32. Explain the close-packed structures in crystal.
33. Explain the rotational spectra of rigid diatomic molecule with energy level diagram.
34. Explain the working of Infrared spectrophotometer.
35. Describe a semiconductor laser and explain its working.

(2 × 10 = 20 marks)

**SIXTH SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, MARCH 2022**

Physics/Applied Physics

PHY 6B 10/APY 6B 11—THERMAL AND STATISTICAL PHYSICS

(2014 to 2018 Admissions)

Time : Three Hours

Maximum : 80 Marks

*Symbols used in this question paper have their usual meanings.***Section A ( Answer in a word or phrase)***Answer all questions.**Each question carries 1 mark.*

1. For an adiabatic process, the \_\_\_\_\_ of the system remains constant.
2. The source of a Carnot's engine can supply any amount of energy. (True or False)
3. The dimension of phase space for a single particle is \_\_\_\_\_.
4. An isochoric process is one in which \_\_\_\_\_ remains constant.
5. When heat is given to a system, its internal energy \_\_\_\_\_.
6. What is statistical probability ?
7. What is a canonical ensemble ?
8. What is a thermodynamic system ?
9. What are bosons ?
10. Explain the terms open system and closed system.

(10 × 1 = 10 marks)

**Section B (Answer in a short paragraph three or four sentences)***Answer all questions.**Each question carries 2 marks.*

11. Define entropy. Discuss the physical meaning of entropy.
12. Distinguish between microstates and macrostates.
13. Give the expressions for isothermal and adiabatic elasticity.



- Which are the *two* ways to represent the work done by the working substance in one complete cycle of a Carnot engine ?
- State and explain the second law of thermodynamics.
- Derive an expression for the work done in an isothermal process.
- Explain the conditions under which FD statistics holds good.

(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.*

- Show that during a reversible adiabatic process, the entropy of the system remains constant.
- Using Maxwell's thermodynamic relations, prove that for any substance, the ratio of the adiabatic and isothermal elasticities is equal to the ratio of the two specific heats.
- What are the limitations of Maxwell-Boltzmann method ?
- What is Bose-Einstein statistics ?
- State the first law of thermodynamics. Express it mathematically and explain its physical significance.
- Deduce the second latent heat equation of Clausius  $C_2 - C_1 = (dL/dT) - (L/T)$  where  $C_1$  and  $C_2$  represent the specific heat of a liquid and its saturated vapour and  $L$  is the latent heat of the vapour.
- State and explain the third law of thermodynamics.

(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.*

- Air at N.T.P is compressed to half of its volume. Calculate the change in its temperature.
- A Carnot's engine whose temperature of the source is 400 K takes 200 calories of heat at this temperature and rejects 150 calories of heat to the sink. What is the temperature of the sink ? Also calculate the efficiency of the engine.
- 1 kg of water at 273K is brought in contact with a heat reservoir at 373K. What is the change in entropy of water as it reaches 373K ?

28. Prove that in a T-S diagram the slope of the isochoric curve is  $T/C_v$  and that of isobaric curve is  $T/C_p$ .
29. Calculate the change in temperature of boiling water when the pressure is increased by 27.12 mm of Hg. The normal boiling point of water at atmospheric pressure is  $100^\circ\text{C}$ . Latent heat of steam =  $537 \text{ cal/g}$  and specific volume of steam =  $1674 \text{ m}^3$ .
30. Calculate the rms velocity of  $\text{H}_2$  at  $27^\circ\text{C}$ . Given  $k = 1.38 \times 10^{-23} \text{ J/deg}$  and mass of hydrogen molecule =  $3.34 \times 10^{-27} \text{ kg}$ .
31. Using Maxwell's thermodynamic relations, prove that the ratio of the adiabatic to the isobaric coefficient of expansion is  $1/(1-\gamma)$ .

(4 × 4 = 16 marks)

**Section E (Essays–Answer in about two pages)**

*Answer any two questions.*

*Each question carries 10 marks.*

32. Derive Maxwell's four thermodynamic relations. Discuss the usefulness of these relations.
33. Define adiabatic process. Derive the equation for an adiabatic process of a perfect gas in terms of pressure, temperature and volume.
34. What is meant by Fermi energy of conduction electrons? Derive an expression for the same.
35. What is T-S diagram? What is its importance? Find the expression for efficiency of a reversible Carnot's engine with the help of T-S diagram.

(2 × 10 = 20 marks)