

الجزء الأول / 15.10.2018

Ministry of Higher Education
& Scientific Research
Muthanna University
College of Science
Department of Physics



Subject: Mathematical
physics
Stage: M.Sc

Date: / /2018
Time : 4 Hours

15.10.2018

((Final exam for the first semester))
2017-2018

45

Q1:(i) If A_j^i is mixed tensor of rank 2 and B_m^{kl} is mixed tensor of rank 3 . prove that $A_j^i B_m^{kl}$ is a mixed tensor of rank 3.

(ii) Express the matrix $A = \begin{bmatrix} i & 2-3i & 4+5i \\ 6+i & 0 & 4-5i \\ -i & 2-i & 2+i \end{bmatrix}$ as a sum of Hermitian and Skew

Hermitian matrix.

[14Marks]

Q2:(i) solve $y'' + (x-1)^2 y' - 4(x-1)y = 0$ in series about the ordinary point $x=1$

(ii) Separate $\log(x+iy)$ into its real and Imaginary parts .

[14Marks]

Q3:(i) show that $\frac{d}{dx} (J_n^2 + J_{n+1}^2) = 2(\frac{n}{x} J_n^2 - \frac{n+1}{x} J_{n+1}^2)$

(ii) If A_k^{ij} and B_n^{lm} are tensors , then their sum and difference are tensors of the same rank and type .

[14Marks]

Q4:(i) using Residue theorem , evaluate $\frac{1}{2\pi i} \oint_C \frac{e^{zt}}{z^2(z^2+2z+2)} dz$, where C is the circle $|z| = 3$

(ii) show that the real and Imaginary parts of the function $w = \log z$ satisfy the (C-R) equations when Z is not zero . Find its derivative .

[14Marks]

Q5:(i) If $A(i, j, k) A^i B^j C^k$ is scalar for arbitrary vectors A^i, B^j, C^k . Show that $A(i, j, k)$ is a tensor of type (1, 2) .

[6Marks]

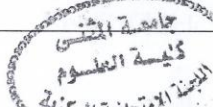
(ii) Find out the zeros and discuss the nature of the Singularities of $f(z) = \frac{(z-2)}{z^2} \sin(\frac{1}{z-1})$

[4Marks]

(iii) Show that $S = \{3^n : n \in \mathbb{Z}\}$ is abelian group w.r. to multiplication .

[4Marks]

Lecturer M.M.KRADY
Assist. Prof. Mousa Krady



Head of Department
Dr. Hassan M. Jaber Al-Ta'ii



18.10.2018

((Assessment of the final exam for the First semester))
Academic year 2017 -2018

45

Note: 10 Mark for each question

Q1/ In cylindrical coordinate system, the potential is a function of (ϕ) and (z) only, if there is no charges in the region find the general solution of the potential function

Q2/ In dielectric material with $\epsilon_r = 3.6$; $D = 285 \text{ nC/m}^2$. Find the magnitude of E , P , and χ

Q3/ A distortionless line has $Z_0=60\Omega$, $\alpha = 20\text{mNp/m}$, $u=0.6C$, where C is the speed of light in vacuum. Find R , L , G , C , and λ at 100MHz .

Q4/ Given the electric field $\vec{E} = -5e^{-r/a}a_r$ in cylindrical coordinates, find the energy stored in the volume described by $r \leq 2a$, $0 \leq z \leq 5a$.

Q5/ In a lossless medium for which $\eta = 60\pi$, $\mu_r = 1$, and $H = -0.1 \cos(\omega t - z) a_x + 0.5 \sin(\omega t - z) a_y$ A/m, calculate ϵ_r , ω , and E .

Q6/ An electromagnetic wave in free space has wavelength 0.2 m , when the same wave enters a perfect dielectric, the wavelength changes to 0.09 m . Assume $(\mu_r=1)$, determine velocity of wave in the dielectric and ϵ_r .

Q7/ In good conductor material and in the case of free source of charge ($\rho_v=0$), use Maxwell equations to show that: $\nabla^2 \vec{E} = \gamma^2 \vec{E}$

Head of Department
Hassan M. Jaber Al-Ta'ii



Examiner
Dr. Amer B. Shaalan

Best of luck



((Final exam for the first semester))
2017 -2018

45

16. 10. 2018

Note: Ten marks for each question

Q 1 / Use Hamilton's principle to find the equations of motion of a particle of unit mass (m) moving on a plane in a conservative force field.

Q 2 / Obtain the Hamiltonian from the Lagrangian and show that it satisfies the Hamilton's canonical equations of motion.

Q 3 / A particle of mass (m) moving on a (xy) plane which is rotating about z -axis with angular velocity (w). The Lagrangian is given by:

$$L = \frac{1}{2} m [(\dot{x} - wy)^2 + (\dot{y} + wx)^2] - V(x, y)$$

Show that the Hamiltonian is given by:

$$H = \frac{1}{2m} (p_x^2 + p_y^2) + p_x wy - p_y wx + V$$

Also find the equations of motion.

Q 4 / Consider the motion of particle of mass (m) moving in space. Using the cylindrical coordinates as a generalized coordinates to calculate the generalized force components if a force \vec{F} acts on it.

Q 5 / Discuss the effect of Coriolis force on:

1. River flowing
2. Air flow
3. Free fall of body

on Earth's surface.

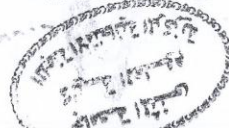
Q 6 / Deduce Kepler's second law (law of areal velocity) using polar coordinates.


Q 7 / Using Poisson's bracket to prove the following:

1. $[L_x, L_x] = L_z$
2. $[L_y, L_z] = L_x$
3. $[L_z, L_x] = L_y$


Lecturer
Dr. Jafer Fahdel

Best of luck




Head of Department
Dr. Hassan M. Al Ta'ii



21.10.2018

((Final exam for the first semester))
2017 -2018

45

Note: Ten marks for each question

Q 1 / Starting from Appleton-Lassen equation, discuss the wave propagating at the principal directions: $\theta = 0$, $\theta = \pi/2$ and $\theta = 70^\circ$. Then show the simplified versions of Clemmow-Mullaly-Allis (CMA) diagram to classify plasma waves.

Q 2 / Explain with detail the idea of (Stop Bands) in a homogenous cold plasma.

Q 3 / Using the kinetic theory to describe non-linear processes both Landau, damping and particle trapping in argon plasma as example.

Q 4 / derive a formula for AC conductivity of magnetized plasma (conductivity tensor).

Q 5 / Define all the following:

1. Local acceleration of a non-stationary flow
2. Plasma losses
3. Debye-Hückel sphere
4. Non-thermal plasma

Q 6 / What about atmospheric pressure discharge plasma? Explain this method to produce plasma with some details.

Q 7 / Compare between radio frequency discharge plasma and microwave discharge plasma.

Lecturer
Dr. Jafer Fahdel

Best of luck



Head of Department
Dr. Hassan M. Al Ta'ii

Ministry of Higher Education
& Scientific Research
Al Muthanna University
College of Science
Physics Department



Class / Ms. C
Subject / Advanced
Laser Physics
Time / 3 hour

45

The Final Examination for the
Second Semester 2017-2018

22. 10. 2018

Notice:- Answer all questions.

Q1/ Answer the following?

(20 Mark)

- What are the problems involved from the manufacturing the optical maser?
- Write the mathematical expression for the Einstein coefficient of stimulated emission?
- A resonator contains of two mirrors, set parallel to one another, name this resonator? what are the advantages and disadvantages of this resonator? Plot the diagram of this resonator?
- Draw: TEM_{21} , TEM_{13} , TEM_{04} ?
- What are the losses sources in the laser system?

Q2/ Calculate the transmission intensity ratio of a material with absorption coefficient of (0.5 cm^{-1}) .

(10 Mark)

Q3/ Prove (mathematically) that a population inversion for four levels results when any pump energy is supplied, where the inversion occurs only after a threshold pump rate is reached.

(10 Mark)

Q4/ An EO modulator has an intrinsic insertion loss of (5%). The crystal itself is (4 mm) long. A He-Ne laser beam is directed through it and a voltage is applied so that the index of refraction changes by (0.0001). Calculate the transmission of the modulator.

(10 Mark)


Q5/ Write out the mode distribution at the mirrors for the TEM_{00} , TEM_{01} , and TEM_{11} modes in terms of the transverse variables x , y , and $\rho = (x^2 + y^2)^{1/2}$.

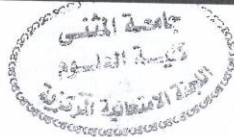
(10 Mark)


Q6/ An AO Q-switch is set up to modulate a He-Ne laser beam. RF energy at (28.0 MHz) is used to drive the switch, which is made of quartz. It is observed that at a distance of (2.36 m) from the screen, the bright dots in the pattern are (12 mm) apart. Calculate the speed of the acoustic wave in the quartz crystal?

(10 Mark)

Good Luck


Assist. Prof. Dr. Firas Faeq Kadhim
Lecturer




Dr. Hassan M. Jaber AL-Ta'ii
Head of Department



23.10.2018

((Assessment of the final exam for the 2nd semester))
Academic year 2017 -2018

45

Q1/ (10 marks)

- Derive Rutherford scattering formula. Calculate the suggested radius of ${}_{29}\text{Cu}^{58}$.
- Write the advantages and disadvantages of measuring nuclear size by electron scattering. Estimate the required scattering energy.

Q2/ (5 marks)

- Prove for even-even nuclei the charge density is: $\rho = 3Ze / 4\pi R^2 A$.
- Calculate the mass defect and packing factor for deuteron.

Q3/ Explain the following:(10 marks)

- Coulomb binding energy is always negative.
- Even-even nuclei are the most stable.
- Isobaric spin preferred to the charge of the nucleus.
- Deuteron wave function is a linear combination of S and D waves.

Q4/ (10 marks)

- Discuss through isobaric mass parabolas the stability and binary factor.
- Talk about the possibility of existence of deuteron bound state.

Q5/ (10 marks)

- Find an expression for length and cross section scattering for S wave scattering.
- Write the values of following deuteron states : E_B , T , J^{π} , S , l , P .

Q6/ (5 marks)

- Explain why gamma spectroscopy is indirect process.
- Why semiconductor detectors are more efficient than gas detectors..

Q7/ (10 marks)

- Discuss Breit frame, what are the three elastic factors of deuteron relate.
- Write the dependence of occurrence of different kinds of gamma interactions





((Assessment of the final exam for the 2nd semester)) 23. 10. 2018
Academic year 2017 -2018

45

Q8/ (10 marks)

- a- Show the relation between detector geometry and pulse shape.
c- Write a short note on the following:
1- Surface barrier detector.
2- Multichannel analysis for acquiring energy spectra.
3- In alpha spectroscopy the energy loss is proportional to electron density of scattering material.



Head of Department
Dr. Hassan M. Jaber Al-Ta'ii

Examiner
Dr. Qahtan A. Abdulqader

good luck



((Final exam for the second semester))
2017 -2018

45

- Q1. Take the Fermi energy of silver 5.52 eV.
(a) Find the corresponding velocity of conduction electron.
(b) If the resistivity of silver at room temperature is $1.62 \times 10^{-8} \Omega m$; estimate the average time between collisions.
(c) Determine the mean free path. Assume the number of conduction electrons as $5.86 \times 10^{28} m^{-3}$. (7 Mark)
- Q2. The density of states function for electrons in a metal is given by:
 $G(E)dE = 13.6 \times 10^{27} E^{1/2} dE$, calculate the Fermi level at a temperature few degrees above absolute zero for copper which has 8.5×10^{28} electrons per cubic metre. (7 Mark)
- Q3. The effective mass m^* of an electron or hole in a band is defined by
$$\frac{1}{m^*} = \frac{1}{\hbar^2} \frac{d^2 E}{dk^2}$$
where k is the wave number. For a free electron show that $m^* = m$. (7 Mark)
- Q4. After adding an impurity atom that donates an extra electron to the conduction band of silicon $\mu_n = 0.13 m^2 / Vs$, the conductivity of the doped silicon is measured as $1.08 (\Omega m)^{-1}$. Determine the doped ratio (density of silicon is $2.420 kg / m^3$).
- Q5. State the mass action law, and show that:
$$P_i = 2 \left(\frac{k_B T}{2\pi m} \right)^{3/2} (m_e m_h)^{3/4} \exp\{-E_g / 2k_B T\}$$
 (7 Mark)
- Q6. The Langevin function is defined as $L(x) = \coth(x) - \frac{1}{x}$; $x = \frac{\mu H}{k_B T}$, use the Maxwellian distribution to evaluate the induced magnetic moment of the molecules for a low field case. (7 Mark)
- Q7. Discuss phonon scattering processes. (7 marks)
- Q8. Write the steps of reduction of 36 elements of cubic crystal. (7 marks)
- Q9. Write the differences between classical and quantum free electron models. (7 marks)
- Q10. What are the main characteristics of Anharmonic effects. (7 marks)

Asst. Prof. Dr. Hadey K. Mohamad

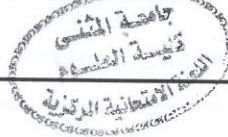
Dr. Eman Adnan

Head of Department



- Q1 / A) What are the basic advantages of 1) electro-expulsion 2) Laser ablation method to produce nanometallic powders? (6 Mark)
B) Describe basic principles of electrospinning and its applications in the production of nanofibers. (6 Mark)
- Q2 / A) Compare between photolithography and soft lithography. (6 Mark)
B) How can you obtain sputtering of insulating materials? (6 Mark)
- Q3 / A) Describe process to product a nanomaterial-based 1) Nanoimprint Lithography (NIL)
2) Ultrasonic Spray Pyrolysis. (6 Mark)
B) How does the electron microscopy different from optical microscopy? (6 Mark)
- Q4 / A) What are the main steps of Sol-Gel approach? (6 Mark)
B) What are the methods of stabilizing nanoparticles in aqueous solutions? (6 Mark)
- Q5 / A) Which all signals may generate upon interaction of electron beam with matter and how are they being utilized in the characterization of nanomaterials? (10 Mark)
- Q6 / A) What are the basic components of scanning electron microscope and their respective functions? (6 Mark)
B) What is the main advantage of scanning lithography over photolithography? (6 Mark)

Good Luck



Dr. Muwafaq F. Jaddoa

Dr. Hassan M. Jaber AL-Ta'ii
Head of Department

Ministry of Higher Education
& Scientific Research
Al Muthanna University
College of Science
Physics Department



Class /MSc
Subject /Research Methodology
Time / 3 hour
Date: - / /2018

The Final Examination for the Second
Academic Semester 2017-2018

45

09. 11. 2018

Notice:- Answer All the Question

Q1 / How to Conduct Background Research? (12 Mark)

Q2 / How to Prepare a Research Proposal, explain that through writing the Article (12 Mark)

Q3 / How to Report Your Findings, explain that through the oral presentation? (12 Mark)

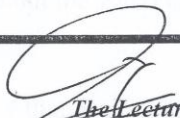
Q4 / How to Define Your Project When you're thinking about your research, ask yourself The five 'Ws': (10 Mark)

Q5 / Describe the different types of research, clearly pointing out the difference between an experiment and a survey. (12 Mark)


Q6 / How you writing the Article in one of these topics demonstrated step by step:-

1-Pasma physics. 2- Synthesis dye- solar cell. 3- Electro-chemical etching for SSNTD (12 Mark)

****Good Luck****


Dr.Hassan M. Jaber AL-Ta'ii




Dr.Hassan M. Jaber AL-Ta'ii
Head of Department