

B.E. (EE) Part-II 3rd Semester Examination, 2007

**Elec. Engg. Materials**  
**(PH-302)**

**Time : 2 hours**

**Full Marks : 35**

Answer any FIVE questions

1. What is magnetic dipole moment? Show that the magnetic dipole moment of an electron moving in a circular path round a nucleus is always an integral multiple of a minimum unit. What is this unit called and what is its value? [2+4+1]
2. a) Consider an electronic subshell corresponding to the orbital quantum number  $l=2$ . How many electrons can it accommodate? What are the possible values of orbital and spin magnetic moments of these electrons? If the subshell is saturated, what will be the total magnetic moment?  
b) Why does an iron atom possess a net magnetic moment? What is the value of this magnetic moment? [(1+3+1)+2]
3. Assuming a system of spins corresponding to +1 or -1 Bohr magnetons only, deduce the expression for magnetisation of a paramagnetic material and show that for low fields, Curie law is satisfied. [7]
4. Distinguish between spontaneous and stimulated emission of radiation for a LASER. Show that the ratio of the rate of spontaneous and stimulated emission is equal to  $(e^{h\nu/kT} - 1)$ , where the symbols have their usual meanings.  
Discuss how the process of population inversion happens in case of a three level laser system. [2+3+2]
5. According to Bohr's theory of Hydrogen atom deduce the expression for wave no. of radiation emitted by an electron when it jumps from higher orbit  $E_2$  to lower orbit  $E_1$ .  
How can you define the modified Rydberg's constant ( $R_H$ )?  
'H' atom in its ground state is excited by means of monochromatic radiation of wavelength  $975\text{\AA}$ . How many different lines are possible in the spectrum? Calculate the longest possible wavelength of the spectrum. Given that the ionisation energy of 'H' atom is 13.6 eV. [3+2+2]

6. a) What are the two basic concepts that can characterise the vector atom model? According to this model how many quantum numbers can be associated with each electron in a given atom? Briefly discuss about them.
- b) Draw the refractive index profile of a step and a graded index optical fiber. Also write the expression for index variation in different parts of the fiber.

[2+3+2]

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