

M.Sc. 3rd Semester Examination, 2018

CHEMISTRY

PAPER — CEM-303

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks

1. Answer any *four* questions : 2 × 4
- (a) What are chemical LASERS ?
 - (b) What are optical cavities in LASERS ?
 - (c) What do you mean by coherence in LASER ?
 - (d) What do you mean by the term "Stokes shift" ?
 - (e) What is Stern-Volmer quenching ?
 - (f) The benzene radical anion has $g = 2.0025$.
At what field should you search for resonance
in a spectrometer operating at 29.453 GHz ?

(Turn Over)

(2)

(g) Write the name and structure of a compound which is used as standard compound for ESR spectroscopic study. Why this compound is used as standard compound ?

(h) What do you mean by "X-band frequency" and "Q-band frequency" in ESR spectroscopy ? What are the advantages and limitations in using "Q-band frequency" ?

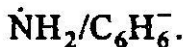
2. Answer any *four* questions : 4 × 4

(a) Explain the construction and function of a He-Ne LASER. 4

(b) "LASERS are non-mechanical knives" – criticize or justify. What kind of dyes are used in modelocking ? 2 + 2

(c) Compare and contrast active and passive modelocking. 4

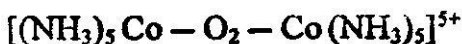
(d) Predict the ESR spectrum of the following radical/anion : 2 + 2



(e) Briefly explain as how you can determine the binding constant of macromolecule with a drug using Benesi-Hildebrand equation. 4

(f) Showing all possible transitions, discuss the ESR spectrum of $[\text{CD}_3]^{\cdot}$ radical. 4

(g) The EPR spectrum of



shows fifteen lines. Derive the structural information of this complex ion from this data. 4

(h) Explain the ESR spectrum of radical anion of pyrazine. 4

3. Answer any two questions : 8 × 2

(a) What is an optical resonator in LASER ? Schematically show the energy diagram of a three level LASER. Why in a Ruby LASER a trace amount of Cr^{3+} ion is doped with aluminium ? Why are waveguides essential in IR-LASERS ? 2 + 2 + 2 + 2

- (b) Show that a two level pumping scheme has no practical significance for lasing. What do you mean by modes in a resonator? What is the relation between the frequency difference between successive modes for a cavity of length L ? 3 + 3 + 2
- (c) How does the polarity of a solvent influence the absorption and emission spectra of a solute? Explain it with iodine as a solute. Why do the phenolic compounds dissociate at lower pH in the excited state while the same is relative higher in the ground state? 4 + 4
- (d) (i) Using following information predict the pattern of the ESR spectrum of a radical $[XY_2]^{\cdot}$. 4

	Nuclear spin quantum number	Hyperfine coupling constant
X	1	$2a$
Y	$1/2$	a

(5)

(ii) Comment about the ESR activity of the following metal ions in the octahedral complexes : 2

Cr(III), Cr(IV)

(iii) Calculate theoretically possible number of lines in the EPR spectrum of $[V(O)(acac)_2]$. (acac = acetylacetonato). 2
