UNIVERSITY OF MYSORE

Ph.D. Entrance Examination, Nov. - 2020

SUBJECT CODE : 4 3

QUESTION BOOKLET NO.

504337

Entrance Reg. No.

QUESTION BOOKLET

(Read carefully the instructions given in the Question Booklet)

SUBJECT : MATERIAL SCIENCE

MAXIMUM MARKS : 100 **MAXIMUM TIME : THREE HOURS**

(Including initial 10 minutes for filling O.M.R. Answer sheet)

INSTRUCTIONS TO THE CANDIDATES

1. The sealed questions booklet containing 50 questions enclosed with O.M.R. Answer Sheet is given to you.
2. Verify whether the given question booklet is of the same subject which you have opted for examination.
3. Open the question paper seal carefully and take out the enclosed O.M.R. Answer Sheet outside the question booklet and fill up the general information in the O.M.R. Answer sheet. If you fail to fill up the details in the form of alphabet and signs as instructed, you will be personally responsible for consequences arising during scoring of your Answer Sheet.
4. During the examination:
   a) Read each question carefully.
   b) Determine the Most appropriate/correct answer from the four available choices given under each question.
   c) Completely darken the relevant circle against the Question in the O.M.R. Answer Sheet. For example, in the question paper if "C" is correct answer for Question No.8, then darken against Sl. No.8 of O.M.R. Answer Sheet using Blue/Black Ball Point Pen as follows:

Question No. 8. Ⓐ Ⓑ ● Ⓓ (Only example) (Use Ball Pen only)

5. Rough work should be done only on the blank space provided in the Question Booklet. Rough work should not be done on the O.M.R. Answer Sheet.
6. If more than one circle is darkened for a given question, such answer is treated as wrong and no mark will be given. See the example in the O.M.R. Sheet.
7. The candidate and the Room Supervisor should sign in the O.M.R. Sheet at the specified place.
8. Candidate should return the original O.M.R. Answer Sheet and the university copy to the Room Supervisor after the examination.
9. Candidate can carry the question booklet and the candidate copy of the O.M.R. Sheet.
10. The calculator, pager and mobile phone are not allowed inside the examination hall.
11. **If a candidate is found committing malpractice, such a candidate shall not be considered for admission to the course and action against such candidate will be taken as per rules.**

INSTRUCTIONS TO FILL UP THE O.M.R. SHEET

1. There is only one most appropriate/correct answer for each question.
2. For each question, only one circle must be darkened with BLUE or BLACK ball point pen only. Do not try to alter it.
3. Circle should be darkened completely so that the alphabet inside it is not visible.
4. Do not make any stray marks on O.M.R. Sheet.

ಗಮನಿಸಿ : ಸೂಚನೆಗಳ ಕನ್ನಡ ಆವೃತ್ತಿಯು ಈ ಪುಸ್ತಕದ ಹಿಂಭಾಗದಲ್ಲಿ ಮುದ್ರಿಸಲ್ಪಟ್ಟಿದೆ.

PART - A

This part shall contains 50 multiple choice/Objective type questions, each questio carrying one mark. **[50 × 1 = 50**

1) The temperature of the surface of the sun is ~ 6000 °K. If we take a huge len and focus the sun rays and able to produce a temperature of 8000 °K. Thi will violation of

(A) Zeroth law
(B) First law
(C) Second law
(D) Third law

2) A system consists of 1024 atoms and is at a temperature of 300 K. Assumin that there is no interatomic energy in the system, its total internal energy is

(A) 12.4 kJ
(B) 12.4 J
(C) 4.12 kJ
(D) 4.12 J

3) An electric current of 3 A flows through a resistance of 10 ohm. It is bein cooled by running water and is kept at temperature 300 °K, change in entrop per second of the resistance is

(A) 0.3 J/deg
(B) 3.0 J/deg
(C) No change
(D) 0.03 J/deg

4) At 0 °K, fluids are assumed to have

(A) Minimum entropy
(B) Maximum entropy
(C) Zero entropy
(D) Fixed value of entropy

5) The area of the Carnot cycle on a *T-S* diagram represents

(A) Heat absorbed from the source
(B) Work done in a cycle
(C) Heat rejected to the sink
(D) Efficiency of the engine

6) For a closed packed bcc structure of hard sphere , the lattice constant a is related to the sphere of radius R is

(A) $a = \frac{4R}{\sqrt{3}}$ (B) $a = 4R\sqrt{3}$

(C) $a = 4R\sqrt{2}$ (D) $a = 2R\sqrt{2}$

7) The intensity of X-rays is determined by

(A) Filament current

(B) Filament voltage

(C) Potential difference between the cathode and anode

(D) Size of the cathode

8) The packing fraction of fcc structure is

(A) 52% (B) 68%

(C) 92% (D) None of these

9) Match list I with list II

	List I		List II
(A)	Simple cubic structure	(p)	Copper
(B)	BCC structure	(q)	Polonium
(C)	FCC structure	(r)	Lithium
(D)	HCP structure	(s)	Zinc

	A	B	C	D
(A)	q	r	p	s
(B)	r	q	p	s
(C)	q	r	s	p
(D)	q	p	r	s

10) Which of the following statement is true?

(A) Phonons always interact irrespective of the nature of force between the atoms

(B) There is no phonon collision if force between the atoms is harmonic

(C) In Unkapp process $\vec{k}_1 + \vec{k}_2 = \vec{k}_3$

(D) Thermal expansion coefficients remain finite as $T \rightarrow 0$

11) Generally solid solutions in alloy systems are

(A) Substitutional

(B) Interstitial

(C) Substitutional and interstitial

(D) None of these

12) The stress-strain curves of the sample are normally used to calculate

(A) Tensile strength

(B) Young's modulus

(C) Elongation at break (%)

(D) All the above

13) The solar cells are commonly prepared from silicon boules, the most regularly used process for creating the boule is called the *Czochralski method*. In this process

(A) A seed crystal of silicon is dipped into melted polycrystalline silicon

(B) A seed crystal of silicon is dipped into melted semicrystalline silicon

(C) A seed crystal of silicon is dipped into melted polycrystalline material

(D) A seed crystal of silicon is dipped into melted polycrystalline compound

14) In compared with Optics, photonics is more emphasis on

(A) Normal optics

(B) Guided waves and optoelectronic devices

(C) Guided waves

(D) Both normal optics and guided waves

15) In metals, the Fermi energy is the maximum energy that occupied by an electron

(A) At 300°K
(B) At 0°K
(C) At 350°K
(D) At 400°K

16) In modern world, an artificial skin made from a prominent polymer is considered as the future of anti-aging efforts

(A) Silicone polymer
(B) Natural rubber
(C) Collagen
(D) Wool

17) Thermal stability of the biopolymers is studied using the following instrument

(A) X-ray diffractometer
(B) Universal testing machine
(C) Differential scanning calorimetry
(D) None of the above

18) Polymer nanocomposites are modern materials which consists of

(A) Microparticles in polymer matrix
(B) Polymer in polymer matrix
(C) Nanoparticles in polymer matrix
(D) Both (A) and (C)

19) The polymers entering in to molten state when they are heated and harden upon cooling

(A) Thermoplastics
(B) Plastics
(C) New polymers
(D) All the above

20) Pure rubber is brittle at low temperature and soft at high temperature, so it can be used only in the temperature range

(A) 10-60°C
(B) 10-70°C
(C) 10-80°C
(D) 10-100°C

21) In polypeptides, the plot of φ, ψ angles are known as

(A) Unkalappa map
(B) Ramappan map
(C) Ramachandran map
(D) None

22) Chou-Fasman rules related to

(A) Protein folding
(B) Peptide folding
(C) Polypeptide folding
(D) None

23) Silk from *Bombyx mori* is a biomaterial

(A) Biocompatible
(B) Biodegradable
(C) both (A) and (B)
(D) None

24) Now a days quantum dots (QDs) are widely using in biological studies due to their unique

(A) Optical properties
(B) Chemical properties
(C) Thermal properties
(D) Electrical properties

25) Generally, to obtain an optical image one can monitor spatial variation of optical properties

(A) Transmission
(B) Reflection, or fluorescence
(C) Only (A)
(D) Both (A) and (B)

26) Hydrothermal and solvothermal techniques are widely used to

(A) Syntheses and growth of conventional and advanced materials
(B) Treatment of wastes
(C) Both (A) and (B)
(D) None

27) During the application of a solvothermal technique, the chemical reaction proceeds in solvent at a temperature above its normal boiling point by containing the reaction mixture within a sealed vessel. These conditions increase the

(A) Solvent's ability to dissolve solids and speed up reactions between solid species

(B) Solvent's ability to dissolve solids

(C) Speed up reactions between solid species

(D) None

28) Chemical vapour deposition (CVD) not includes the following

(A) APCVD

(B) LPCVD

(C) PECVD

(D) MBE

29) It is well-known that Graphene is a crystalline allotrope of carbon with 2-dimensional structure. Its carbon atoms are densely packed in a regular atomic-scale pattern of

(A) Hexagonal

(B) Octagonal

(C) Pentagonal

(D) Heptagonal

30) Hydrothermal crystal growth is used to grow the crystal

(A) $AlPO_4$

(B) $GaPO_4$

(C) $GaAsO_4$

(D) All the above

31) Thermogravimetric analysis of the samples are usually carried out in the presence of

(A) Oxygen atmosphere

(B) Nitrogen atmosphere

(C) Carbon dioxide atmosphere

(D) Carbon monoxide atmosphere

32) The AFM principle is based on the cantilever/tip assembly that interacts with the sample; this assembly is also commonly referred as

(A) Probe

(B) Substrate

(C) Control unit

(D) Monitoring unit

33) The dielectric loss tangent ($\tan\delta$), signifies the

(A) Dielectric gain of the sample

(B) Dielectric loss of the sample

(C) Both (A) and (B)

(D) None of the above

34) High-resolution transmission electron microscopy (HR-TEM) is mainly used to study

(A) Normal particles

(B) Microparticles

(C) Big particles

(D) Nanoparticles

35) Morphology of the polymer blends are normally studied using

(A) UV-Visible spectroscopy

(B) DSC

(C) SEM

(D) TEM

36) Hydrodynamic size of the nanoparticles are determined using

(A) TEM

(B) HR-TEM

(C) HR-SEM

(D) DLS

37) The band gap energy of quantum dots is inversely proportional to

(A) Range

(B) Radius

(C) Shape

(D) None

38) The process/technique includes fabrication of the elastomeric mold usually in poly(dimethylsiloxane) (PDMS) and the use of that mold to create features with geometries defined by the mold's relief structure is

(A) Soft lithography

(B) Lithography

(C) Hard lithography

(D) Nanofabrication

39) In 1857, the famous scientist was fascinated by the ruby colour of the colloidal gold and he was discovered the optical properties of the gold colloids differ from those of the corresponding bulk metal

(A) Heinrich Rohrer
(B) Michael Faraday
(C) Richard Feynman
(D) None

40) Using the Mie theory relation $\lambda_{max}^2 = \frac{(2\pi c)^2 m_e(\varepsilon_0 + 2n_0^2)}{4\pi^2 N_e}$ one can calculate

(A) Density of the free electrons in the metal nanoparticles
(B) Size of the metal nanoparticles
(C) Shape of metal nanoparticles
(D) None

41) In nanotechnology, the self-assembled monolayers (SAMs) of thiols on gold surfaces are one of the most popular model systems for the study of the self- assembly of

(A) Organic molecules on metal surfaces
(B) In-organic molecules on metal surfaces
(C) Molecules on metal surfaces
(D) None

42) Microfluidics is the technology of fluid manipulation in channels with dimensions of

(A) Micrometers
(B) Decameters
(C) Millimeters
(D) Nanometers

43) The potential applications of QDs include

(A) Single-electron transistors
(B) Solar cells
(C) LEDs
(D) All the above

44) For mono-dispersed gold nanoparticles (~30nm), the surface plasmon resonance phenomenon causes an absorption of light in the portion of the spectrum

(A) ~450 nm
(B) ~400 nm
(C) ~550 nm
(D) ~650 nm

45) Plasmonic nanoparticles are metal nanoparticles, this includes

(A) Gold
(B) Silver
(C) Platinum
(D) All the above

46) Concentrated solar power (CSP) technologies utilises

(A) Focused sunlight
(B) Diffused sunlight
(C) Both (A) and (B)
(D) None of the above

47) The primary components of fuel cell are

(A) Electrolyte
(B) Cathode
(C) Anode
(D) All the above

48) Galvanic corrosion refers to

(A) Degradation of one metal near a joint
(B) Degradation of one metal near a point
(C) Degradation of one metal near at the top
(D) None

49) Corrosion resistant metal

(A) Aluminum
(B) Stainless steel
(C) Iron
(D) Both (A) and (B)

50) Microbial corrosion is generally a biodeterioration and is frequently called as biocorrosion or microbially influenced corrosion (MIC). This degradative process mostly acts on

(A) Metals
(B) Metalloids
(C) Minerals
(D) All the above

PART - B

This part shall contains five questions, each question carrying ten marks.

[5 × 10 = 50]

1. a) Discuss the principles of X-ray powder diffraction method. **[5]**

   b) Intensity peaks were measured at $2\theta = 20°, 29°, 36.5°, 43.4°, 50.2°, 50.35°$, and $65.55°$ for a cubic powdered metal bombarded with Cu radiation of $\lambda = 1.54$ Å. Determine the crystal structure and the lattice parameters of the metal. **[5]**

2. a) Enumerate the factors that influence the properties of the polymer composites. **[5]**

   b) Write a note on elastomeric composites. **[5]**

3. a) Discuss the preparation of semiconductor single crystals. **[5]**

   b) Write a note sol-gel technique. **[5]**

4. Explain the construction and working principle of atomic force microscope. **[10]**

5. a) What are ceramic materials? Classify the ceramic materials and give their structures. **[5]**

   b) Discuss the mechanism of oxidation. Explain oxidation resistant materials. **[5]**

⌘⌘⌘

ಅಭ್ಯರ್ಥಿಗಳಿಗೆ ಸೂಚನೆಗಳು

1. ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆಯ ಜೊತೆಗೆ 50 ಪ್ರಶ್ನೆಗಳನ್ನು ಹೊಂದಿರುವ ಮೊಹರು ಮಾಡಿದ ಪ್ರಶ್ನೆ ಪುಸ್ತಕವನ್ನು ನಿಮಗೆ ನೀಡಲಾಗಿದೆ.
2. ಕೊಟ್ಟಿರುವ ಪ್ರಶ್ನೆ ಪುಸ್ತಕವು, ನೀವು ಪರೀಕ್ಷೆಗೆ ಆಯ್ಕೆ ಮಾಡಿಕೊಂಡಿರುವ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ್ದೇ ಎಂಬುದನ್ನು ಪರಿಶೀಲಿಸಿರಿ.
3. ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯ ಮೊಹರನ್ನು ಜಾಗ್ರತೆಯಿಂದ ತೆರೆಯಿರಿ ಮತ್ತು ಪ್ರಶ್ನೆಪತ್ರಿಕೆಯಿಂದ ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆಯನ್ನು ಹೊರಗೆ ತೆಗೆದು, ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಸಾಮಾನ್ಯ ಮಾಹಿತಿಯನ್ನು ತುಂಬಿರಿ. ಕೊಟ್ಟಿರುವ ಸೂಚನೆಯಂತೆ ನೀವು ನಮೂನೆಯಲ್ಲಿನ ವಿವರಗಳನ್ನು ತುಂಬಲು ವಿಫಲರಾದರೆ, ನಿಮ್ಮ ಉತ್ತರ ಹಾಳೆಯ ಮೌಲ್ಯಮಾಪನ ಸಮಯದಲ್ಲಿ ಉಂಟಾಗುವ ಪರಿಣಾಮಗಳಿಗೆ ವೈಯಕ್ತಿಕವಾಗಿ ನೀವೇ ಜವಾಬ್ದಾರರಾಗಿರುತ್ತೀರಿ.
4. ಪರೀಕ್ಷೆಯ ಸಮಯದಲ್ಲಿ:
   a) ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಯನ್ನು ಜಾಗ್ರತೆಯಿಂದ ಓದಿರಿ.
   b) ಪ್ರತಿ ಪ್ರಶ್ನೆಯ ಕೆಳಗೆ ನೀಡಿರುವ ನಾಲ್ಕು ಲಭ್ಯ ಆಯ್ಕೆಗಳಲ್ಲಿ ಅತ್ಯಂತ ಸರಿಯಾದ/ ಸೂಕ್ತವಾದ ಉತ್ತರವನ್ನು ನಿರ್ಧರಿಸಿ.
   c) ಓ.ಎಂ.ಆರ್. ಹಾಳೆಯಲ್ಲಿನ ಸಂಬಂಧಿಸಿದ ಪ್ರಶ್ನೆಯ ವೃತ್ತಾಕಾರವನ್ನು ಸಂಪೂರ್ಣವಾಗಿ ತುಂಬಿರಿ. ಉದಾಹರಣೆಗೆ, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯಲ್ಲಿ ಪ್ರಶ್ನೆ ಸಂಖ್ಯೆ 8ಕ್ಕೆ "C" ಸರಿಯಾದ ಉತ್ತರವಾಗಿದ್ದರೆ, ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್ ಪಾಯಿಂಟ್ ಪೆನ್ ಬಳಸಿ ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆಯ ಕ್ರಮ ಸಂಖ್ಯೆ 8ರ ಮುಂದೆ ಈ ಕೆಳಗಿನಂತೆ ತುಂಬಿರಿ:

   ಪ್ರಶ್ನೆ ಸಂಖ್ಯೆ 8. Ⓐ Ⓑ ● Ⓓ (ಉದಾಹರಣೆ ಮಾತ್ರ) (ಬಾಲ್ ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರ ಉಪಯೋಗಿಸಿ)
5. ಉತ್ತರದ ಪೂರ್ವಸಿದ್ಧತೆಯ ಬರವಣಿಗೆಯನ್ನು (ಚಿತ್ತು ಕೆಲಸ) ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯಲ್ಲಿ ಒದಗಿಸಿದ ಖಾಲಿ ಜಾಗದಲ್ಲಿ ಮಾತ್ರವೇ ಮಾಡಬೇಕು (ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಮಾಡಬಾರದು).
6. ಒಂದು ನಿರ್ದಿಷ್ಟ ಪ್ರಶ್ನೆಗೆ ಒಂದಕ್ಕಿಂತ ಹೆಚ್ಚು ವೃತ್ತಾಕಾರವನ್ನು ಗುರುತಿಸಲಾಗಿದ್ದರೆ, ಅಂತಹ ಉತ್ತರವನ್ನು ತಪ್ಪು ಎಂದು ಪರಿಗಣಿಸಲಾಗುತ್ತದೆ ಮತ್ತು ಯಾವುದೇ ಅಂಕವನ್ನು ನೀಡಲಾಗುವುದಿಲ್ಲ. ಓ.ಎಂ.ಆರ್. ಹಾಳೆಯಲ್ಲಿನ ಉದಾಹರಣೆ ನೋಡಿ.
7. ಅಭ್ಯರ್ಥಿ ಮತ್ತು ಕೊಠಡಿ ಮೇಲ್ವಿಚಾರಕರು ನಿರ್ದಿಷ್ಟಪಡಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ಓ.ಎಂ.ಆರ್. ಹಾಳೆಯ ಮೇಲೆ ಸಹಿ ಮಾಡಬೇಕು.
8. ಅಭ್ಯರ್ಥಿಯು ಪರೀಕ್ಷೆಯ ನಂತರ ಕೊಠಡಿ ಮೇಲ್ವಿಚಾರಕರಿಗೆ ಮೂಲ ಓ.ಎಂ.ಆರ್. ಉತ್ತರ ಹಾಳೆ ಮತ್ತು ವಿಶ್ವವಿದ್ಯಾನಿಲಯದ ಪ್ರತಿಯನ್ನು ಹಿಂದಿರುಗಿಸಬೇಕು.
9. ಅಭ್ಯರ್ಥಿಯು ಪ್ರಶ್ನೆ ಪುಸ್ತಕವನ್ನು ಮತ್ತು ಓ.ಎಂ.ಆರ್. ಅಭ್ಯರ್ಥಿಯ ಪ್ರತಿಯನ್ನು ತಮ್ಮ ಜೊತೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
10. ಕ್ಯಾಲ್ಕುಲೇಟರ್, ಪೇಜರ್ ಮತ್ತು ಮೊಬೈಲ್ ಫೋನ್‌ಗಳನ್ನು ಪರೀಕ್ಷಾ ಕೊಠಡಿಯ ಒಳಗೆ ಅನುಮತಿಸಲಾಗುವುದಿಲ್ಲ.
11. **ಅಭ್ಯರ್ಥಿಯು ದುಷ್ಕೃತ್ಯದಲ್ಲಿ ತೊಡಗಿರುವುದು ಕಂಡುಬಂದರೆ, ಅಂತಹ ಅಭ್ಯರ್ಥಿಯನ್ನು ಕೋರ್ಸ್‌ಗೆ ಪರಿಗಣಿಸಲಾಗುವುದಿಲ್ಲ ಮತ್ತು ನಿಯಮಗಳ ಪ್ರಕಾರ ಇಂತಹ ಅಭ್ಯರ್ಥಿಯ ವಿರುದ್ಧ ಕ್ರಮ ಕೈಗೊಳ್ಳಲಾಗುವುದು.**

ಓ.ಎಂ.ಆರ್. ಹಾಳೆಯನ್ನು ತುಂಬಲು ಸೂಚನೆಗಳು

1. ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಗೆ ಒಂದೇ ಒಂದು ಅತ್ಯಂತ ಸೂಕ್ತವಾದ/ಸರಿಯಾದ ಉತ್ತರವಿರುತ್ತದೆ.
2. ಪ್ರತಿ ಪ್ರಶ್ನೆಗೆ ಒಂದು ವೃತ್ತವನ್ನು ಮಾತ್ರ ನೀಲಿ ಅಥವಾ ಕಪ್ಪು ಬಾಲ್ ಪಾಯಿಂಟ್ ಪೆನ್ನಿನಿಂದ ಮಾತ್ರ ತುಂಬತಕ್ಕದ್ದು. ಉತ್ತರವನ್ನು ಮಾರ್ಪಡಿಸಲು ಪ್ರಯತ್ನಿಸಬೇಡಿ.
3. ವೃತ್ತದೊಳಗಿರುವ ಅಕ್ಷರವು ಕಾಣದಿರುವಂತೆ ವೃತ್ತವನ್ನು ಸಂಪೂರ್ಣವಾಗಿ ತುಂಬುವುದು.
4. ಓ.ಎಂ.ಆರ್. ಹಾಳೆಯಲ್ಲಿ ಯಾವುದೇ ಅನಾವಶ್ಯಕ ಗುರುತುಗಳನ್ನು ಮಾಡಬೇಡಿ.

Note : English version of the instructions is printed on the front cover of this booklet.