CHE-10

ASSIGNMENT BOOKLET

Spectroscopy

Bachelor's Degree Programme (B.Sc.)

(Valid from 1st January, 2021 to 31stDecember, 2021)

Please Note

- **You can take electives (56 to 64 credits) from a minimum of TWO and a maximum of FOUR science disciplines, viz. Physics, Chemistry, Life Sciences and Mathematics.**
- **You can opt for elective courses worth a MINIMUM OF 8 CREDITS and a MAXIMUM OF 48 CREDITS from any of these four disciplines.**
- **At least 25% of the total credits that you register for in the elective courses from Life Sciences, Chemistry and Physics disciplines must be from the laboratory courses. For example, if you opt for a total of 64 credits of electives in these 3 disciplines, at least 16 credits should be from lab courses.**
- **You cannot appear in the Term-End Examination of any course without registering for the course. Otherwise, your result will not be declared and the onus will be on you.**

School of Sciences
Indira Gandhi National Open University
New Delhi
(2021)

Dear Student,

We hope, you are familiar with the system of evaluation to be followed for the Bachelor's Degree Programme. At this stage you may probably like to re-read the section on assignments in the Programme Guide that we sent you after your enrolment. A weightage of 30 percent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment. The assignment is based on Blocks 1, 2, 3 and 4.

Instructions for Formatting Your Assignments

Before attempting the assignments, please read the following instructions carefully.

1 On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLMENT NO.…..……..……

NAME:……..……

ADDRESS:…….....……

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COURSE CODE : ….....……

COURSE TITLE : ….....……

ASSIGNMENT NO.: ….....……

STUDY CENTRE : ….....…… DATE:..…….
(NAME AND CODE)

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2 Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3 Leave 4 cm margin on the left, top and bottom of your answer sheet.

4 Your answers should be precise.

5 While writing answers, clearly indicate the Question No. and part of the question being solved.

6 Please note that:

i) The Assignment is valid from 1st January, 2021 to 31st December, 2021.

ii) The response to this assignment is to be submitted to the Study Centre Coordinator within eight weeks of the receipt of this booklet in order to get the feedback and comments on the evaluated assignment.

iii) In any case, you have to submit the assignment response before appearing in the term end examination.

7 We strongly suggest that you should retain a copy of your assignment responses.

Wishing you all good luck.

Tutor Marked Assignment
CHE-10: Spectroscopy

Course Code: CHE-10
Assignment Code: CHE-10/TMA/2021
Maximum Marks: 100

Note: * This assignment is based on all the four Blocks of the entire course.

* All questions are compulsory. Marks for the questions are shown within brackets on the right hand side.

* Please answer in your **own words**; do not copy from the course material.

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1. Draw the schematic representations of absorption and emission spectrometers and explain briefly about them. (5)

2. Calculate the value of Rydberg constant for hydrogen, R_H. Why does the experimental value of R_H differ from its calculated value? (5)

3. List various symmetry elements and give the symmetry operations associated with them. (5)

4. Illustrate the symmetry elements present in chloroform molecule. What is its point group? (5)

5. If the transition from $J = 0$ to $J = 1$ for NO molecule takes place at $\bar{\nu} = 1.70$ cm^{-1}, then calculate its bond length. (5)

   (You can use the relevant data given in the course material.)

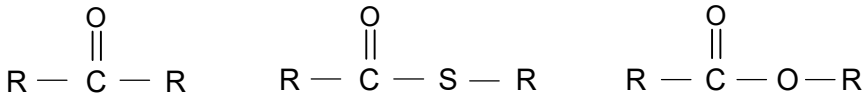
6. Briefly discuss about the various types of rotors according to their moments of inertia. Give suitable examples and rotational constant for each of these classes. (5)

7. Desire the expression for oscillation frequency, $\bar{\nu}_{OSC}$ (5)

$$\bar{\nu}_{OSC} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

8. If the wave number of absorption for C-H bond, $\bar{\nu}_{C\text{-}H}$ is 2900 cm^{-1}, then calculate the wave number of absorption for C-D bond. (You can use the relevant data given in the course material.) (5)

9. Arrange the following molecules in the increasing order of their carbonyl group frequencies: (5)



   Also explain the reason for your answer.

10. Using suitable diagram, discuss the pure rotational Raman spectrum of a diatomic molecule. (5)

11. Comment on the structures of CO_2 and SO_2 molecules, if (5)

    (i) IR spectrum of CO_2 exhibits two peaks which are absent in the Raman spectrum, and

    (ii) IR spectrum of SO_2 exhibits three peaks which are exhibited in Raman spectrum also.

12. Draw and explain the formation of σ and σ^*, π and π^* molecular orbitals by LCAO. (5)

13. State the rules used for deriving term symbols of many electron diatomic molecules. (5)

14. Draw the five 3*d* orbitals. Also explain the effect of octahedral crystal field on their energies using a suitable diagram. (5)

15. Answer the following: (5)

    i) What is the role of littron mirror in IR spectrometer?

ii) Why glass container cannot be used for IR spectroscopy?

iii) What is the significance of monochromators?

iv) What are the sources of radiation in microwave spectrometer?

v) What is the significance of water jacket in Raman spectrometer?

16. How is NMR spectrum recorded? Explain giving a suitable representation of an NMR spectrometer. (5)

17. Draw and explain the NMR spectrum of ethanol solution. (5)

18. The esr spectrum of hydrogen atom shows two equally spaced intense lines. Explain using suitable diagram. (5)

19. Discuss the origin of various peaks exhibited in the mass spectrum of 2-butanol. (5)

20. Discuss the spectral data expected for benzyl alcohol explaining the important features. (5)