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M.Sc. RNLKWC-/CEM-301/22

2022

ADVANCE SPECTROSCOPY-I

M.Sc. Third Semester End Examination - 2022

PAPER - CEM-301

Full Marks : 40

Time : 2 hours

*The figures in the right-hand margin indicate marks.
Candidates are required to give their answers in their own
words as far as practicable.
Illustrate the answers wherever necessary.*

Group-A

Answer any four questions each carrying 5 marks. $4 \times 5 = 20$

1. a) Write down rate of primary photophysical process.
b) What do you mean by self quenching in fluorescence?
2+3
2. a) What is P-type delayed emission? Give one example.
b) What are excimer and exciplex emission? 3+2

(Turn Over)

(2)

3. a) Why thermal activation to excited singlet state at room temperature is not possible in pyrene?
b) What are α -phosphorescence and β -phosphorescence?
2+3=5
4. a) What is population inversion?
b) Write down the characteristics of LASER light. 2+3=5
5. A laser rated at 0.10 J can generate radiation in 3 ns pulss at a pulse repetition rate of 10Hz. Assuming that the pulses are rectangular, Calculate the peak power output and the average power output of this laser. Comment on the result obtained. 5
6. (a) Discrete electrons can't be observed in electron ionisation of an atom. Explain.
(b) What is hyperfine splitting. Predict the high resolution spectrum (Showing spin-spin interation) of CH_3CHO in CCl_4 solution. 2+1+2=5
7. (a) Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33T, given that for the free electron, $g_e=2$ and $\mu_B=9.273 \times 10^{-24}$ J.T. ⁻¹.

(3)

- (b) Between the two molecules N_2 and O_2 which will show an ESR spectrum and why? 3+2=5
8. (a) Enumerate the NQR frequencies for a nucleus with $I=9/2$ in an axially symmetric EFG ($\eta=0$). How do they arise?
(b) NQR is not observed in gassous and solid state. Explain. 3+2=5

Group - B

Answer any two questions each carrying 10 marks. 2×10=20

9. (a) How do you measure quantum fluorescense and phosphorescence in a unimolecular photophysical process.
(b) Discuss the effect of temperature on emission processes. 5+5=10
10. (a) Deduce the stern-volmer equation.
(b) What is the basis difference between prompt fluorescence and delayed fluorescence? What is E-type delayed fluorescence? 5+1+4=10

(4)

11. (a) Write a short notes on (any one)

(i) Gas lasers (b) Q-switching

(b) What is Q-switching in LASER. Discuss one application of lasers in chemistry. 4+3+3=10

12. (a) Mention the selection rule for NQR transition. 1

In $^{27}_{13}\text{Al}$, $I=5/2$. Whow that the NQR frequency ratio

$Y_1:Y_2=1:2$

(b) The hyperfine constants in the ESR spectrum of naphtholene at the α and β positions are $a=0.49$ mT and $a=0.183$ mT respectively. Map the unpaired electron spin density around the ring. 1+4+5=10
