

وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education
& Scientific Research
Al-Muthanna University
Faculty of Science
Physics Department



Class / Third
Subject / Mathematical Physics I
Time / 3 hour
Date: - /01/2018

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The Final Examination for the First
Semester 2017-2018

23. 01. 2018

Q1 / If $f(z) = \frac{1+z}{1-z}$, by using the basic definition of derivative, prove that $f'(z_0) = \frac{2}{(1-z_0)^2}$
(8 Mark)

Q2 / Prove the following (*chose two only*) (12 Mark)

a) $\sin(z) = \sin(x)\cosh(y) + i\cos(x)\sinh(y)$

b) $\cos^{-1}(z) = -i\ln\left(z + \sqrt{z^2 - 1}\right)$

c) $|z_1 \cdot z_2| = |z_1| \cdot |z_2|$

Q3 / For cylindrical polar coordinates, prove that the unit vectors can be written by the following equations (8 Mark)

$$\hat{e}_\rho = \cos(\varphi)\hat{i} + \sin(\varphi)\hat{j}, \quad \hat{e}_\varphi = -\sin(\varphi)\hat{i} + \cos(\varphi)\hat{j}, \quad \hat{e}_z = \hat{k}$$

Q4 / If $\sin(\alpha + i\beta) = x + iy$, prove that (12 Mark)

a) $\frac{x^2}{\cosh^2(\beta)} + \frac{y^2}{\sinh^2(\beta)} = 1$

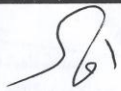
b) $\frac{x^2}{\sin^2(\alpha)} - \frac{y^2}{\cos^2(\alpha)} = 1$

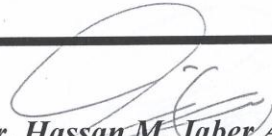
Q5 / Determine which of the following functions satisfies the Cauchy-Riemann conditions and have derivative, if the derivative is there find it. (20 Mark)

a) $w = z^2$

b) $w = \sin(z)$

Good Luck


Dr. Ahmed S. Jbara
Lecturer


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



21.01.2018

المادة: كواسف نوويه
التاريخ: / / 2018
الوقت: ثلاث ساعات
المرحلة: الثالثه

اسئلة الامتحانات النهائية / الفصل الاول / للعام الدراسي (2017 - 2018)

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- س1/ اكمل العبارات الآتية بما يناسبها موضحاً جوابك بالتفصيل:
- 1- يعرف اشعاع شيرنكوف على انه وهو ينبعث عندما
 - 2- يعبر عن اشعة كاما على انها وهي تنتج تبعاً لـ أو عندما
 - 3- يقصد بالحركة الانسيابية (drift motion) للالكترونات والايونات على انها حيث تحدد السرعة المتوسطة للحركة الانسيابية من العلاقة
 - 4- عادة ما يستخدم المسح الاشعاعي لتحديد واهم انواع الاجهزة المستخدمة لذلك ما يلي.....
 - 5- ان اهم مميزات كاشف الغرفة الفقاعية (The bubble chamber) ما يلي
 - 6- ان عدد الازواج الايونية المتكونة في غرفة مملوءة بالهواء عند الظروف المعيارية الاعتيادية يساوي الى وذلك عند سقوط بروتون طاقته تساوي (1MeV) عليها، وان الشحنة الناتجة عن هذا البروتون تساوي الى
 - 7- يعرف الكري (Gy) على انه وهو يعادل راد، أو رونتكن.

س2/ أ- اشرح ماذا تعني كواشف اشباه الموصلات؟ ولماذا يتميز هذا النوع من الكواشف بقدرة تحليله عالية؟ وما هي اهم مزايا وعيوب هذا النوع من الكواشف؟ (6 درجات)

ب- اذا كانت الجرعة القصوى الفعالة المسموح بها في الاسبوع تساوي (0.6 mSv)، ما هو الزمن الذي يسمح خلاله لشخص ما بالوجود داخل محطة للطاقة النووية خلال خمسة ايام، اذا كان معدل الجرعة الفعالة داخل هذه المحطة يساوي (100 μ Sv/ hr)؟ (7 درجات)

س3/ أ- اشرح ماذا يعني النشاط الاشعاعي (Radioactivity)، ثم وضع الاسباب التي تؤدي الى نشوء الاشعاع (Radioactive decay) (6 درجات)

- ب- في احد مختبرات الفيزياء النووية وضعت لجنة الوقاية الاشعاعية المعدلات التاليه للتعرض:
- 1- الالكترونات والميونات بواقع (0.2 Rad/ hr) ، ($W_R=1$)
 - 2- نيوترونات بطاقة (6 MeV) بواقع (0.8 Rad/ hr) ، ($W_R=5$)
 - 3- جسيمات الفا ونوى ثقيلة بواقع (0.06 Rad/ hr) ، ($W_R=20$)
- ما هي الجرعة المكافئة الكلية التي تتعرض لها انسجة باحث مكث في المختبر خمسة ايام؟ (7 درجات)

س4/ أ- ما هو كاشف غرفة التأين (Ionization chamber)؟ كيف يعمل ومم يتألف؟ اشرح ذلك وموضحا الغرض من استخدام هذا النوع من الكواشف؟ (7 درجات)

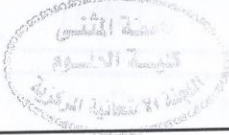
ب- اشعاع نووي معين ساقط على (1 Kgm) من الهواء الجاف في الظروف المعيارية الاعتيادية. ما هو مقدار الطاقة الكلية التي ينقلها (6 رونتكن) من هذا الاشعاع الى هذه الكمية من الهواء؟ (6 درجات)

مع امتناتي بالنجاح

استاذ المادة
أ.د. عبدالأمير كاظم الخفاجي



رئيس القسم
م.د. حسن مكخوف جبر



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

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Q1: -Prove that the concentration of holes in valance band in intrinsic semiconductor is given by . $P_0 = N_v \exp\left[\frac{-(\mu - E_v)}{k_B T}\right]$ (10 Marks)

Q2:- Assume that the Fermi energy level for a particular material is 6.25eV, and that the electrons in this material follow the Fermi-Dirac distribution function. Calculate the temperature at which there is a 1 percent probability that a state 0.30eV below the Fermi energy level will not contain an electron. (10 Marks)

Q3: Explain the origins of energy levels and energy band in solid material . (10 Marks)

Q4:- Calculate the intrinsic carrier concentration in gallium arsenide at T = 300 K and at T = 450 K, where values N_c and N_v at T = 300 K for gallium arsenide $4.7 \times 10^{17} \text{ cm}^{-3}$ and $7.0 \times 10^{18} \text{ cm}^{-3}$, respectively. Assume the band gap energy of gallium arsenide is 1.42eV and does not vary with temperature over this range. (10 Marks)

Q5:- Answer the following: (10 Marks)

- (a)- What are the difference between Metals, Insulators and Semiconductors.
(b)- Drive an equation to calculate the electric conductivity coefficient.

Q6: What happens if we introduce a group III element, such as boron, as a substitution impurity to silicon. (10 Marks)

Not:- $N_A = 6.02 \times 10^{23} \text{ atom/mol}$, $k_B = 1.3806 \times 10^{-23} \text{ J/K}$, $1\text{eV} = 1.602 \times 10^{-19} \text{ J}$

Lecturer
Salah.A. Hassan



Head of Department
Dr-Hassan Al-Taii

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



Class / Three
Subject / Geometrical
Optics
Time / 3 hour

45

The Final Examination for the
First Semester 2017-2018

19. 01. 2018

Notice: - Use diagrams to confirm your answers.

Q1 / Define the following terms (choose five only): (10 Mark)

- 1) Dispersion 2) Critical Angle 3) Optical Path 4) V-number 5) Diopter 6) Law of Reflection.

Q2 / A) Identify the cases by which a convex lens formed an image. (10 Mark)

- B) An object located at 25 cm far from a concave lens which has a focal length of 15 cm. Find the location and the properties of formed image? (5 Mark)

Q3 / A toy is located at 14cm far from a convex lens with a focal length of 10cm, then another convex lens with a 7cm focal length is located to the right of first lens with a distance of 40cm from it. What are the position, properties and magnification of final image? (10 Mark)

Q4 / Derive each of the following formulas: (15 Mark)

- 1) $XX' = f^2$
2) $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ (for concave mirror) 3) $\sin\theta_c = \frac{1}{n_1}$ (n_2 is air)

Q5 / A) A man look at a concave mirror with a focal length of 50cm. How far should be the mirror to get a 2 times magnify image of his face? (5 Mark)

- B) A prism has angles of $90^\circ-45^\circ-45^\circ$ and immersed in water ($n_w=1.33$). Find the refractive index of prism's matter if a ray reflected totally when fall perpendicular on one short face of prism? (5 Mark)

Good Luck

Dr. Muwafaq F. Jaddoa
Lecturer

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



Q1 / Define the following expressions: (choose four only) (12 Mark)
1- Cavity. 2- Unstable Resonator. 3- Normal Population. 4- Stimulated Emission.
5- Monochromaticity.

Q2 / Solve the following: (12 Mark)
A. Calculate the threshold gain coefficient for a laser cavity contains fully reflected mirror from one side and 97% reflected from the other side if the loss coefficient is equal to ().
B. Laser cavity of length (1.8m) contains of two equal concave mirrors with radius of curvature ($R=1.2m$). Find if this cavity stable or not?
C. Calculate the approximate number of longitudinal CO_2 laser modes ($\lambda=10.6 \mu m$) made by an optical cavity of (50 cm) length.

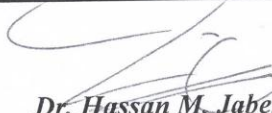
Q3 / Compare between the following: (choose two only) (12 Mark)
A. Stimulated and Spontaneous emissions.
B. Optical and Chemical pumping.
C. Confocal and Concentric resonators.

Q4 / Answer the following: (12 Mark)
A. Write the mathematical expression for the Einstein coefficient of spontaneous emission?
B. According to Boltzmann distribution equation, describe the relation between temperature and the population number?
C. A resonator contains of two spherical mirrors having same radius (R) and the foci are coincident, name this resonator? What are the advantages and disadvantages of this resonator? Plot the diagram of this resonator?

Q5 / Give the reasons for the following: (choose three only) (12 Mark)
A. Maser cannot give the same properties like Laser?
B. Violet light carries more energy than red light?
C. The spot of laser light is very small at short distances?
D. Although the power of condensed lamp is higher than the laser radiation, the laser is more dangerous than the condensed lamp?

Good luck


Dr. Firas Faeq Kadhim
Lecturer


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



Q1 / A. If $\psi(x) = \frac{N}{x^2 + a^2}$, calculate the normalization constant N .

B. An operator \hat{A} is defined as $\hat{A} = \alpha\hat{x} + i\beta\hat{p}$, where α and β are real numbers, calculate the commutators $[\hat{A}, \hat{A}]$, $[\hat{A}, \hat{x}]$ and $[\hat{A}, \hat{p}]$.

(12 Mark)

Q2 / Show that (a) for any two operators A and B : $[A^2, B] = A[A, B] + [A, B]A$
(b) the momentum operator is Hermitian.

(12 Mark)

Q3 / A particle of mass m moves in a 2-D potential box, $V(x, y) = 0$ for $0 < x < a$, and $0 < y < a$, with walls at $x = 0, a$ and $y = 0, a$, respectively. Obtain the eigen wavefunctions and energy eigenvalues.

(12 Mark)

Q4 / Consider a stream of particles with energy E travelling in one dimension from $x = -\infty$ to ∞ . The particles have an average spacing of distance L . The particle stream encounters a potential barrier at $x = 0$. The potential can be written as

1. $V(x) = 0$, if $x < 0$
2. $V(x) = V_b$, if $0 < x < a$; a is the width of potential barrier.
3. $V(x) = 0$, if $x > a$

Suppose $E < V_b$,

(a) For each of the three regions, write down Schrödinger equation and calculate the wave function ψ and its derivatives $\frac{d\psi}{dx}$.

(b) At the boundaries, ψ and $\frac{d\psi}{dx}$, must be continuous. Equate the solutions that have you at $x = 0$ and $x = a$, and manipulate these equations to derive the transmission coefficient T . Assume that $A_1 = 1$.

(12Mark)



Q5 / (a) The one-dimensional time-independent Schrödinger equation is

$$\left(-\frac{\hbar^2}{2m}\right)\frac{d^2\psi}{dx^2} + V(x)\psi(x) = E\psi(x)$$

Give the meanings of the symbols in this equation.

(b) A particle of mass m is contained in a one-dimensional box of width L . The potential energy is infinite at the walls of the box ($x=0$ and $x=L$), and zero in between ($0 < x < L$). Solve the Schrödinger equation

for this particle and hence show that the normalized solutions have the form $\psi_n(x) = \left(\frac{2}{L}\right)^{1/2} \sin\left(\frac{n\pi x}{L}\right)$, where n is an integer ($n > 0$).

(c) For the case $n=3$, find the probability that the particle will be located in the region $\frac{L}{3} < x < \frac{2L}{3}$.

(12Mark)

Best of Luck



Examiner: Dr. Hadey K. Mohamad

Dr. Hassan W. Jabbar Al-Ta'ii
Head of Department



Q1 / A. If $\psi(x) = \frac{N}{x^2 + a^2}$, calculate the normalization constant N .

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(12Mark)

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



Class / Third
Subject / Quantum
Mechanics
Time / 3 hours
Date: - /01/2018
13. 01. 2018

The Final Examination for the
First Semester 2017-2018

45

Q5 / (a) The one-dimensional time-independent Schrödinger equation is

$$\left(-\frac{\hbar^2}{2m}\right)\frac{d^2\psi}{dx^2} + V(x)\psi(x) = E\psi(x)$$

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where n is an integer ($n > 0$).

(c) For the case $n=3$, find the probability that the particle will be located in the region $\frac{L}{3} < x < \frac{2L}{3}$.

(12Mark)

Best of Luck



Examiner: Dr. Hadey K. Mohamad

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

المرحلة/الثالثة
المادة/حزمة برنامج ماتلاب
الزمن/ 3 ساعات
التاريخ / / 2018



وزارة التعليم العالي والبحث العلمي
جامعة المثنى
كلية العلوم
قسم الفيزياء

15.01.2018

اسئلة الامتحانات النهائية الكورس الاول
للعام الدراسي 2017-2018

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ملاحظه / الإجابة عن جميع الأسئلة ولكل سؤال (10) درجات

س(1) عرف المصفوفة . وماهي شروط إنشاء المصفوفة في برنامج ماتلاب.

س(2) وضح استخدام كل من الدوال التالية : (لخمس فقط)

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س(3) املأ الفراغات التالية بما يناسبها :

1- المتغيرات هي ----- وانواعها ----- و----- و-----.

2- لغرض تكرار جملة معينه اكثر من مره نستخدم ايعاز ----- ويعمل هذا اليعاز عمل ايعاز -----.

3- من ايعازات الاستثناء هي ----- و-----.

4- يستخدم ايعاز $\text{text}(x,y,\text{text})$ ل-----.

5- يمكن استخدام ايعاز ----- لتوليد قائمه بالأعداد الأولية .

س(4) أ) ارسم دالة $y = \log(x)$ للفترة $[0,0.01,5]$ بين في الرسم كل من

1- أضف عنوان الى الرسم 2- اجعل الرسم بيانياً .

ب) ماهي ايعازات التحكم بالعمليات الخاطئة ضمن نطاق هيكلية برنامج ماتلاب .

حسن مكتوف جبر الطائي
رئيس قسم الفيزياء



نداء حسن حاجي
أسم التدريسي: م.م. نداء حسن حاجي
مدرسة المادة