2B6M21624

(Pages : 2)

Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc. Degree Examination, March/April 2021

BPHY6B10 – Thermal & Statistical Physics

(2018 Admission onwards)

Time: 3 hours

Max. Marks:80

SECTION A

(Answer all in a sentence; each question carries one mark)

1. State first law of thermodynamics.
2. Give two examples for isothermal process.
3. What is meant by efficiency of a heat engine?
4. Explain how entropy is related to disorder.
5. Give an expression for v_{rms}.
6. What are fermions? Give twoexamples.
7. Write down the Boltzmann's entropy relation and explain the symbols.
8. State Wien's displacement law.
9. Give the Clausius statement of second law of thermodynamics.
10. Write the theorem of equipartitionof energy.

(10x1=10 marks)

SECTION - B

(Answer in two or three sentences)

(Answer all questions. Each Question carries 2 marks)

11. State Carnot's theorem.
12. Distinguish between first order and second order phase transitions.
13. Give expressions for Bose Einstein distribution function and Fermi Dirac distribution function.
14. Distinguish between reversible and irreversible processes and state the conditions of reversibility.
15. How can we increase the efficiency of a heat engine?
16. Define coefficient of performance of a refrigerator.
17. Why is it difficult to cook on the top of a mountain ?

(7x2=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 third law of thermodynamics.
19. Give two advantages and disadvantages of Diesel engine.
20. Explain thermodynamic equilibrium.

21. Derive Stefan's law from Planck's radiation law.
22. Write a note on thermodynamic functions (a) Enthalpy (b) Gibbs function and (c) Helmholtz free energy.
23. Derive an expression for the work done during an adiabatic process.
24. Treating electrons as fermi gas, derive an expression for their fermi energy.

(5x4=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 quantity of dry air at 27°C is compressed (i) slowly and (ii) suddenly to ⅓ of its volume. Find the change in temperature in each case.
26. A carnot engine whose sink is at 27°C has its efficiency 40%. What is the temperature of thesource? By how much should the temperature of the source be raised if the efficiency is to be raised to 70%.
27. Calculate the increase in entropy when 1Kg of ice is converted to steam. Given specific heat of water is 1KCal/Kg/°C. . Latent heat of ice is 80KCal/Kg and the latent heat of steam is 540Kcal/Kg.
28. Calculate the depression in the melting point of ice produced by 1 atmospheric increase of pressure. Latent heat of ice = $3.36 \times 10^5 JKg^{-1}$ and specific volume of ice and water at 0°C are 1.091 cm^3 and 1.0 cm^3 respectively.
29. Calculate the rms velocity of H_2 at 27°C. Given $K=1.38\times10^{-23}$J/degree and mass of Hydrogen molecule = 3.34×10^{-27}Kg
30. The first excited level of Hydrogen atom is 10.2 eV above its ground state. What temperature is needed to excite hydrogen atoms to the first excited level.
31. Fermi energy of conduction electrons in silver is 5.48 eV. Calculate number of such electrons per cm^3. Given that $h=6.62\times10^{-34}$J sec and $1eV=1.62\times10^{-19}$J.

(4x4=16 marks)

SECTION - E

(Essay-answer in about two pages)
(Answer any two questions; each question carries 10 marks)

32. Describe with necessary theory, the construction and working of an Otto engine. Derive an expression for its efficiency.
33. Derive Maxwell's four thermodynamical relations and hence find two TdS equations.
34. Starting from B.E energy distribution law, derive Planck's law of blackbody radiation.
35. Show that for a homogenous fluid. $C_P - C_V = T(\partial P/\partial T)_V(\partial V/\partial T)_P$
    Also show that for a perfect gas, $C_P - C_V = R$

(2 x 10 = 20 marks)

2B6M21625

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Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc. Degree Examination, March/April 2021

BPHY6B11 – Solid State Physics, Spectroscopy & Laser Physics

(2018 Admission onwards)

Time: 3 hours

Max. Marks:80

SECTION A

(Answer all in a sentence; each question carries one mark)

1. Define a primitive cell.
2. What is Laue's pattern?
3. Calculate the number of ions in the unit cell of CsCl crystal.
4. What is Meissner effect?
5. Explain the term stimulated emission in laser
6. What is coherence length in a superconductor?
7. Convert 9 GHz to cm^{-1}
8. What is a symmetric top molecule?
9. Draw the Morse curve and energy levels of a diatomic molecule
10. Give a method for the determination of bond distance of a homo nuclear diatomic molecule.

(10×1=10 marks)

Section B

(Answer in two or three sentences)

Answer all questions. Each Question caries 2 marks

11. Describe the process of optical pumping in laser
12. Whatis coordination number?
13. Describe the quantum theory of Raman effect.
14. Write a short note on BCS theory
15. What are the hot bands in vibrating diatomic molecules?
16. Discuss the effect of temperature on critical magnetic field.
17. Calculate the packing fraction for a body centered cubic crystal lattice

(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. Describe the structure of diamond
19. Explain the factors affecting the intensity of spectral lines
20. Discuss breakdown of Born oppen heimer approximation.
21. Obtain Einstein's coefficients related to emission and absorption

22. Distinguish between type I and type II superconductors
23. Discuss the rotational Raman spectra for linear molecules
24. Explain the working of a semiconductor laser

(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 crystal reflects monochromatic x-rays when the Bragg's glancing angle for the first order reflection is 15°. What are the glancing angles for second and third order reflections of the same type ?
26. The transition temperature for mercury with an average atomic mass of 200.59 amu is 4.153K.Calculate its critical temperature when its isotopic mass changes to 203.4amu. The α value is 0.5.
27. The first rotational line of $^{12}C^{16}O$ is observed at 3.8424 cm^{-1} and that of $^{13}C^{16}O$ is 3.6734 cm^{-1}.Calculate the atomic weight of ^{13}C, assuming the mass of ^{16}O to be 15.9949amu.
28. The fundamental and first overtone transition of $^{14}N^{16}O$are centred at 1876.06 cm^{-1} and 3724.20 cm^{-1} respectively. Evaluate the equilibrium vibration frequency, the an harmonicity constant and zero point energy.
29. If the bond length of H_2 is 0.07417nm, what would be the position of first three rotational Raman lines in the spectrum? Mass of $^1H=1.673\times10^{-27}$ kg.
30. Find the relative population of two states in a ruby laser that produces light beam of wavelength 6943Å at 300K.
31. Calculate the lattice constant for iron belonging to bcc structure. The density of iron is 7.86×10^3 kg/m^3 and the atomic weight of iron is 55.85amu.

(4×4=16 marks)

Section E

(Essay-answer in about two pages)
Answer any two questions; each question carries 10 marks

32. Discuss the interaction of radiation with rotating molecules. Explain the spectrum of a non- rigid diatomic rotator.
33. Derive Bragg's law of X-ray diffraction. Also describe the rotating crystal method to find the crystal structure.
34. Explain the rotational Raman spectrum of a symmetric top molecule with example.
35. Explain the working of a He-Ne laser with a schematic diagram.

(2×10=20 marks)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc. Degree Examination, March/April 2021

BPHY6B12 – Nuclear Physics, Particle Physics & Astrophysics

(2018 Admission onwards)

Time: 3 hours

Max. Marks:80

Symbols used in this question paper have their usual meanings

SECTION A

(Answer *ALL* in a sentence. Each question carries 1 mark)

1. What is meant by mass number of a nucleus?
2. Define gyromagnetic ratio.
3. What are alpha particles?
4. Give the relationship between radioactive decay constant and mean life.
5. Where will the intensity of cosmic rays be the maximum?
6. Give the quark structure of a neutron.
7. What are the exchange particles in the case of nuclear force?
8. What are bosons?
9. What is the absolute magnitude of a star?
10. What is meant by heat index of stars?

(10 × 1 = 10 marks)

SECTION B

(Answer in Two or Three sentences)

Answer *ALL* questions. Each question carries 2 marks

11. What are isotopes, isobars and isotones?
12. What is meant by internal conversion?
13. What are the limitations of a cyclotron?
14. What are secondary cosmic rays?
15. Give the one to one correspondence between the symmetries and the laws of conservation.
16. What is isospin? Give its significance.
17. Name the celestial co-ordinate systems used to specify the location of heavenly objects.

(7 x 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. Draw the binding energy curve. Explain the important features of the curve.
19. Describe the principle of NMR. Mention its applications.
20. Explain the meson theory of nuclear force.
21. Explain compound nuclear reactions, giving examples.
22. Explain any two geomagnetic effects of cosmic rays.
23. Explain Pauli's neutrino hypothesis.
24. Write a short note on stellar constellations.

(5 × 4 = 20 marks)

SECTION D

(Problems- Write all relevant formulae. All important steps carry separate marks)
(Answer any *FOUR* questions. Each question carries 4 marks)

25. Calculate the mass number of a nucleus whose radius is 3.6 fm. Given $R_0 = 1.2$ fm.
26. Calculate the binding energy per nucleon in $_{26}Fe^{56}$ nucleus. Given $m_p = 1.00759$ u, $m_n = 1.00898$ u and mass of $_{26}Fe^{56}$ nucleus = 55.9572 u.
27. A carbon specimen found in a cave contained 1/8 as much as ^{14}C as an equal amount of carbon in living matter. Calculate the approximate age of the specimen. Given that half life of ^{14}C = 5568 years.
28. A cyclotron with dees radius 60 cm uses an oscillator of frequency 15 MHz. What should be the magnetic field for accelerating protons, using this cyclotron? Also calculate the maximum kinetic energy of the protons in MeV.
29. Calculate the Q-value in MeV of the reaction $_1H^2 + _1H^2 \rightarrow _2He^3 + _0n^1$. Given masses of $_1H^2 = 2.0114$ u, $_2He^3 = 3.01603$ u , $_0n^1 = 1.008665$ u.
30. Check the possibility of the following reactions. State the conservation principles involved: (i) $p + p \rightarrow K^0 + \Lambda^0 + \pi^+$ (ii) $\pi^- + p \rightarrow n + \pi^0$
    (iii) $p \rightarrow n + e^+ + \nu$ (iv) $p + p \rightarrow n + p + \pi^+$
31. The apparent magnitude of a star is +3.3 and its parallax is 0.025 Calculate the absolute magnitude of the star.

(4 × 4 = 16 marks)

SECTION E

(Essays – Answer in about two pages)
(Answer any TWO questions. Each question carries 10 marks)

32. On the basis of the liquid drop model, derive the semi-empirical mass formula.
33. Explain tunnel theory of alpha decay. Obtain the expression for the decay constant in alpha decay.
34. Describe the classification of elementary particles.
35. Explain the construction and working of a linear accelerator. What are its limitations?

(2 × 10 = 20 marks)

2B6M21627

(Pages : 3) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc. Degree Examination, March/April 2021

BPHY6B13 (E1)– Computational Physics

(2018 Admission onwards)

Time: 3 hours

Max. Marks:80

Section A

Answer all questions

1. Which of the symbol is used for comments in Python.
2. Give an example for compound data type.
3. If the step size in Euler method is h, then the global error is proportional to....
4. Originator of free software movement is.....
5. When step size increases truncation error will.....
6. Given ='01234567', write python code to remove the last two elements.
7. What gets printed if we typed in python?

```
>>> x=3
>>> y=2
>>> print x/y
```

8. ..... translate high level language to low level language.
9. What is the result of the python statement >>> print type(5+8j)
10. What is the output of the following program

```
num=10
n=1
m=[]
while n<=num:
        m.append(n*n)
        n+=1
print m
```

(10 x1 =10 Marks)

Section B

Answer all questions

11. Mention any four properties of the Python languages.
12. How will you use the value of π from the Python module?
13. List the advantages of numerical methods from analytical methods.
14. What is meant by a syntax error? Give an example.
15. Write a python program which accept the radius of a circle from the user and compute the area and perimeter and print the results.
16. What is touple? How does it differ from a list?
17. Compute sin 45 and cos 30 using Taylor series.

(7 x 2 = 14 Marks)

Section C

Answer any *five*

18. Write a note on modify loops using break and continue
19. Briefly explain the Euler method to solve a differential equation.
20. Explain the basic data types available in Python with examples.
21. Write a program in python to solve a quadratic equation where coefficients a,b, and c are provided by the user.
22. Discuss the following dictionary methods with an example.
    a) get() b) keys() c) pop() d) update() e) values() f) items()
23. Explain about 'modules' in python.
24. Discuss Numerical differentiation. Write a general formula for the same.

(5 x 4 =20 Marks)

Section D

Answer any *four*

25. An experiment gave the following table of values for the dependent variable y for a set of known values of x. Obtain an appropriate least square fit for the data

x	1	2	3	4	5	6	7	8	9
y	5.5	7.0	9.6	11.5	12.6	14.4	17.6	19.5	20.5

26. Solve using Runge-Kutta method

$\frac{dy}{dx} = x^2 + y^2; y(0) = 1$ Find y(1) use step size 0.2

27. Find the negative root of the equation $x^3 - 21x + 35 = 0$ correct two decimal places using Newton-Raphson method.

28. Using Bisection method solve the equation $xe^x = 3$ correct to four decimal places.

29. Write a python program for Taylor series expansion for e^{-x}

30. Using Simpson's $1/3$ rule with a step size of 1 $\int_0^6 \frac{dx}{1+x^2}$.

31. A body is falling freely from a height under gravity. Find the velocity and position at the end of 1 second. Tabulate the values at an interval of 0.2 seconds.

(4 x 4 =16 Marks)

Section E

Answer any two

32. (a) Explain control structures in python with suitable examples

(b) Elucidate the difference between if ..... else and if .....elif statements.

(c) Write a python program to find a given year is leap year or not.

33. Discuss freely falling body in viscous medium. A gently placed metallic ball of radius 0.05 m and mass of 100 gm is moving down in caster oil of coefficient of viscosity 0.7 PaS, Estimate the position and velocity after o.5 seconds under the influence of viscous force, Use step size 0.1 sec.

34. (a) Obtain Newton's forward difference interpolation formula.

(b) The population of a city in a census taken once in ten years is given below. Estimate the population in the years 1925 and 1945.

Year	1921	1931	1941	1951	1961	1971	1981
Population in thousands	35	42	58	84	120	165	220

35. (a) Explain the Trapezoidal rule of integration with the help of suitable diagram. What is the significance of size of the interval in the integration?

(b) Write a program in python for computing $\int_1^2 \frac{2+x^3}{2+x^2} dx$ using Trapezoidal rule.

(2x 10 =20 Marks)