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

45

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

The Final Examination for the First
Semester 2017-2018

23. 01. 2018

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

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

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

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

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

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

التعليم العالي والبحث العلمي
جامعة المثنى
كلية العلوم
قسم الفيزياء

بسمه تعالى

21. 01. 2018

المادة: كواشف نوويه
التاريخ: / /2018
الوقت: ثلاث ساعات
المرحله : الثالثه

44

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

س1/ اكمل العبارات الآتية بما يناسبها موضحاً جوابك بالتفصيل: (21 درجة)

1- يعرف اشعاع شيرنكوف على انه ..... وهو ينبعث عندما ..... .
2- يعبر عن اشعة كاما على انها ..... وهي تنتج تبعا لـ ..... أو عندما ..... .
3- يقصد بالحركة الانسياقية (drift motion) للالكترونات والايونات على انها .... حيث تحدد السرعة المتوسطة للحركة الانسياقية 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 المعياريه الاعتياديه 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 المحطه يساوي (100 μSv/ hr)؟ (7درجات)

س3/ أ- اشرح ماذا يعني النشاط الاشعاعي (Radioactivity)، ثم وضح 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 الكميه من الهواء؟ (6 درجات)

مع امنياتي بالنجاح

استاذ المادة
أ.د. عبدالأمير كاظم الخفاجي

رئيس القسم
م.د. حسن مكطوف جبر

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

Subject: Semiconductor
Stage: Third

Date: / /2018 21. 01. 2018
Time : 3 hours

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

45

Q1: -Prove that the concentration of holes in valance band in intrinsic semiconductor is given by . $P_0 = N_v \exp[\frac{-(\mu - E_v)}{k_B T}]$ (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 $4.7\times10^{17}\,cm^{-3}$ and $7.0\times10^{18}\,cm^{-3}$,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:- $N_A = 6.02\times10^{23}\,atom/mol$, $k_B = 1.3806\times10^{-23}\,J/K$, $1eV = 1.602\times10^{-19}\,J$

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

45

The Final Examination for the
First Semester 2017-2018

Class / Three
Subject / Geometrical Optics
Time / 3 hour

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. Fined 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 90^0-45^0-45^0 and immersed in water (n_w=1.33). Fined 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

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

45

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

The Final Examination for the First Semester 2017-2018

17. 01. 2018

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 (λ=10.6 μm) 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

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

45

The Final Examination for the
First Semester 2017-2018

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

13. 01. 2018

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)

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

45

The Final Examination for the
First Semester 2017-2018

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

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 M. Jaber Al-Ta'ii
Head of Department

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

45

The Final Examination for the
First Semester 2017-2018

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

13. 01. 2018

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)

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

45

The Final Examination for the
First Semester 2017-2018

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

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 M. Jaber Al-Ta'ii
Head of Department

وزارة التعليم العالي والبحث العلمي
جامعة المثنى
كلية العلوم
قسم الفيزياء

15. 01. 2018

اسئلة الامتحانات النهائية الكورس الاول
للعام الدرلسي 2017-2018

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

44

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

س1) عرف المصفوفة . وماهي شروط أنشاء المصفوفة في برنامج ماتلاب.

س2) وضح استخدام كل من الدوال التالية :(لخمس فقط)

Prod(1 Min (2 grid off (3 break(4 try (5 Linewidth (6 .

س3) املأ الفراغات التالية بما يناسبها :

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

2- لغرض تكرار جمله معينه اكثر من مره نستخدم ايعاز-------- ويعمل هذا الايعاز عمل ايعاز --------- .

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

4- يستخدم ايعاز text(x,y,text) لـ ----------.

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

س4) أ) ارسم دالة $y = \log(x)$ للفترة [0,0.01,5] بين في الرسم كل من

1- أضف عنوان الى الرسم 2- اجعل الرسم بيانيا" .

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

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

نداء حسن حاجي

جامعة المثنى
كلية العلوم
اللجنة الامتحانية المركزية

د. حسن مكطوف جبر الطائي
رئيس قسم الفيزياء