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1M4A24216 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2024

MPH4C12 – Atomic and Molecular Spectroscopy

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

Answer all questions. Each question carries a weightage of 1

1. Outline the physical concept of space quantization in vector atom model.
2. Explain briefly Paschen-Back effect.
3. Explain singlet and triplet states with examples.
4. Briefly outline the advantages of FTIR spectroscopy over the conventional procedure.
5. The occurrence of Raman spectrum depends on the polarizability of the molecule but is entirely independent of the presence of permanent dipole moment. Discuss.
6. Applying Frank Condon principle explain how we can account for the intensity variation of electronic spectra of molecules.
7. Discuss rotational fine structure of a particular vibrational electronic transition for a diatomic molecule with B'>B". Draw the Fortrat diagram.
8. Draw the energy level diagram and transitions for the odd electron of the free radical in 1,4-benzosemiquinone.
   (In the benzosemiquinone free radical ion, the odd electron can move throughout the molecule and interact with the nuclear moments of the four equivalent protons.)

8 x 1 = 8 weightage

Section B

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

9. Explain the theory of anomalous Zeeman effect. Illustrate with diagrams of the Zeeman splitting of Sodium Yellow D-lines.
10. With necessary energy level diagram discuss the rotational fine structure of vibrational band in a diatomic molecule.
11. Deduce Bloch equations.
12. Explain classical theory of Raman effect. Describe various rotational Raman lines in a linear molecule.

2 x 5 =10 weightage

Section C

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

13. The spacing of a series of lines in the microwave spectrum of AlH is constant at 12.604 cm^{-1}. Calculate the moment of inertia and internuclear distance of the AlH molecule. What is the energy of rotation and the rate of rotation when J=15? (Reduced mass of AlH molecule is 0.9718 au)
14. In the rotational Raman spectrum of HCl the displacement from the exciting line is represented by $\Delta v = \pm(62.4 + 41.6)cm^{-1}$. Calculate the moment of inertia of the HCl molecule.
15. The values of $\bar{v}_e$ and x_e for lower and upper states of CO are 2170.21 cm^{-1}, 0.0062 and 1515.61 cm^{-1}, 0.0114 cm^{-1} respectively. The (0,0) transition is observed at 64746.55 cm^{-1}. Calculate the energy difference of the two electronic states.
16. Prove that in the electronic spectroscopy of a diatomic vibrator, the highest vibrational quantum number that can be reached is given by $v_{max} = \frac{1}{2\chi_e} - 1$, where notations have their usual meanings.
17. A Mossbauer nucleus ^{57}Fe makes the transition from the excited state of energy 14.4 keV to ground state. What is the recoil energy?
18. Rotational and centrifugal distortion constants of HCl molecule are 10.593 cm^{-1} and 5.3×10^{-4} cm^{-1} respectively. Estimate the vibrational frequency and force constant of the molecule.
19. (i) A free electron is placed in a magnetic field of strength 1.3 T. Calculate the resonant frequency if g=2.0023 and $\mu_B = 9.274 \times 10^{-24} JT^{-1}$.

    (ii)ESR is observed for hydrogen with an instrument operating at 9.5 G Hz. What is the applied magnetic field?

4 x 3 = 12 weightage

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1M4A24217 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2024

MPH4E13 – Laser & Fibre Optics

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A
(Answer all questions ,each carries one weightage)

1. Define population inversion. What are the conditions required to have a low threshold value of population inversion?
2. What are the distinctive features of carbon dioxide lasers?
3. What makes Semiconductor laser well suited for use in telecommunications?
4. What is the significance of the acceptance angle in optics and how does it influence the performance of optical devices?
5. What does numerical aperture measures in optics? How does it affect the light-gathering ability of optical systems?
6. What are the primary disadvantages associated with stepped index monomode fibres?
7. What role do leaky modes play in affecting the efficiency of optical fibres?
8. How an Optical Time Domain reflectometer does accurately measures fibre attenuation?

(8 × 1 = 8 weightage)

Section B
(Essay questions. Answer any *two* questions. Each carries *five* weightage)

9. Explain the laser rate equation of the three level laser system and calculate the gain coefficient.
10. Explain (I) Ruby Laser (II) He- Ne laser.
11. Use Maxwell's equations and analyse the propagation of light through optical fibre.
12. Discuss the following signal degradation in optical fibres (1) scattering losses (2) bending losses (3) core cladding losses.

(2 × 5 = 10 weightage)

Section C

(Problems. Answer any *four* questions. Each carries *three* weightage)

13. The 629.9 nm line neon has an Einstein coefficient of $1.7 \times 10^7 s^{-1}$. Find the temperature at which the natural and doppler line widths will be same in low pressure pump.
14. An Argon laser operating at 488 nm with a gain-region length of 0.3 m is determined to have a population density of $1 \times 10^{16}/m^3$ in the upper level and $4 \times 10^{15}/m^3$ in the lower laser level. If a very low power beam of intensity I_0 is transmitted into the gain medium then what would be the measured ratio of $\frac{I}{I_0}$, where I is the output beam intensity after traversing the medium?
15. The attenuation in optical fibre is 3.6 dB/km. What fraction of its initial intensity remain after 1.5 Km ?
16. A laser produces 5mW beam of of light at 632.8 nm. Find the number of photons emitted by the laser in each second.
17. In an optical fibre the core refractive index is 1.6 and cladding refractive index is 1.3 . Determine the critical angle also calculate the value of angle of acceptance core.
18. Calculate the cutoff wavelength for a step- index fibre to exhibit single- mode operation when the core refractive index is 1.46 and the core radius is 4.5 micrometer, with the relative refractive index difference of 0.25%.
19. How much will a light pulse spread after travelling along 1 km of step-index fibre whose numerical aperture NA= 0.275 and refractive index of the core is 1.487?

($4 \times 3 = 12$ weightage)

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Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fourth Semester M.Sc Physics Degree Examination, April 2024

MPH4E20 – Microprocessors, Microcontrollers and Applications

(2022 Admission onwards)

Time: 3 hours Max. Weightage : 30

Section A

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

1. Timing and control unit can be regarded as the brain of a computer system. Why?
2. Discuss the generation of control signal $\overline{MEMR}$ for memory read operation in 8085 microprocessors.
3. Describe the interrupt request register (IRR) in programmable interrupt controller Intel 8259. Give its function.
4. Give the functions of DMA address register and byte count register in Intel 8257 programmable DMA controller.
5. Name the different operating modes of operation of Intel 8253 programmable counter/interval timer?
6. Name the four broad groups of AVR microcontroller family. Give their general features.
7. Describe the status register in AVR microcontroller.
8. What is meant by bit addressability of I/O ports in AVR? Give an example.

Total weightage 8x1=8

Section B

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

9. What do you mean by an instruction of a microprocessor? What are the various groups of instruction sets of 8085? Explain in detail with three example instructions for each group.
10. Explain the architecture of Intel 8255 programmable peripheral interface. Explain the different modes of operation.
11. Explain the conditional branch instructions and looping in the AVR microcontroller using the instructions BRNE, BREQ and BRSH. Give simple example for each.
12. What is meant by addressing modes in AVR? Explain the various types of register addressing modes, direct addressing and register indirect addressing mode in AVR microcontroller.

Total weightage 2x5=10

Section C

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

13. Write an assembly level program for 8085 microprocessor to find the two's complement of an 8-bit number stored in the memory location 2501 H. The result is to be stored in the memory location 3501 H.
14. Explain the memory write machine cycle in 8085 microprocessor using a timing diagram.
15. Calculate the time delay generated by the following subroutine in an 8085 microprocessor operating on a clock frequency of 3MHz.

```
        MVI B, FF H
LOOP:   DCR B
        JNZ LOOP
        RET
```

16. The control word register of Intel 8253 programmable interval timer/counter is loaded with 70 H. Which counter is selected? Which is the mode of operation? Is it acting as BCD or binary counter?
17. Write an assembly language program for AVR microcontroller to add the content of data memory location 0x220 with the content of data memory location 0x221 and store the result in location 0x221.
18. Write the AVR code line to make lower nibble of port B as output and higher nibble as input.
19. What does the below code implement in AVR microcontroller?

```
DDRA = 0x00;      //make PORTA all inputs
PORTA = 0xFF;     //enable all pull-ups
data = PINA;      //read PORTA pins into variable data
```

Total weightage 4x3=12