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SEAT No. \_\_\_\_\_

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## SARDAR PATEL UNIVERSITY

M. Sc. (Semester – IV) Physical Chemistry (CBCS)-2019

Monday, 18<sup>th</sup> March 2019

2.00 p.m. to 5.00 p.m.

## PS04CPHC21 Atomic Spectroscopy and Microscopic Techniques

Total Marks : 70

Note : (a) Attempt all questions, (b) Figures to right indicate full marks, (c) Unless otherwise mentioned, symbols and notations have their usual standard meanings, (d) Neat sketches are to be drawn to illustrate answers, wherever required. (e) Assume suitable data, if necessary and indicate the same clearly.

Q. 1 Select the correct answer from the alternatives given below to the each question; [08]

- [i] Auger electron spectroscopy involves the irradiation of the surface to be analysed with a beam of electrons of energy in the \_\_\_\_\_ range.  
(a) 1-2 KeV      (b) 2-4 KeV      (c) 4-8 KeV      (d) 1-8 KeV
- [ii] By studying which of the following can we determine if the surface corresponds to C-O or C=O chemical form?  
(a) Mass of the electron      (b) Energy of the carbon peak  
(c) Binding energy      (d) Charge of electron
- [iii] At what pressure should the gases in the sealed tube be maintained in the Hollow cathode lamp?  
(a) 1 to 5 torr      (b) 20 to 30 torr      (c) 40 to 50 torr      (d) 50 to 55 torr
- [iv] The advantage of the ICP-AES technique over conventional AES analysis is that:  
(a) analysis of a single metal is faster  
(b) multi-element analysis can be performed in one run  
(c) multi-element analysis can be performed in sequential runs  
(d) several atomic absorption spectra can be recorded simultaneously
- [v] A mixture of \_\_\_\_\_ gas is used in detector of XWDS.  
(a) argon and ethane      (b) argon and methane  
(c) neon and methane      (d) neon and ethane
- [vi] In phosphorescence phenomena, typical electron life time is,  
(a)  $\leq 10^{-8}$  s,      (b)  $\geq 10^{-8}$  s      (c)  $\leq 10^{-10}$  s,      (d)  $\leq 10^{-12}$  s
- [vii] In STM, high resolution image can be obtained by detecting;  
(a) tunnelling of electrons      (b) auger electrons  
(c) primary electrons      (d) secondary electrons
- [viii] Which of the following technique is suitable for non-conducting sample ?  
(a) SEM      (b) STM      (c) TEM      (d) AFM

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(P.T.O.)

- Q . 2 Answer the following in short ; (ANY SEVEN) [14]
- [ a ] What are the main differences between UPS and XPS?
  - [ b ] Discuss Photoelectron spectrum of Vanadium dibromide and HBr molecules.
  - [ c ] "Atomic absorption spectroscopy is based on the same principle as the flame test used in qualitative analysis" - Justify the statement.
  - [ d ] Explain how Microwave Plasma Atomic Emission Spectroscopy measuring Major and Minor Elements present in the Milk.
  - [ e ] Explain elastic cum backscattering phenomena.
  - [ f ] Why ultra-high vacuum is essential in SEM and TEM?
  - [ g ] "Bio-organic samples required special sample preparation for SEM"- Justify the statement.
  - [ h ] Define singlet ground state and singlet & triplet excited state.
  - [ i ] Using appropriate figure, explain vibration relaxation.

- Q . 3 [ a ] Explain the role of X-rays chamber and cylindrical mirror analyzer (CMA) in instrumentation of electron spectroscopy for chemical analysis. [06]
- [ b ] What is Angle-resolved XPS? Discuss in brief, how angle-resolved XPS analysis of self-assembling monolayers being done? [06]

**OR**

- [ b ] [ i ] What is Auger Electron? Give two ways to produce Auger electrons. [03]
- [ ii ] Define: Fermi-level of the solid; Work function ( $\phi$ ) and Binding Energy. [03]

- Q . 4 [ a ] Express (i) Hydride generation technique and (ii) Cold vapor technique Atomizers in Atomic Absorption Spectroscopy. Write their advantages and limitations. [06]
- [ b ] Give brief account on (i) Chemical Interferences/Errors and (ii) Spectral Interferences in Flame Photometry. [06]

**OR**

- [ b ] [ i ] Discuss the Standard addition method for calibrating the flame photometer. [03]
- [ ii ] Write vis-à-vis advantages and disadvantage in Graphite Furnace and Flame atomic absorption in Atomic Absorption Spectroscopy. [03]
- Q . 5 [ a ] [ i ] Discuss type of electron guns used in SEM & TEM. [03]
- [ ii ] Explain working principle of STM. [03]

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- Q.5 [b] [i] Give differences between AFM and STM. [03]  
[ii] Explain various operational modes of AFM and also discuss contact mode in detail. [03]

OR

- [b] [i] Define Microscope. Give classification of microscopes with the name of the techniques associated with it. [03]  
[ii] Explain working principle of AFM in detail. [03]
- Q.6 [a] Give differences between XWDS (X-ray Wavelength Dispersive Spectroscopy) and XEDS (X-ray Energy Dispersive Spectroscopy). [06]  
[b] Discuss quantitative analysis of SEM and TEM. [06]

OR

- [b] [i] Using appropriate diagram, explain the mechanism of luminescence. [03]  
[ii] Discuss various components of spectrofluorometer. [03]

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