M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Materials Science

MATERIALS PHYSICS

(CBCS – 2022 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A   (10 × 1 = 10)

Answer **all** questions.

1. In plastic deformation of metal, the metal strength decreases as ——————— in its temperature.

    (a) Increases

    (b) Decreases

    (c) Remains constant

    (d) None

2. The first stage of creep is also known as ——————— creep .

    (a) Transient   (b) Viscous

    (c) Flow   (d) Teritary

3. How can a dielectric converted into a conductor?

    (a) compression   (b) Heating

    (c) Exchanging   (d) Freezing

4. The induced dipole moment per unit electric field is called

    (a) Dipole   (b) Dipole moment

    (c) Polarization   (d) None

5. Which of the material is having the small area of hysteresis loop.

    (a) saturable magnetic material

    (b) soft magnetic material

    (c) Hard magnetic material

    (d) Diamagnetic material

6. The Supermaloy is primarily composed of

    (a) Nickel   (b) Iron

    (c) Copper   (d) Cobalt

7. Which of the following is not a characteristic of LED?

    (a) Fast action

    (b) High warm-up time

    (c) Low Operational voltage

    (d) Long life

8. What should be the bandgap of semiconductors to be used as LED?

    (a) 0.5 ev   (b) 1 ev

    (c) 1.5 ev   (d) 1.8 ev

9. The change couples device (CCD) is made by using

    (a) IC   (b) Resistive

    (c) Capacitive   (d) Inductive

10. Satellite Power requirement is provided through

    (a) Solar cell

    (b) Dry cell

    (c) Nickel Cadmium Cell

    (d) Lead acid batteries

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Part B $(5 \times 5 = 25)$

Answer **all** the questions, choosing either (a) or (b).

11. (a) Mention the characteristics of brittle fracture.

Or

(b) obtain an expression for hardness of a material.

12. (a) Derive the relation between dielectric polarization and dielectric constant.

Or

(b) What is domain in a ferroelectric material?

13. (a) Explain the classification of magnetic material and its applications.

Or

(b) Briefly explain the molecular theory of magnetism.

14. (a) What is meant by liquid crystals and explain its properties and classification.

Or

(b) Write a short note on band to band absorption.

15. (a) Write short note on hysteresis losses factors and its application.

Or

(b) How LCD utilizes liquid crystals and polarized light.

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Part C (5 × 8 = 40)

Answer any **five** questions.

16. Explain in detail about the tensile, hardness and creep tests.

17. Describe in detail about the different kinds of polarization.

18. Explain the magnetic properties of Langevin and Weiss theories.

19. Explain in detail about magnetic domains properties and its uses.

20. Write short notes on

    (a) Piezo electric

    (b) Magnetostrictive and

    (c) Shape memory alloys

21. Differentiate between Piezoelectric, Pyroelectric and Ferroelectric materials and its properties.

22. Discuss about charged coupled devices and their applications.

23. Explain in detail about super luminescent LED material.

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R7711	Sub. Code
	542102

M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022.

First Semester

Materials Science

THERMODYNAMICS

(CBCS – 2022 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A   (10 × 1 = 10)

Answer **all** questions.

1. Using Hamilton's equations of motion, we can find equation of motion for any F (q, p) in terms of.

    (a) Commutator brackets
    (b) Poisson Bracketets
    (c) Lagrange brackets
    (d) All of these

2. If the Lagrangian does not depend on time explicitly.

    (a) The Hamiltonian is constant
    (b) The Hamiltonian cannot be constant
    (c) The kinetic energy is constant
    (d) The potential energy is constant

3. The Poisson bracket operation is used in what type of space?

    (a) Phase space   (b) Configuration space

    (c) Hilbert space   (d) None of these

4. A rigid body capable of oscillating in a vertical plane about a fixed horizontal axis is called a ———————— pendulum.

   (a) Simple   (b) Conical

   (c) Torsional   (d) Compound

5. Which of the following is chosen as the standard thermometric substance?

   (a) Liquid   (b) Solid

   (c) Gas   (d) None of the mentioned

6. Heat does not spontaneously flow from a colder body to a hotter one. Which of the following thermodynamics law states this?

   (a) Zeroth law of thermodynamics
   (b) First law of thermodynamics
   (c) Second law of thermodynamics
   (d) Third law of thermodynamics

7. Maxwell-Boltzmann law is for the ———————— .

   (a) Distinguishable particles
   (b) Indistinguishable Particles
   (c) Particles with half integral spin
   (d) Particles with integral spin

8. According to the F-D Statistics, the number of particles in a phase cell can be:

   (a) any number   (b) only two

   (c) only three   (d) only one

9. The energy emitted by a black surface should not vary in accordance with.

   (a) Wavelength
   (b) Temperature
   (c) Surface characteristics
   (d) Time

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10. The difference between fermions and bosons is that boson's wave function is —————.

   (a) Continuous   (b) Single Valued

   (c) Symmetric   (d) Differentiable

Part B   ($5 \times 5 = 25$)

Answer **all** questions, choosing either (a) or (b).

11. (a) Obtain the Lagrange's equation of motion for non-conservative system.

Or

   (b) State and explain the principle of least action.

12. (a) Show that Poisson bracket is invariant under canonical transformation.

Or

   (b) Give an account of angular momentum of a rigid body.

13. (a) Define Gibb's and Helmholtz functions and explain its significances.

Or

   (b) Establish the inequality of Clausius.

14. (a) What do we determine which thermodynamic properties characterize an ensemble?

Or

   (b) Explain Fermi – Dirac statistics.

15. (a) Find the mean energy per mode of the radiation in the box assuming the radiation is quantised.

Or

   (b) Describe Bose Condensation in detail.

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Part C (5 × 8 = 40)

Answer any **five** questions.

16. Using Hamilton's equation of motion, show that the Hamiltonian $H = \dfrac{p^2}{2m}e^{-n} + \dfrac{1}{2}mw^2x^2e^{rt}$ leads to the equation of motion of a damped hormonic oscillator $\ddot{x} + r\dot{x} + w^2x = 0$.

17. Explain the rigid body dynamics and Euler's angles.

18. Derive the expression for the Gibbs phase rule and phase equilibria for multicomponent systems.

19. Compare Mb, BE and FD statistics and discuss the advantages and disadvantages of each.

20. State Ideal gas law and calculate the partition function of monoatomic and diatomic.

21. Derive Lagrange's equations from D'Alembert's principle.

22. Explain the law of thermodynamics in detail.

23. A silicon crystal that has 5×10^{22} atoms/cm³ is known to contain 10^{-4} atomic percent of arsenic (As) as an impurity. It then receives a uniform doping of $3 \times 10^{16} cm^{-3}$ phosphorus (P) and a subsequent uniform doping of $10^{18} cm^{-3}$ boron (B) atoms. A thermal annealing treatment then completely activates all impurities.

    (a) What is the conductivity type of the silicon sample?

    (b) What is the density of majority carriers? Why?

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M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Materials Science

ELECTRONICS AND INSTRUMENTATION

(CBCS – 2022 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** questions.

1. Which of these is incorrect for an operational amplifier?

    (a) It has a high voltage gain

    (b) It is a direct coupled amplifier

    (c) It is only useful for amplifying AC signals

    (d) It was originally designed to perform mathematical operations

2. How many types of voltage regulators are there?

    (a) One   (b) two

    (c) three   (d) four

3. The basic gates are:

    (a) AND, NOR and NOT gate

    (b) AND, OR and NOT gate

    (c) AND, NAND and NOT gate

    (d) NAND, OR and NOT gate

4. In a JK flipflop, J and K inputs are set to logic 1, the output Q(0) will be ———————— when Q(–1) is ————

    (a) 0,0   (b) 1,1

    (c) –1,1   (d) 1,0

5. A LED is basically a ——————————P-N junction.

    (a) forward-biased   (b) reverse-biased

    (c) lightly-doped   (d) heavily-doped

6. A solar cell operates on the principle of

    (a) diffusion

    (b) recombination

    (c) photo voltaic action

    (d) carrier flow

7. Transducer must have a —————————— input vs output characteristic response.

    (a) non-linear   (b) unit step

    (c) linear   (d) exponential

8. LVDT has ——————————

    (a) One primary coil and two secondary coils

    (b) Two primary coils and one secondary coil

    (c) One primary coil and one secondary coil

    (d) Two primary coils and two secondary coils

9. What type of a device is MOSFET?

    (a) Current-controlled

    (b) Voltage-controlled

    (c) Voltage-controlled Current source

    (d) Voltage-controlled Voltage source

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10. Which one of the following memory units is considered as the largest?

   (a) Peta Byte (PB)

   (b) Exa Byte (EB)

   (c) Zetta Byte (ZB)

   (d) Yotta Byte (YB)

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain the block diagram of op-amp.

Or

   (b) Explain the mathematical operation of an op-amp.

12. (a) Describe the operation of TTL logic circuit working as NAND gate.

Or

   (b) Draw digital ramp ADC and write down its operation.

13. (a) Write a short note on avalanche photodiode.

Or

   (b) Define the quantum efficiency of photodetector.

14. (a) Describe with suitable diagrams the working principle of strain gauges.

Or

   (b) Explain the working principle of load cell and flow meter.

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15. (a) Explain the resonant tunnelling effect with neat diagrams.

Or

(b) Explain the principle and applications of NEMS.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. Derive the expression of exact voltage gain and ideal voltage gain of a voltage shunt feedback amplifier using OP-AMP.

17. Draw and explain the operation of the following flip-flops,

(a) RS flip-flops using NOR gate

(b) D flip-flops using NAND gate.

18. Draw the schematic of typical optical fiber communication system and demonstrate the need of wavelength division switching system with suitable diagram.

19. What are the main characteristics the transducers? Describe the principles of operation of transducers and mention their applications.

20. Explain parallel transport in quantum structures and various scattering mechanisms associated with this transport.

21. Explain the working of instrumentation amplifier using Transducer Bridge and derive the expression of output voltage.

22. Draw and explain the architectural diagram of 8086 microprocessor.

23. What is molecular switch and explain how it is applicable for information storage?

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M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022

First Semester

Materials Science

ELECTROMAGNETIC THEORY AND OPTICS

(CBCS – 2022 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A $(10 \times 1 = 10)$

Answer **all** questions.

1. Different form of Gauss's law in magneto statics is _____

   (a) div B = ρ / ε_0 (b) div B = 0

   (c) div B = -dB/dT   (d) div B = μJA

2. Which of the following is a scalar quantity?

   (a) Electric field   (b) Electrostatic potential

   (c) Electrostatic force (d) Intensity of electric field

3. The coefficient of reflection of voltage for a short – circuited line is :

   (a) 1.0   (b) 0

   (c) -1.0   (d) 2.0

4. What is meant by the polarisation of electromagnetic waves?

(a) The polarisation is the direction of the elecric current in an electromagnetic wave.

(b) The polarisation is the direction of the elecric field in an electromagnetic wave.

(c) The polarisation is the magnitude of the voltage in an electromagnetic wave.

(d) The polarisation is the inverse of the electric field in an electromagnetic wave

5. A crystal that looks black every 90^0 of rotation in a polariscope must be

(a) anisotrophic

(b) isotropic

(c) monoclinic or triclinic

(d) hexagonal or tetragonal

6. Optically anisotropic minerals differ from isotropic minerals by

(a) having low critical angles.

(b) being able to polarize light.

(c) having high critical angles.

(d) being fluorescent in ultraviolet light.

7. Nonlinear effects which are defined by the intesity – dependent refractive index of the fibre is called as _____

(a) Scattering effects   (b) Kerr effects

(c) Raman effects   (d) Tomlinson effects

8. Raman and Brillouin scattering are usually observed at _____

(a) Low optical power densities

(b) Medium optical power densities

(c) High optical power densities

(d) Threshold power densities

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9. Linear scattering effects are ———————— in nature.
   (a) Elastic   (b) non-Elastic
   (c) Mechanical   (d) Electrical

10. Self-phase modulation can be used for ————————
    (a) Enhancing the core diameter
    (b) Wavelength shifting
    (c) Decreasing the attenuation
    (d) Reducing the losses in the fibre

Part B   (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) State and prove Faraday's Law.

Or

(b) A long solenoid with 15 turns per cm has a small loop of area 22.0 cm placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1s, what is the induced emf in the loop while the current is changing?

12. (a) Write down the expression for the wave equation of an Insulator.

Or

(b) What happens when an electromagnetic wave makes a normal incidence on a perfect conductor? Explain.

13. (a) Write short note on Index ellipsoid and wave plates.

Or

(b) List out the types of electro optic effect and explain them.

14. (a) State and explain Magnetic optical Kerr and Pockel effect.

Or

(b) What is sum frequency generation? Explain with an example.

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15. (a) Why do we need optical switches? What are the advantages of optical switches over electrical switches?

Or

(b) What are NLO crystal? Explain its properties.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. Explain Maxwell's equations in terms of scalar and vector potential.

17. Derive an expression for Fresnel equation for parallel and perpendicular polarization.

18. Write short note on

(a) optical axes (2)

(b) positive and negative crystals with example (6)

19. Discuss in detail the Stimulated Raman Scattering (SRS)

20. Describe the phase conjugation of an optical signal.

21. Write down the equation for the plane wave in an isotropic medium.

22. Explain the application of SBS and SRS for material characterization with examples.

23. What are NLO materials explain with an example.

————————

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M.Sc. DEGREE EXAMINATION, NOVEMBER – 2022.

First Semester

Materials Science

BIOMATERIALS

(CBCS – 2022 onwards)

Time : 3 Hours   Maximum : 75 Marks

Part A   (10 × 1 = 10)

Answer **all** questions.

1.   Metallic bonds do not have

   (a)   Highly directed bonds

   (b)   Mobile valence electrons

   (c)   Delocalised electrons

   (d)   Overlapping valence orbitals

2.   Creep is

   (a)   permanent deformation of material as a function of time

   (b)   permanent deformation of material irrespective of time

   (c)   Viscoelastic deformation of material as a function of time

   (d)   Elastic deformation of material as a function of time

3. Bone is a/an

   (a) elastic material   (b) viscous material

   (c) isoelastic material (d) hard material

4. Polymeric biomaterials are generally sterilized by

   (a) dry heat sterilization

   (b) moist heat sterilization

   (c) gas sterilization

   (d) gamma sterilization

5. The streaming (zeta) potential of blood vessel is

   (a) 1 to 5 mV   (b) 8 to 13 mV

   (c) -l to-5 mV   (d) -8 to -13 mV

6. The first phenomena during blood-material interaction is

   (a) platelet interaction

   (b) albumin adsorption

   (c) intrinsic coagulation

   (d) fibrinogen polymerization.

7. The bioactive dental material is

   (a) stainless steel   (b) aluminium

   (c) titanium   (d) gold.

8. The outer most hard layer of teeth is called

   (a) Dentin   (b) Enamel

   (c) Endosteal   (d) Gum

9. Intraocular lens (LOL) is used in

   (a) Ear   (b) eye

   (c) nose   (d) mouth

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R7714

10. Albuminised surface is used to improve

    (a) tissue compatibility

    (b) mechanical properties

    (c) blood compatibility

    (d) contour

Part B $(5 \times 5 = 25)$

Answer **all** questions, choosing either (a) or (b).

11. (a) Define the term 'biocompatibility' Mention different methods for improving blood and tissue compatibility problems.

Or

(b) What are the effects of host on the implant material when it is implanted in the body?

12. (a) Briefly explain about the different methods of prothesis fixation with bone.

Or

(b) Classify bio-ceramics with appropriate examples. Give the advantage and disadvantage of ceramic materials.

13. (a) Describe the microscopic structure of blood vessel along with a neat sketch.

Or

(b) Explain the application of pacemakers.

14. (a) Write short notes on dental implants.

Or

(b) Describe the indication, advantages and disadvantages of tooth colored restorative materials.

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15. (a) Explain the biomaterials used for contact lenses and intraocular lenses.

Or

(b) Briefly describe the connective tissue grafts.

Part C (5 × 8 = 40)

Answer any **five** questions.

16. Explain the possible biocompatibility problems of biomaterials Which tests are to be performed for newer biomaterials before clinical trials.

17. What are the primary uses of metallic implant materials? Mention the uses of 316 L SS, Co-Cr alloy, Ti and its alloys in orthopedic surgery.

18. Discuss about the blood substitutes and extracorporeal blood circulation devices.

19. Classify dental cements. Describe the composition, setting reaction and uses of zinc phosphate cement

20. Explain in detail the potential use of biomaterials in ophthalmology. Mention its merits and demerits.

21. What are the possible biomedical uses of ceramics? Why are ceramic materials more advantageous metallic implant?

22. Define amalgam? Describe the classification, properties and manipulation of dental amalgam.

23. Describe the selection and performance of polymeric encapsulants for implantable sensors.

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