

## D-6316

M.Sc. (I<sup>st</sup> Semester) Examination, 2020

### CHEMISTRY

(Group Theory, Spectroscopy &  
Diffraction Methods)

*Time Allowed : Three Hours*

*Maximum Marks : 70*

Note : Section-A : Objective type.	10
Section-B : Very short answer type.	10
Section-C : Short answer type.	20
Section-D : Essay type.	30

#### SECTION - A

Note : Attempt any ten questions. Each question carries one mark. **1×10=10**

Q. 1. Question (i) to (vi) objective type.

Question (vii) to (xii) fill in the blanks type.

- (i) Which of the following belongs to  $C_{2v}$  point group ?

- (a)  $SO_3$   
(b)  $NH_3$   
(c)  $H_2O$   
(d)  $PH_3$

(ii) Which molecule has  $D_{3h}$  symmetry ?

- (a)  $CHCl_3$   
(b)  $NH_3$   
(c)  $BF_3$   
(d)  $PH_3$

(iii) The absorption of x-rays in a material is governed by :

- (a) Bragg's law  
(b) Beer-Lambert law  
(c) Stephen's law  
(d) All of the above

(iv) The Miller indices of crystal plane which cut through the crystal axes at  $6a$ ,  $3b$  and  $3c$  are :

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- (a) 2 1 3  
(b) 1 2 2  
(c) 3 1 2  
(d) 1 3 1
- (v) The PMR spectra of  $H_2$ ,  $CH_4$ ,  $C_2H_6$  and  $C_6H_6$  exhibit :
- (a) Singlet  
(b) Doublet  
(c) Triplet  
(d) Quintet
- (vi) Which one is a standard method for monitoring  $NO_x$  in the atmosphere :
- (a) Phosphorescence  
(b) Fluorescence  
(c) Chemiluminescence  
(d) All of these

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- (vii) ESR was discovered by \_\_\_\_\_.
- (viii) Scaler coupling is also termed as \_\_\_\_\_.
- (ix) Unit of coupling constant 'J' is \_\_\_\_\_.
- (x) Best known free radical used in calibrating ESR spectra is \_\_\_\_\_.
- (xi)  $SO_2$  belongs to \_\_\_\_\_ point group.
- (xii) The phenomenon of NMR was first enunciated by \_\_\_\_\_ and \_\_\_\_\_ in the year \_\_\_\_\_.

**SECTION - B**

**Note :** Attempt any five questions. Each question carries 2 marks. **5×2=10**

**Q. 2.** Very short answer type (25-30 words) :

- (i) What is zero field splitting ?  
(ii) Define group and subgroup.  
(iii) Give different uses of character table.  
(iv)  $C^{13}$  is NMR active while  $C^{12}$  is not, why ?

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- (v) Why water and alcohol are not suitable solvent for ESR studies ?
- (vi) What is photoelectric effect ?
- (vii) What is deshielding ?

**SECTION - C**

**Note :** Attempt any five questions. Each question carries 4 marks. **5×4=20**

**Q. 3.** Short answer type (250 words) :

Describe the following (any five) :

- (i) Factors affecting the 'g' value.
- (ii) Debye-Scherrer method.
- (iii) Symmetry element and symmetry operation.
- (iv) Fluorescence and phosphorescence.
- (v) Applications of NMR.

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- (vi) The great orthogonality theorem.
- (vii) Hyperfine coupling constants.

**SECTION - D**

**Note :** Attempt any three questions. Each question carries 10 marks. **3×10=30**

**Q. 4.** Essay type (more than 500 words) :

- (i) Discuss the basic principle, instrumentation and applications of ESR.
- (ii) What is fluorescence spectroscopy ? Describe its principle, basic instrumentation and applications.
- (iii) (a) What is chemical shift ? Discuss its measurement and the factors which influencing chemical shift.

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(b) Discuss spin-spin coupling.

(iv) (a) What is X-ray diffraction? Describe Bragg's law.

(b) Give the basic idea of  $^{13}\text{C}$  NMR.

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