Roll No. _____ [Total No. of Pages : 2

PGIIIS-N-1500 B-17

M.Sc. IIIrd Semester Degree Examination

PHYSICS

(Electronics & Instrumentation)

Paper : HCT 3.1

(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates :

*Answer **all** questions of **15** marks and **two** questions of **10** marks.*

1. a) Explain the functioning of an inverting amplifier using op-amp with relevant circuit diagram and derive expressions for closed loop voltage gain and bandwidth with feedback. **(11+4)**

b) Determine the values of A_F and f_F for an inverting amplifier where $R_1 = 470\ \Omega$ and $R_F = 4.7\ K\Omega$. Calculate output voltage when the input voltage is 1 V peak-to-peak sine wave at 1 kHz and draw the i/p and o/p waveforms. (Note: For the op-amp 741C, $A = 2,00,000$; $R_i = 1\ M\Omega$; $R_o = 75\ \Omega$ and $f = 5Hz$).

OR

2. a) Describe the functioning of an op-amp based closed loop non-inverting amplifier with a neat circuit diagram and obtain expressions for closed loop voltage gain and input resistance with feedback. **(10+5)**

b) Calculate the values of A_F, R_{iF}, R_{oF} and f_F for a closed-loop non-inverting amplifier where $R_1 = 1\ k\Omega$ and $R_F = 4.7\ k\Omega$. (Note: For the op=amp 741C, $A = 2,00,000$; $R_i = 1M\ \Omega$; $R_0 = 75\ \Omega$ and $f = 5Hz$).

3. What are counters? Give a comparative account of synchronous and asynchronous counters. **(15)**

OR

4. a) What is a flip-flop? Distinguish between the operations of SR, D and JK flip-flop. **(9+6)**

b) With the help of circuit diagram explain the working of 4-bit ripple counter.

5. Describe the working principles of Linear Variable Differential Transducer (LVDT) and discuss an application. **(15)**

OR

6. Discuss the principles of thermoelectric transducers. Explain the working of Resistance Temperature Detector (RTD). **(15)**

7. Explain the working of nuclear magnetic resonance spectrometer with the help of block schematic and discuss an application. **(15)**

OR

8. Name the methods used to measure vacuum pressure. Discuss the working of Pirani vacuum gauge with relevant diagram. **(15)**

9. Explain the generation of sinusoidal waveform using Wein bridge oscillator using relevant circuit diagram. **(10)**

10. Write a note on shift registers. **(10)**

11. With the help of circuit diagram, discuss the working of a photomultiplier tube. **(10)**

12. Explain the working of Differential Scanning Calorimeter (DSC). **(10)**

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Roll No. _____

[Total No. of Pages : 2

PGIIIS-N-1503 B-17
M.Sc. IIIrd Semester Degree Examination
PHYSICS
(Mathematical Physics-II)
Paper : HCT - 3.2

Time : 3 Hours

Maximum Marks : 80

Instructions to the Candidates :

*Answer any **Six** questions of **15** marks and **Two** questions of **10** marks.*

1. Express the function : **(7+8)**

a) $f(x) = x$ in the interval $[0,2\pi]$

b) $f(x) = 1$ for $-\pi < x < 0$

$= 0$ for $0 < x < \pi$

As a Fourier series of sine and cosine functions.

OR

2. Find the Fourier transform of : **(15)**

a) $f(x) = \exp(-ax^2)$ for $a > 0$

b) $f(x) = t^2$ for $0 \le t \le \pi$

$= 0$ elsewhere

With an example, detail the method for solving a differential equation using Laplace transform.

3. a) Prove that Sturm-Liouville operator is Hermitian.

b) Solve : $\phi(x) = x + \frac{1}{2}\int_{-1}^{1}(t-x)\phi(t)\,dt$

(6+9)

OR

4. Find the Green's function for the boundary value problem $\frac{d^2x}{dt^2}+k^2y=f(x)$ with the boundary conditions $y(\pm\infty)=0$. **(15)**

5. Describe the method of finding the root of an equation using the Bisection method. **(15)**

OR

6. Explain a method of evaluating the solution of a differential equation Comment on the limitations of the method. **(15)**

7. Write down the C program to solve the differential equation $\frac{dy}{dx}=x+y$. You may choose relevant boundary condition. **(15)**

OR

8. State and prove the convolution theorem for Fourier transforms. **(15)**

9. How do we write the Fourier series of a given function in the complex form? **(10)**

10. Find the inverse Laplace transform of $f(s)=\frac{1}{s^2+a^2}$. **(10)**

11. Outline the least square fit method of data analysis. **(10)**

12. What are different data types used in C programming? Explain with examples. **(10)**

Roll No. _____ [Total No. of Pages : 2

PGIIIS-N-1505 B-17
M.Sc. III[rd] Semester Degree Examination
PHYSICS
(Solid State Physics - I)
Paper : SCT - 3.1
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates :

*Answer **all** the questions of **15** marks each and any **two** questions of **10** marks each.*

1. a) State the properties of reciprocal lattice. **(5+10)**
   b) What are Bloch functions? State and prove Bloch's theorem.

OR

2. a) What are free, electrons? Highlight the major results of free electron model. **(6+9)**
   b) Describe the Nearly Free electron model of band structure calculations.
3. a) Derive the phonon dispersion relation in a one dimensional diatomic lattice. **(9+6)**
   b) Explain how discontinuity arises in density-of-states function.

OR

4. a) Discuss the diffraction by a crystal with lattice vibrations. **(9+6)**
   b) Explain how the Debye-Waller factor accounts for the decrease in the intensity factor.
5. a) Distinguish between the Einstein and Debye models of specific heat of solids. **(5+10)**
   b) Explain Debye's theory of specific heat of solids. Compare it with experimental results.

OR

6. a) Explain strain energy, elastic constants of solids. **(5+10)**
   b) Describe the Ultrasonic Pulse echo interferrometric technique to determine the elastic constants of solids.

Roll No.

7. a) Explain the method of construction of Fermi surface in a square lattice. (6+9)

b) Explain degeneracy of Landau levels. Describe Landau quantization.

OR

8. a) What are extremal orbits? Explain. (6+9)

b) Describe the de Has-an Alphen effect.

9. Discuss Tight Binding method of band structure calculations. (10)

10. Explain lattice spectrum. (10)

11. Discuss anharmonicity and thermal expansion. (10)

12. Explain electron, hole and open orbits. (10)

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(6+9)

Roll No. _____

[Total No. of Pages : 2

PGIIIS-N-1507 B-17
M.Sc. IIIrd Semester (CBCS) Degree Examination
PHYSICS
(Materials Physics - I)
Paper : SCT - 3.1
(New)

Time : 3 Hours

Maximum Marks : 80

Instructions to Candidates :

*Answer **all** the questions of **15** marks each and any **two** questions of **10** marks each.*

1. a) What are different levels of structure in materials? Explain. (7+8)

   b) Discuss structure-property relations in engineering materials.

OR

2. a) Explain covalent and ionic bond formations. (7+8)

   b) Discuss the properties of covalent solids.

3. What are single crystals? Describe the methods of crystal growth from melt and solution. (15)

OR

4. What are point, line and planar defects? Discuss the production of color centres and their different configurations in ionic solids. (15)

5. a) What are single and multiphase solids. Mention rules to be satisfied by the elements to form solid solutions. (8+7)

   b) What are phase diagrams? Sketch and explain a unary phase diagram.

OR

6. a) Distinguish between eutectic, eutectoid and peritectic reactions. Give examples. (6+9)

   b) With a neat phase diagram, explain different phases and reactions taking place in Pb=Sn system.

7. Give qualitative discussion of theory of diffusion in solids. Obtain laws of diffusion for both steady and non-steady flows of matter. **(15)**

OR

8. Explain time scales associated with phase transformations. Discuss nucleation kinetics with regard to phase transformations. **(15)**

9. Write a note on metallic bonds. **(10)**

10. Discuss Burger's circuit. **(10)**

11. What are Isomorphous systems? Explain. **(10)**

12. Explain the re-crystallization process. **(10)**

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Roll No. _____ [Total No. of Pages : 2

PGIIIS-N-1512 B-17
M.Sc. IIIrd Semester Degree Examination
PHYSICS
(Biophysics - I)
Paper : SCT - 3.2
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to Candidates :

*Answer any **Six** questions of 15 marks each and **two** questions of 10 marks.*

1. Describe the main organellar constituents and their functions in a living cell. **(15)**

OR

2. What do you mean by biological energy flow? Explain with a neat diagram the mechanism of photosynthesis. **(15)**

3. Obtain the Nernst's equation for the ionic flux across a cell membrane and mention its importance. **(15)**

OR

4. What is meant by transport process across the membrane? Distinguish between passive and active processes. **(15)**

5. Discuss the mechanism of sound perception with relevant diagram of Vertebral auditory receptor. **(15)**

OR

6. What is temporal organization? Explain. Elucidate the principle of biorhythms. **(15)**

7. What are antibodies and antigens? Describe the mechanism of immunological memory. **(15)**

OR

8. Discuss in detail about the genetic code and genome organization. (15)

9. Write a note on Kreb's cycle. (10)

10. Explain Hodgkin-Huxley model. (10)

11. Discuss in brief the physics of sensory organs. (10)

12. Write about visceral receptors. (10)

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Roll No. _____ [Total No. of Pages : 2

PGIIIS-N-1512A B-17
M.Sc. IIIrd Semester Degree Examination
PHYSICS
(Energy Physics - I)
Paper : SCT-3.2
(New)

Time : 3 Hours Maximum Marks : 80

Instructions to the Candidates :

*Answer all the questions of **15** marks each and any **two** questions of **10** marks each.*

1. a) What is "energy crisis"?

b) Take stock of non-replenishable sources of energy and hence make out a case for replenishable sources of energy.

(5+10)

OR

2. a) Define and discuss **"Solar time"** and **"equation of time"**.

b) With a neat diagram discuss the composition of Sun.

(5+10)

3. a) Give an account of heat transport process.

b) With the help of P-V diagram discuss Otto cycle.

(5+10)

OR

4. a) What is turbine? Mention the types of turbines.

b) Give the construction and working of impulse turbine.

(5+10)

5. a) Explain photo voltaic effect.

b) Give the solar cell characteristics, efficiency and spectral response.

(5+10)

OR

6. Describe how a hetero junction solar cell is fabricated. Explain its working and mention the factors affecting the efficiency of cells. **(15)**

7. Derive energy balance equation for liquid flat plate solar collector. **(15)**

OR

8. a) Give the merits of solar concentrators.

   b) Outline the construction and working of a solar tracking device. **(5+10)**

9. Discuss the spectral composition of solar radiation. **(10)**

10. Briefly discuss about compressors. **(10)**

11. Give an account of performance of solar panels. **(10)**

12. Discuss how solar energy can be stored and utilised. **(10)**

Roll No. _____ [Total No. of Pages : 2

PGIIIS-N-1510 B-17

M.Sc. IIIrd Semester Degree Examination

PHYSICS

(Nuclear Physics - I)

Paper : SCT 3.2

(New)

Time : 3 Hours Maximum Marks : 80

Instructions to the Candidates :

*Answer all questions of **15** marks and two questions of **10** marks each.*

Section-A

1. a) Explain why the deuteron does not have excited states.

b) Discuss the theory of the ground state of the deuteron as an admixture of S and D states.

(5+10)

OR

2. a) Explain the important features of high energy p-p scattering and n-p scattering. Discuss the effect of coulomb and nuclear scattering.

b) Explain the spin dependence of n-p interaction.

(10+5)

3. a) What are Nordheim's rules? Explain. Using Nordheim theorem, predict the ground state spin of odd-odd nucleus.

b) Deduce the ground state spin of $^{18}_{9}F$ nucleus based on Nordheim's rules.

(10+5)

OR

4. a) What are the evidences for the collective motion of the nucleons in a nucleus? Discuss the rotational motion of the deformed even-even nucleus and predict the energy levels.

b) A nucleus exhibits rotational states and first excited state 2^+ has energy of 80 keV, calculate the excitation energy of 8^+ state.

(10+5)

5. a) What are strange particles? Discuss the strangeness quantum number and explain how this quantum number is incorporated in Gellmann-Nishijima to estimate the charge.

b) Explain the law of conservation of isospin in strong interactions. **(10+5)**

OR

6. a) Discuss the CP symmetry in weak interactions and explain why the CP violation is observed in neutral K-decay.

b) Explain why parity is not conserved in weak interaction. **(10+5)**

7. a) Give the experimental evidence for the existence of quarks in nucleon and show that mesons consist of two quarks and baryons consists of three quarks.

b) Discuss about Gellmann-Okubo mass formula. **(12+3)**

OR

8. a) Describe the symmetry classification of elementary particles with inclusion of eight-fold symmetry and weight diagram.

b) Explain how the eight-fold symmetry could predict Ω^- particle. **(10+5)**

9. Discuss the effective range theory for *n-p* scattering. **(10)**

10. Describe the Fermi gas model of nucleus and obtain the expressions for Fermi energy and Fermi momentum. **(10)**

11. Discuss how the elementary particles are classified based on the fundamental interaction, conservation laws and their basic features. **(10)**

12. Distinguish between SU(2) and SU(3) symmetry groups in the quark structure analysis. **(10)**