

2017

M.Sc. 3rd Semester Examination

CHEMISTRY

PAPER—CEM-303

Full Marks : 40

Time : 2 Hours

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

(Organic + Inorganic + Physical Special)

Answer any five questions, taking at least two from each group.

Group—A

1. (a) How is the fluorescence of pyrene influenced by polarity of the medium ? 2

(Turn Over)

- (b) Schematically show the potential energy curves of iodine molecule in its ground and higher energy states. 3
- (c) Write down the relation between excited state lifetime and the rate constant involving IC, ISC. 3
2. (a) Differentiate between optical pumping and electrical pumping scheme. 3
- (b) What are optical cavities? How are they useful in laser action? 3
- (c) Schematically show the energy diagram of a three level LASER. 2
3. (a) Showing all possible transitions predict the intensity distribution in the hyperfine lines of the ESR spectrum of radical *CD_3 . 4
- (b) The ESR spectrum of $[(NH_3)_5Co-O_2-Co(NH_3)_5]^{5+}$ shows fifteen lines. Derive structural information for this complex ion from this data. 4

4. (a) What is the convenient way in describing the XPS patterns? 2
- (b) Explain the difference between XPS and AES. 3
- (c) What are the maximum depths of AES and XPS? 2
- (d) Besides the beam electrons, how many electrons are involved in AES? 1

Group—B

5. (a) What happens to the absorption spectra of iodine solution in carbon tetrachloride, when pyridine is added to it? 3
- (b) Which of the following statements are correct?
- (i) Maxima of the wavefunctions for the second vibrational energy state are at the centre and the same for the zero th vibrational level are at the edges.
- (ii) Maxima of the prob. density of wavefunctions for the second vibrational energy state are at the edges and the same for the zero th vibrational level is at the centre.

- (iii) Maxima of the wavefunctions for the second vibrational energy state are at the centre and the same for the zero th vibrational level are at the centre.
- (iv) Maxima of the wavefunctions for the second vibrational energy state are at the centre and the same for the zero th vibrational level are at the edges.

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- (c) Write down the relation between the protolytic dissociation constant of phenolic compounds in the ground and excited state with the difference in electronic transition frequencies.

3

6. (a) Show that a two level pumping scheme has no practical significance for lasing. 2
- (b) What is an optical resonator in LASER ? 2
- (c) What is a gain in lasers ? What is the condition for a threshold gain ? 2
- (d) Why are waveguides essential in IR-LASERS ? 2

7. (a) Explain the ESR spectrum of *bis*-salicylaldimine copper (II) complex. 3
- (b) Name the best known free radicals used in calibrating ESR spectra. Why this compound is suitable for calibrating ESR spectra? 2
- (c) Explain the appearance of two lines in the ESR spectrum of hydrogen atom. 3
8. (a) Can the Auger electron emission process be initiated with x-rays? 2
- (b) Which of the following statements is true?
- (i) XPS is more a qualitative than quantitative analytical tool.
 - (ii) XPS is equally a qualitative and quantitative analytical tool.
 - (iii) XPS is more a quantitative than qualitative analytical tool.
 - (iv) None of the above.
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(c) Which of the following statements is true ?

(i) Both the NMR, NQR studies are done in an environment without a static (or DC) magnetic field.

(ii) Since unlike NQR, NMR is done in an environment without a static (or DC) magnetic field, it is sometimes called "zero field NMR".

(iii) Since unlike NMR, NQR is done in an environment without a static (or DC) magnetic field, it is sometimes called "zero field NMR".

(iv) None of the above.

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(d) Show in the spectra (not necessarily according to the scale) the sequence of the appearance of the XPS lines for Li in pure metallic form and in the form of its oxide.

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