

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
Fourth Semester M.Sc Physics Degree Examination, April 2025

MPH4C12 – Atomic and Molecular Spectroscopy

(2022 Admission onwards)

Time: 3 hours

Max. weightage : 30

Section A

Answer all questions, each question carry weightage 1.

1. Explain Lande interval rule.
2. What are hot bands? Why are they called so?
3. What is Stark effect? Outline the importance of Stark effect studies in microwave spectroscopy.
4. Explain inverse Raman scattering.
5. Describe Franck Condon principle.
6. Distinguish between spin lattice and spin-spin relaxation.
7. What is a Fortrat parabola?
8. What is isomer shift? Explain with examples.

(8 x 1=8 weightage)

Section B

Answer any two questions, each carry weightage 5

9. Compare anomalous Zeeman effect and Paschen Back effect? Illustrate with the example of principle series doublet of Sodium.
10. Discuss the energy's and spectra of a diatomic vibrating rotator as an anharmonic oscillator. Explain how different branches occur in the spectra.
11. Describe the rotational Raman Spectra of a top symmetric molecule? Illustrate with an example.
12. Derive the Bloch equations. Solve them to find the longitudinal and transverse susceptibilities.

(2 x 5=10 weightage)

Section C
Answer any Four questions, each carry weightage 3

13. What are the intensity rules? Illustrate with an example.
14. Consider an atom with two electrons in the valence shell. One in p state and other in f state. Obtain the possible L, S and J values and the term symbols of two electron systems.
15. Rotational and centrifugal distortion constants of HCl molecule are 10.593cm^{-1} and $5.3 \times 10^{-4} \text{cm}^{-1}$ respectively. Estimate the vibrational frequency and force constant of the molecule.
16. Write a note on Raman spectrometer.
17. The band origin of a transition in C_2 is observed at $19,378\text{cm}^{-1}$ while the rotational fine structure indicates that the rotational constants in excited and ground states are respectively $B' = 1.7527\text{cm}^{-1}$ and $B'' = 1.6326\text{cm}^{-1}$. Estimate the position of the band head. Which state has the larger internuclear distance?
18. With the help of energy level diagram, explain the ESR hyperfine structure of hydrogen atom.
19. A Mossbauer nucleus ^{57}Fe makes the transition from the excited state of energy 14.4keV to ground state. What is its recoil energy and recoil velocity?

(4 x 3= 12 weightage)

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MPH4E13 – Lasers & Fibre Optics

(2022 Admission onwards)

Time: 3hours

Max. Weightage : 30

Section A

(Answer all questions, each carries one weightage)

1. What are Einstein's coefficients?
2. Discuss various reasons for line broadening.
3. Describe the excitation mechanism in a He-Ne LASER.
4. What is self focusing?
5. What is attenuation in optical fiber?
6. How refractive index is measured using transmitted near field technique.
7. What are leaky modes in an optical fiber?
8. Why it is difficult to achieve laser action in two level systems?

(8 × 1 = 8 weightage)

Section B

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

9. Discuss the concept of optical resonator. What are cavity modes? Explain Q factor of a cavity.
10. Explain a 3 level laser system and obtain the condition for sustained laser oscillation.
11. Derive the wave equations for step index fibers
12. Discuss the measurement of fiber loss by cut- fiber method.

(2 × 5 = 10 weightage)

Section C

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

13. The length of a laser tube is 150mm and the gain factor of LASER material is 0.00005/cm if one of the cavity mirrors reflects 100% of light incident on it, what is the reflectance of other cavity mirror?
14. A step index fiber of diameter 50 μm has a numerical aperture of 0.23. If the wave length of light energy is 0.82 μm , then determine the number of modes in the cable.
15. The upper and lower levels of a 2-level system are separated by 1.8 eV energy. Find the ratio of stimulated to spontaneous emission at 300 K.
16. The wave length of emission is 6000\AA and the coefficient of spontaneous emission is 10^6 per second. Determine the coefficient of stimulated emission.
17. An optical fiber has length 150 m and fed with an optical signal power, 10 μW The output power measured to be 10 μW . Calculate the power loss per kilometer.
18. Find the ratio of populations in the two states in He – Ne LASER that produces light of wavelength 6328\AA at 27°C .
19. Calculate the percent of power lost when light moves from air to glass when the angle of incidence is 0°

(4 \times 3 = 12 weightage)

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Fourth Semester M.Sc Physics Degree Examination, April 2025

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. What is a microprocessor?
2. With an example explain a programmable peripheral interface.
3. Explain machine cycle.
4. Briefly explain how an ADC works?
5. Explain EEPROM.
6. Explain AVR microcontroller I/O points.
7. Write a note on 7 segment LED display.
8. Explain DMA data transfer scheme.

Total Weightage 8x1=8

Section B

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

9. With a neat schematic explain the architecture of 8085 microprocessor.
10. Explain the instruction cycle. Draw and explain the timing diagram for fetch operation.
11. With the help of a neat diagram explain the function of Intel 8259 programmable interrupt controller. Explain the three internal registers of 8259.
12. Explain the main features of the I/O ports of AVR.

Total Weightage 2x5=10

Section C

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

13. Write an assembly level programme for the division of two 8bit numbers stored at consecutive address.
14. Write an assembly language programme to find the largest number among numbers in an array starting at address 5000 and store it at address the 60000.
15. Explain the function of instruction LDA 4050 H in 8085 microprocessors. Which are the machine cycles present in its instruction cycle? How many T-states are there?
16. Write an AVR C program to send hex values for ASCII characters of 0, 1, 2, 3, 4, 5, A, B, C, and D to port B.
17. With a block diagram explain the function of Sample and Hold circuit:
18. Write a program using C for AVR micro controller such that it will "Turn LED on when Button are Pressed based on Bit Positions".
19. Write the AVR code line for "PORTB set to tri-state inputs".

Total Weightage4x3=12