1M4A23213 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2023

MPH4C12 – Atomic and Molecular Spectroscopy

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

Answer all Questions. Each question carries a weightage of 1

1. Distinguish between Zeeman effect and Paschen back effect.
2. State and explain Hund's rule. Give an example.
3. The intensity of J=0 $\rightarrow$ $J = 1$ is not the most intense rotational line. Why?
4. What parameters one can get from a study of the vibration-rotation spectrum of a heteronuclear diatomic molecule? How are they estimated?
5. Comment on the statement 'Homonuclear diatomic molecules give no microwave or infrared spectra whereas they do give a rotational Raman spectrum'.
6. The rotation raman spectra of CH_3Cl molecules shows an alternation in intensity. Why?
7. State and explain Franck-Condon principle.
8. What is screening constant? Explain the different contribution to screening constant of molecules.

$8 \times 1 = 8$ weightage

Section B

Answer any 2 questions. Each question carries a weightage of 5

9. Discuss the energy and spectra of a diatomic vibrating rotator as an unharmonic oscillator. Explain how different branches occur in spectra.
10. With the help of a schematic diagram, describe the construction and working of a Raman spectrometer.

11. With the diagram, discuss the rotational fine structure of electronic-vibration spectra and explain band origin and band head. Will there be a band head at the band origin? Explain. From the fortrat parabola, find the position of band head.

12. Explain the principle of ESR. Explain the factors responsible for the hyperfine structure in ESR spectra. Explain the hyperfine component of ESR spectrum of a system having an unpaired electron interacting with (i) two equivalent protons (ii) two non-equivqlent protons.

$2 \times 5 = 10$ weightage

Section C

Answer any 4 question. Each question carries a weightage of 3

13. Determine the Zeeman components in $\AA$ unit, when a spectral line of wavelength $4500\AA$ is subjected to a magnetic field of strength 0.3 Tesla. Mass of the electron is $9.1\text{x}10^{-31}$kg; c=$3\text{x}10^{8}$m/s; charge of the electron is $1.6\text{x}10^{-19}$C.

14. Find the interaction energies between two sp (valence) electrons in LS coupling. Give the schematic representation.

15. The equilibrium vibration frequency of the iodine molecule is $215cm^{-1}$ and the anharmonicity constant χ_e=0.003. What is the intensity of the hot band ν=0 → ν=2 relative to that of the fundamental ν=0 → ν=1, if the temperature is 300K?

16. The bond length of N_2 molecule is $1.097\text{x}10^{-10}$m. What would be the positions of the first three rotational Raman lines of N_2? ^{14}N=$23.25\text{x}10^{-27}$kg.

17. The values of $\overline{\nu_e}$ and χ_e for ground and excited states of C_2 molecule are 1641.4 cm^{-1}, $7.11\text{x}10^{-3}$ and 1788.2 cm^{-1}, $9.19\text{x}10^{-3}$ respectively. If its $\overline{\nu_{00}}$ is at 19.378 cm^{-1}, calculate the energy difference of the two electronic states.

18. Calculate the difference in the energies of protons oriented with and against a magnetic field of strength 2T. What is the freqeuency of radiation that has this energy? g_N=5.585.

19. Calculate the recoil velocity of a Mossbauer nucleus of mass $9.4684\text{x}10^{-26}$kg, when emitting a γ-ray of wavelength $8.57\text{x}10^{-11}$m. What is the Doppler shift of the γ-ray frequency to an outside observer?

$4 \times 3 = 12$ weightage

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2023

MPH4E13 – Laser & Fibre Optics

(2019 Admission onwards)

Time: 3 hours

Max. Weightage : 30

Section A

(8 Short questions, each answerable within 7.5 minutes
Answer ALL questions, each carries weightage 1)

1. Write down the Boltzmann's law of population at the energy level at thermal equilibrium. Explain the term involved.
2. How material dispersion effect fiber optic communication ?.
3. What are leaky modes in optical fibers?
4. Describe the advantages of cladding in optical fibres?
5. What are the applications of Holography?
6. What is 'V' parameter of an optical fibre?
7. What is the role of Q switching in a LASER?
8. Explain significance of the phase matching condition in second harmonic generation of light.

(8 x 1 =8 weightage)

Section B

(4 Essay questions, each answerable within 30 minutes

(Answer ANY TWO questions, each carries weightage 5)

9. Analyse the optical resonators using geometrical optics and hence obtain the condition to be satisfied for a stable resonator.
10. Analyse light propagation through optical fibres using Maxwell's equations.
11. Discuss various signal degradation mechanisms in optical fibre communication.
12. Explain following measurement techniques used in Optical Fibre Communications.
    a) Optical time domain reflectometer (OTDR)
    b) Reflection method and transmitted near field method to measure refractive index

(2 x 5 =10 weightage)

Section C

7 Problem questions, each answerable within 15 minutes)
(Answer any FOUR questions, each carries weightage 3)

13. Obtain the expression for threshold pump power of laser oscillations in a three level laser systems.
14. A step-index fibre has radius a = 5 pm, core refractive index $n_1 = 1.45$, and fractional refractive-index change $\Delta = 0.002$. Determine the shortest wavelength λ_c, for which the fiber is a single-mode waveguide
15. A fibre has 500 m length and is fed with an optical power of 10 μW. The output power is found to be 7 μW. Calculate the loss in dB/km.
16. A Laser produces 10mW beam of light at 632.8 nm. Find the number of photons emitted by the laser in each second.
17. Find the longitudinal mode spacing of a laser resonator of cavity length d=100 cm. Assume cavity is filled with a gas of refractive index 1.00037.
18. The areal density parameter (pR) of the combustion in inertial confinement of a Laser fusion is $0.3 g/cm^2$.Find the factional burn up of the fuel.
19. Compare the properties of step index and graded index optical fibers using refractive index profile diagram. Also compare single mode and multimode optical fiber using 'V' parameter.

(4 x3 = 12 weightage)

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Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2023

MPH4E20 – Microprocessors, Microcontrollers & Applications

(2019 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

(Short answer type questions. Answer all questions. Each carry weightage 1)

1. Differentiate between CALL and RET instructions in 8085 microprocessor.
2. Explain I/O mapped I/O scheme of address space partition in 8085 microprocessor.
3. What are the different operating modes of Intel 8253 programmable counter/interval timer?
4. Describe DMA data transfer scheme.
5. Write a note on 7-segment LED display.
6. Differentiate between a general purpose microprocessor and microcontroller.
7. What is meant by assembler directives in microcontroller? Illustrate with an example.
8. Write a short note on C language data types commonly used for AVR microcontroller.

Total weightage 8 x 1 = 8

Section B

(Essay type questions. Answer ANY TWO questions. Each carry weightage 5)

9. With the help of block diagram explain the internal architecture of 8085 microprocessor.
10. With the help of a diagram explain the function of Intel 8259 programmable interrupt controller. Explain the three internal registers of 8259.
11. Discuss the general purpose registers in the AVR. Explain the function of LDI, ADD and SUB instructions of AVR with respect to the general purpose registers.
12. Describe the I/O Ports A, B, C and D of the AVR and explain their functions. Give the alternate function of pins of port A.

Total weightage 2 x 5 = 10

Section C

(Problem type questions. Answer ANY FOUR questions. Each carry weightage 3)

13. Write a ALP program for adding the contents of memory locations 8500 H and 8501H and store the result in 8502 H in 8085 microprocessor. (Assume the sum is 8 bit)
14. With the help of a timing diagram explain the memory read machine cycle in 8085 microprocessor.
15. Explain the function of instruction LDA 4050 H in 8085 microprocessor. Which are the machine cycles present in its instruction cycle? How many T-states are there?
16. Form control word for the following configuration of the ports of Intel 8255 programmable peripheral interface for Mod - 0 operation. Port A – Output, Port B – Output, Port C_{lower} – Output, Port C_{upper} – Input.
17. What is the content stored in general purpose register R17 after the execution of the following ALP code in AVR microcontroller?

```
LDI R16, 0x18
STS 0x330, R16
LDI R17, 0x34
LDS R20, 0x330
SUB R17, R20
```

18. Write a program using C for AVR microcontroller to send hexadecimal values from 00 to FF to port B.
19. What operation is implemented with the below C program in AVR microcontroller?

```
#include <avr/io.h>
int main(void)
{
    unsigned int x;
    DDRB = 0xFF;
    PORTB = 0xAA;
    for(x = 0; x<=200; x++)
        PORTB = ~PORTB;
    while(1);
    return 0;
}
```

Total weightage 4 x 3 = 12