8. State the sequential stages of radiation action?

9. What is the difference between external and internal radiation exposures?

6. In a radioactive transformation, the parent element has a half-life T_P, which is very much greater than the half-life T_D of the daughter element. Find out the time required, in terms of T_D, to have transient equilibrium between the parent and daughter, and calculate it within 75%.

7. Find the stopping power of water for protons with energy 50 MeV. Knowing that the volume of water is 9 m^3.

   ($m_p = 1.672648 \times 10^{-27}$ kg; $k_e = 8.987 \times 10^9$ N·m^2/C^2; $e = 1.6 \times 10^{-19}$ C; $N_A = 6.022 \times 10^{23}$ mol^{-1})

3. The half-life of strontium-90 is 28 years. How long will it take a 60-mg sample to decay to a mass of 33.6 mg?

4. Find out the time required, to have equilibrium between the parent and daughter.

5. In an archaeological expedition, charcoal from an ancient fire-pit was excavated. This sample showed a ^{14}C activity of 11.3 counts per gm per min. The absolute activity of ^{14}C is 15.3 counts per gm per min. Estimate the age of the charcoal sample.

2. Answer the following questions: (30 degrees)

1. Carbon-14 has a half-life of 5730 years; estimate the age of a fossil which contains 12.5% of the carbon-14 content of living tissue

2. Photons passing through matter transfer their energy through three main processes, explain each process?

V9

5. Characteristic x-ray photons produced during the photoelectric effect can contribute to increasing patient dose.
   A. True
   B. false

6. The energy losses by an electron moving through a medium with density ρ are described by the total mass energy
   A. Stopping power
   B. Specific ionization
   C. The range

7. An 80 milligram sample of a radioactive isotope decays to 5 milligram in 32 days. What is the half-life of this element?
   A. 8 days.
   B. 2 days.
   C. 16 days.
   D. 4 days.

8. An original sample of a radioisotope has a mass of 10 grams. After 2 days, 5 grams of the radioisotope remains unchanged. What is the half-life of this radioisotope?
   A. 1 day
   B. 2 days
   C. 5 days
   D. 4 days

9. The number of ion pairs produced per unit track length is
   A. Specific ionization
   B. Stopping power
   C. The range

10. Radium-221 has a half-life of 30 sec. How long will it take for 95% of a sample to decay?
   A. 60 sec.
   B. 2.16 min.
   C. 3.285 min.
   D. 180 sec.

Assiut University
Faculty of science – Physics department

Exam time	3 hours	Course	Radiation physics P444
degree	50	Exam	Final term

1. Choose the correct answer (20 degrees)

1. What are isotopes?
   A. Atoms of the same element with different numbers of electrons
   B. Atoms of the same element with different numbers of protons
   C. Atoms of the same element with different numbers of neutrons

2. A radioactive element has a half-life of 2 days. Which fraction represents the amount of an original sample of this element remaining after 6 days?
   A. 1/8
   B. 1/2
   C. 1/3
   D. 1/4

3. What form of radioactive decay is shown in the following reaction?
   $^{4}_{2}He + {}^{11}_{5}B \rightarrow {}^{15}_{7}N + \cdots$
   A. Beta negative.
   B. Beta positive.
   C. Alpha decay.
   D. Gamma decay

4. As the temperature of a sample of a radioactive element decreases, the half- life of the element will.
   A. Decrease.
   B. Increase.
   C. Remain the same.

السؤال السادس

أجب عن من الفقرات التالية – بوضع علامة صح (٧) أو خطأ (X) بين القوسين أمام كل فقرة مع ملاحظة أن أى شطب أو تغيير يلغى الدرجة

١-تعتبر أشعة الليزر موجات كهرومغناطيسية طولية ( ) ( ).

٢-وضع اينشتاين معادلة مشهورة لطاقة الفوتون الضوئي هي ثابت بلانك مقسوما علي تردد الفوتون. ( ) ( ).

٣-يتم توليد أشعة الليزر في الانابيب الزجاجية المفتوحة الطرفين ( ) ( ).

٤-يعتبر ثابت بلانك من الثوابت الهامة بالفيزياء وحدة قياسه المتر لكل سم ( ) ( ).

٥-تتعين سرعة الضوء في الوسط المادي من علاقة ماكسويل المشهورة $c = \sqrt{\frac{1}{\mu\varepsilon}}$ (μ,ε ثابتي السماحية الكهربية والنفاذية المغناطيسية للوسط المادي, علي الترتيب). ( ) ( ).

٦-الليزرات ذات الاربعة مستويات طاقة لها قلب تعداد بطيئ عن غيره. ( ) ( ).

٧-تبدأ فكرة عمل الليزر عندما تكون هناك حالة من الاتزان الحراري للنظام. ( ) ( ).

٨-اذا كان تردد الانتقالات في المنطقة المايكروية فيسمي المضخم ميزر. ( ) ( ).

٩-التوازن الحراري عدد الفوتونات الممتصة تساوي تلك من الانبعاث التلقائي فقط ( ) ( ).

١٠- لا يحدث شعاع الليزر بين مستويي الطاقة الاكثر استقرارا في الليزر الرباعي. ( ) ( ).

انتهت الأسئلة مع أطيب التمنيات بالتوفيق

أ.د/ رضا الكريمى

جامعة أسيوط
كلية العلوم - قسم الفيزياء

إمتحان دور مايو ٢٠٢٥
مقرر فيزياء الليزر وتطبيقاته ٤٧٢ ف

الزمن : ثلاث ساعات
التاريخ: ٢٠٢٥/٥/٢٥م

الإمتحان فى صفحتين

أجب عن الأسئلة الآتية

السؤال الأول:

عرف المصطلحات الليزرية التالية

(الاتزان الحراري – انقلاب التعداد – المادة الفعالة)

السؤال الثاني

تكلم مع التوضيح بالرسم عن الستويات الطاقية لليزرات التي تم دراستها بالمقرر .

السؤال الثالث

أ- عرف المصطلحات الليزرية التالية :-

(انعدام الاتزان الحراري – الضخ الليزري – المستوي الأكثر استقراراً)

ب- أكتب مع التوضيح بالرسم أحد الليزرات الصلبة التي تم دراستها بالمقرر.

السؤال الرابع

تكلم عن تفاعل الموجات الكهرومغناطيسية مع المادة مع التوضيح بالرسم .

السؤال الخامس

تكلم عن ما يأتي :-

١ – مميزات أشعة الليزر.

٢ – خصائص أشعة الليزر.

٣ – بعض فوائد أشعة الليزر الهامة

أنظر خلفه

v. From the vibration spectra of NO molecule it is found that the fundamental line at 1876.06 cm^{-1} and the first overtone at 3724.2 cm^{-1}. Calculate

A. the oscillation frequency w_e

B. the anharmonicity constant χ_e. (6 marks)

Electron chaege e	1.6×10^{-19} C		Plank's constant h	6.626×10^{-34} Joul.sec
Electron mass m_e	9.1×10^{-31} kg		Light velocity c	3×10^{8} m.sec^{-1}
Proton mass m_p	1.672×10^{-27} kg		Coulomb constant k	9×10^{9} J.m.C^{-2}
Bohr radius a_o	0.529×10^{-10} m		Rydberg constant R	1.097×10^{7} m^{-1}
Bohr magneton μ_B	9.274×10^{-24} J.T^{-1}		Ionization energy of the hydrogen atom E_o	13.6 eV
mass of Nitrogen atom	2.32×10^{-26} kg		mass of an oxygen atom	2.6567×10^{-26} kg

WITH MY BEST WISHES

Dr. Azza M. Hassan

iv. Describe the differences between two types of symmetric top molecule and then write the energy level equation, selection rules and its spectra. (5marks)

ii. Describe diatomic molecule as a rigid- rotator and explain rotational energy level, wavenumber, selection rules, spectra and the information obtained from spectra. (5 marks)

iii. Describe Bohr's assumptions for atomic model and write down the success of Bohr's model. (6 marks)

13. In rotational -vibrational spectrum the frequency of R- branch lines is .... the fundamental frequency.
    a. smaller than
    b. equal to
    c. higher than
    d. both a & b

14. What is the cause of the R branch lines moving closer together as energy increase in a real spectrum of molecule?
    a. Rotational -vibrational coupling
    b. Independent Rotation and vibration
    c. Rigid rotor only
    d. Harmonic oscillation only

15. For P branch ΔJ should be ....
    a. $\Delta J = 0$
    b. $\Delta J = -1$
    c. $\Delta J = +1$
    d. $\Delta J = \pm 2$

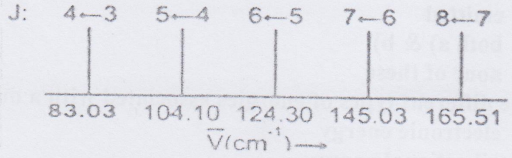
16. The energy separation in the normal Zeeman effect is
    a. $\Delta E = m_l \mu B B$
    b. $\Delta E = g m_j \mu B B$
    c. $\Delta E = g m_s \mu B B$
    d. $\Delta E = (2m_s + m_l)\ \mu B B$

Question (2): (26 marks)

Answer the following:

i. Stern–Gerlach experiment clearly showed evidence for space quantization and demonstrated the existence of a spin magnetic moment for the electron, discuss that. (4 marks)

6. The region of electromagnetic spectrum for rotational spectra is...
   a. Uv-visible region
   b. x-ray
   c. microwave
   d. visible light
7. The number of normal Zeeman splitting components of $P \rightarrow D$ transition is
   a. 3
   b. 4
   c. 8
   d. 9
8. The rotational (microwave) spectrum of a rigid diatomic rotor consists of equallyspaced lines with spacing equal to:
   a. $\bar{B}$
   b. $2\bar{B}$
   c. $3\bar{B}/2$
   d. $\bar{B}/2$
9. The rotational absorption spectrum of HCl shows the following lines
   Neglecting the centrifugal distortion, Calculate the value of rotational constant $\bar{B}$ in cm^{-1}



   a) 3
   b) 5
   c) 10
   d) 20

10. If $n = 5$, which one of the following is not an allowed orbital quantum number l
   a. 5
   b. 2
   c. 4
   d. 0
11. In a rotational spectrum, transitions are only observed between rotational levels of ΔJ =...
   a. ± 1
   b. ± 2
   c. 5
   d. ± 3
12. The expression for the second overtone frequency in the vibrational absorption spectra of a diatomic molecule in terms of the harmonic frequency w_e and anharmonicity constant χ_e is
   a. $2w_e(1 - \chi_e)$
   b. $2w_e(1 - 3\chi_e)$
   c. $3w_e(1 - 2\chi_e)$
   d. $3w_e(1 - 4\chi_e)$

Assiut University
Faculty of Science
Department of Physics
Second semester 2025

Course: *Atomic and Molecular Spectroscopy*
Code: P432
Time: 3 Hour
Final Exam (50%)

Q1 (24)	Q2 (26)	Total (50)

Answer the following questions

Question (1): (1.5 mark for each one, 24 Marks)

Choose the correct answer

1. When electrons move from the higher energy level to a lower energy level, energy is
   a. absorbed
   b. emitted
   c. both a) & b)
   d. none of these
2. The different types of energies associated with a molecule are …
   a. electronic energy
   b. vibrational energy
   c. rotational energy
   d. all the mentioned

2- The correct order of different types of molecular energies is

a. $E_{rot.} > E_{vib.} > E_{elect.}$
b. $E_{vib.} > E_{rot.} > E_{elect.}$
c. $E_{elect.} > E_{rot.} > E_{vib.}$
d. $E_{elect.} > E_{vib.} > E_{rot.}$

3-The splitting of spectral lines because of in the presence of electric field is known as
   a. Zeeman effect
   b. Paschen back effect
   c. Stark effect
   d. Doppler effect

4. Which one of the following exhibits rotation spectra:
   a. CO
   b. N_2
   c. CO_2
   d. H_2

5. According to Bohr model, the orbital angular momentum of electron in the orbit n=2 is…

a) $2\pi h$ b) $\frac{h}{2}$ c) $\frac{h}{2\pi}$ d) $\frac{h}{\pi}$

3. Sketch the energy band diagram for such a $p-n$ junction in thermal equilibrium, reverse bias. Indicate the following: Band gap (E_g), Fermi level (E_F), and Contact potential (V_0).

4. Explain the different types of optical absorption transitions in semiconductors and their physical mechanisms.

Best wishes,

14. Design a *pn* junction to meet maximum electric field and voltage specifications. Consider a silicon pn junction at T = 300 K with a *p*-type doping concentration of $N_a = 2\times10^{17}\ cm^{-3}$. Determine the *n*-type doping concentration such that the maximum electric field is $|E_{max}| = 2.5\times10^5$ V/cm at a reverse-biased voltage of $V_R = 25$ V.

Question IV: **(10 Marks)**

1. In a semiconductor, why do electrons and holes have different effective masses? How does this affect mobility?

2. What is the Tauc equation, and how is it used to determine the optical band gap of semiconductors?

11. Describe briefly the carrier concentration versus temperature characteristics, including freeze-out, extrinsic, and intrinsic regions.

12. Consider a silicon *pn* junction at T = 300 K with doping concentrations of $N_a = 2\times10^{17}\ cm^{-3}$ and $N_d = 10^{15}\ cm^{-3}$. Calculate the built-in potential barrier in a *pn* junction.

13. A silicon *pn* junction at T = 300 K with zero applied bias has doping concentrations of $N_d = 5\times10^{16}\ cm^{-3}$ and $N_a = 5\times10^{15}\ cm^{-3}$. Determine the space charge region that extends into the *n* regions (x_n), extends into the *p* regions (x_p), and the total depletion or space charge width (W), and the peak electric field $|E_{max}|$. [Hint: $\varepsilon_0 = 8.854\times10^{-14}$ F/cm & dielectric constant for Si $(k_{Si}) = 11.7$]

6. In a silicon sample at T = 300 K, the Fermi level is located at 0.26 eV above the intrinsic Fermi level. What are the hole and electron concentrations? [Hint: $N_c = 2.8 \times 10^{19}$ cm^{-3}, $k_B = 1.38 \times 10^{-23}$ J.K^{-1}, $e = 1.6 \times 10^{-19}$ C, $n_i = 10^{10}$ cm^{-3}].

7. Given $\mu_p = 470$ cm^2/V·s (hole mobility) for Si, what is the hole drift velocity (v) at $\varepsilon = 10^3$ V/cm? What is τ_{mp} and what is the mean free path? [Hint: $v_{th} = 10^7$ cm/s]

8. Calculate the density of intrinsic carriers for Silicon at 27 °C, where $B = 7.3 \times 10^{15}$ K$^{-3/2}$ cm^{-3} for Si and E_g for Si = 1.12 eV, $k_B = 8.62 \times 10^{-5}$ eV/K.

9. What is the number of atoms in a cubic meter of Ge? ($A_{Ge} = 72.63$ g/mol, $\rho_{Ge} = 5.323$ g/cm^3, $N_A = 6.022 \times 10^{23}$ atoms/mol)

10. An n-type sample of silicon has uniform density ($N_d = 10^{19}$/cm^{-3}) of arsenic. Determine the temperature at which the intrinsic concentration n_i exceeds the impurity density by a factor of 10.

2. An indium phosphide (InP) sample is illuminated with light of wavelength 600 nm. The reflectivity is 28%, and the absorption coefficient (α) is 4.5×10^5 m^{-1}. If the thickness of the sample is 15 μm, determine its transmission and optical density.

3. If a solar cell material must absorb sunlight up to 1100 nm, what is the minimum band gap in eV it should have? [Hint: h =6.63×10^{-34} J.s, c= 3×10^8 m/s].

4. The complex refractive index of Ge at 400 nm is given by $\tilde{n} = 4.141+i\,2.215$. Calculate for Ge at 400 nm: **(a)** the phase velocity of light, **(b)** the absorption coefficient, and **(c)** the reflectivity.

5. Estimate the thermal velocity, v_{th}, of electrons and holes in silicon at 350 K. [Hint: m_0 =9.11×10^{-31}kg, for Si: $m_e^* \sim 0.26\, m_0$ & $m_h^* \sim 0.39\, m_0$]

10. **Both donor and acceptor impurities are present in the combination of:**
    a. Phosphorus–arsenic
    b. Aluminum–antimony
    c. Boron–gallium
    d. Arsenic–antimony
11. **The barrier potential of a *p-n* junction does not depend on:**
    a. Temperature
    b. Forward bias
    c. Reverse bias
    d. Diode design
12. **The part of the depletion layer in the *n*-type contains:**
    a. Holes
    b. Positive ions
    c. Negative ions
    d. Free electrons
13. **In an intrinsic semiconductor at thermal equilibrium, the number of electrons (n) and holes (p) are related as:**
    a. $n > p$
    b. $n < p$
    c. $n = p = 0$
    d. $n = p = n_i$
14. **Recombination in semiconductors is most likely to occur when:**
    a. An electron meets a hole
    b. A hole meets another hole
    c. An electron enters the nucleus
    d. The semiconductor is cooled to 0 K
15. **What is the hole diffusion constant in a piece of silicon with μ_p = 410 cm²/V.s at 300 K?**
    a. 1.3 cm²/s
    b. 5.2 cm²/s
    c. 10.6 cm²/s
    d. 16.8 cm²/s
16. **What happens when electrons and holes recombine in a direct bandgap semiconductor like GaAs?**
    a. Only heat is released
    b. No energy is released
    c. Light is emitted
    d. Both heat and light are emitted
17. **In indirect semiconductors like Si, what is the primary form of energy released during electron-hole recombination?**
    a. Phonons
    b. Photons
    c. Radio waves
    d. X-rays
18. **Which of the following is NOT a primary cause of charge carrier scattering in semiconductors?**
    a. Phonon scattering
    b. Ionized-impurity scattering
    c. Lattice vibrations
    d. Photon absorption

Question III: Answer the following problems: **(21 Marks)**

1. The electron concentration in a piece of Si at 300 K is 10^5 cm^{-3}. What is the hole concentration? (n_i =1.5×10^{10} cm^{-3})

.....
.....
.....
.....

18. Semiconductors containing many holes and few electrons are called p-type semiconductors ( ).

19. Semiconductors have small but nonzero bandgaps, typically between 0.1 eV and 3 eV ( ).

20. Doping a semiconductor shifts the position of the valence and conduction bands relative to each other ( ).

Question II: Choose the correct answer to the following: **(9 Marks)**

1. **GaAs is an example of a:**
   a. Elemental semiconductor
   b. Organic semiconductor
   c. Magnetic semiconductor
   d. III-V compound semiconductor
2. **The two types of charge carriers in semiconductors are:**
   a. Electrons and positrons
   b. Protons and neutrons
   c. Electrons and holes
   d. Ions and phonons
3. **At 0 K, each silicon atom in a crystal is bonded to how many nearest neighbors?**
   a. 2
   b. 6
   c. 4
   d. 8
4. **The direction [100] is perpendicular to:**
   a. (011)
   b. (010)
   c. (100)
   d. (001)
5. **In intrinsic (or pure) Si at room temperature, some electrons move to the conduction band, leaving behind:**
   a. Positrons
   b. Broken ionic bonds with no effect
   c. Holes in the valence band
   d. Negative ions
6. **The thermal energy at 250 K equals:**
   a. 26 meV
   b. 17.25 meV
   c. 10.3 eV
   d. 21.6 meV
7. **According to classical free electron theory, the electrons follow ..... distribution of energy:**
   a. Binomial
   b. Maxwell-Boltzmann
   c. Fermi-Dirac
   d. Bose-Einstein
8. **At low temperature, the resistivity of a metal is proportional to:**
   a. T
   b. T^2
   c. T^5
   d. $\sqrt{T}$
9. **The value of the Fermi Function at T > 0 K for $E = E_F$ is:**
   a. 0
   b. 0.5
   c. 0.75
   d. 1

Assiut University **Faculty of Science** **Physics Department**		**Final:** Second term 2025 **Date**: May 19th, 2025 **Allowed time:** 3 hours.

Course name: Physics of Semiconductors and Thin Solid and its Applications **Course code**: P451
Coordinator: Prof. Alaa Abd-Elnaiem **Grade:** 50 Marks

Answer all the following questions

Question I: Put (✓) for the correct sentences and (✗) for the incorrect sentences for the following: **(10 Marks)**

1. The Bohr model accurately describes the electronic band structure of silicon ( ).
2. Energy bands in solids are discrete like in isolated atoms ( ).
3. Every silicon (Si) atom has two other silicon atoms as its nearest neighbor atoms ( ).
4. Semiconductors containing many mobile electrons and few holes are called *n*-type semiconductors ( ).
5. A Si atom is connected to each neighbor with four dots representing the two shared electrons in the covalent bond ( ).
6. In semiconductors, current conduction by holes is as important as electron conduction in general ( ).
7. In the energy band model, the top nearly filled band is called the valence band, and the lowest nearly empty band is called the conduction band ( ).
8. A much larger number of conduction electrons can be introduced in pure Si and Ge if desired by introducing suitable impurity atoms ( ).
9. The crystal structure for Si and Ge crystals is known as the diamond structure ( ).
10. The equilibrium condition is the greatest energy configuration in the presence of thermal agitation ( ).
11. There are no free electrons to conduct an electric current in pure Si at 0 K ( ).
12. According to Beer's Law, light intensity decreases linearly with distance in an absorbing medium ( ).
13. Elements from groups V and VI of the periodic table, such as phosphorus (P), sulfur (S), selenium (Se), and tellurium (Te), can exhibit semiconducting properties ( ).
14. The gap between the conduction band and the valence band is called the band gap ( ).
15. All chalcogenide elements (S, Se, Te) are metals with zero bandgap ( ).
16. In reverse bias, after breakdown occurs, a small change in the bias voltage can cause a large change in current ( ).
17. Optical density (O.D.) is related to the absorption coefficient (α) by the equation $O.D. = \frac{\alpha l}{log_e(10)}$, where *l* is the length of the medium ( ).

QUESTION 3: [10 POINTS]

For the oscillator circuit shown in Figure (1)

a) State type of the oscillator **[2 points]**

b) Determine the required value of R_f necessary for the circuit to operate as an oscillator. **[4 points].**

c) Determine the frequency of oscillation **[4 points].**

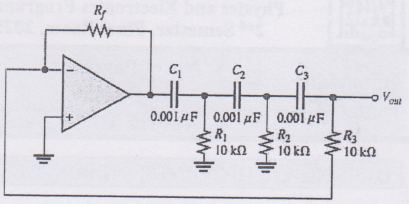


Figure (1)

QUESTION 4: [15 POINTS]

For the amplifier circuit shown in Figure (2), determine

a) Critical frequencies associated with the low-frequency response **[3 Points]**

b) Dominant critical low frequency **[3 Points]**.

c) Critical frequencies associated with the high-frequency response **[3 Points]**.

d) Dominant critical high frequency **[3 Points].**

e) The bandwidth of the amplifier **[3 Points].**

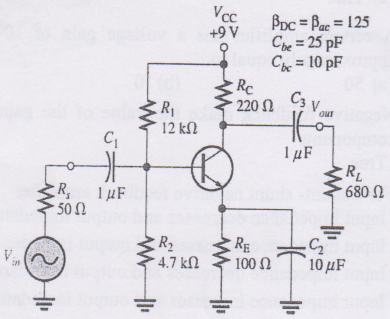
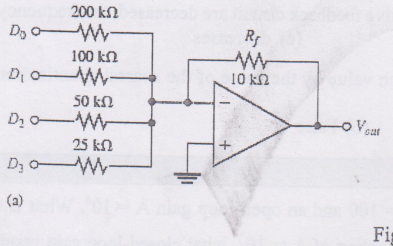


Figure (2)

QUESTION 5: [10 POINTS]

Determine the output voltage and **Draw** the binary input with output waveform of the digital to analog converter shown in Figure (3-(a)). The sequence of four digit binary codes represented by the waveforms shown in Figure (3-(b)) are applied to the inputs.

Hint: A high level (+5V) is a binary 1, and a low level (0V) is a binary 0. The least significant binary digit is *D*0.



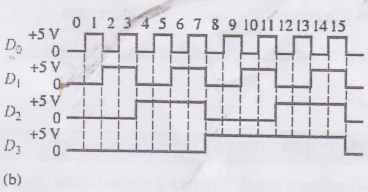


Figure (3)

********** End, Best Wishes **********

Assiut University, Faculty of Science
Physics Department
Physics and Electronics Program
2nd Semester, Final Exam, 2025

Course: Electronic Circuits (2)
Course Code: EE422
Time: 3 Hours, Marks: 50

Important remarks

- No. of Pages: 2
- No of Questions : 5
- Answer All the Questions

QUESTION 1: [10 POINTS] – [1 POINT EACH]

Choose the correct answer:

1. Coupling capacitors in an amplifier determine the low-frequency response
   (a) True (b) False

2. A certain amplifier has a voltage gain of 100 at midrange. If the gain decreases by 6 dB, it is approximately equal to
   (a) 50 (b) 0 (c) 70.7 (d) 20

3. Negative feedback make the value of the gain more sensitive to variations in the values of circuit components
   (a) True (b) False

4. For a shunt- shunt negative feedback amplifier
   (a) Input impedance decreases and output impedance increases.
   (b) Input impedance increases and output impedance increases.
   (c) Input impedance decreases and output impedance decreases.
   (d) Input impedance increases and output impedance decreases.

5. The appropriate feedback topology for Transconductance amplifiers is
   (a) the voltage-mixing, current-sampling (b) the current-mixing, current-sampling
   (c) the current-mixing, voltage-sampling (d) the voltage-mixing, voltage-sampling

6. One condition for oscillation is
   (a) a phase shift around the feedback loop of 0° (b) a phase shift around the feedback loop of 180°

7. In a certain oscillator, $A_v = 50$, The attenuation of the feedback circuit must be
   (a) 1 (b) 0.01 (c) 10 (d) 0.02

8. The Wien-bridge oscillator's positive feedback circuit is.....circuit.
   (a) RL (b) LC (c) voltage divider (d) RC

9. In a Wien-bridge oscillator, if the resistances in the positive feedback circuit are decreased, the frequency
   (a) remains the same (b) increases (c) decreases

10. Sampling of an analog signal is done by replacing each value by the value of the nearest quantization level
    (a) True (b) False

QUESTION 2: [5 POINTS]

A negative-feedback amplifier has a closed-loop gain $A_f = 100$ and an open-loop gain $A = 10^4$. What is the feedback factor β? If a manufacturing error results in a reduction of A to 10^3, what closed-loop gain results? What is the percentage change in A_f corresponding to this factor of 10 reduction in A?

12- If $T_c = 150$ K and $\lambda(0) = 0.51$ μm, then $\lambda(100\ K)$ equals

(a) 0.569 μm **(b) 0.549 μm** **(c) 0.579 μm**

13- If r = 0.45 μm and $H_c = 0.125$ T, then I_c equals

(a) 2.81×10^{-8} (A) **(b) 2.5×10^{-8} (A)** **(c) 3.01×10^{-8} (A)**

14- The crystal structure of the Y:123 superconductor is

(a) orthorhombic **(b) hexagonal** **(c) monoclinic**

15- The surface sheath of a type (I) superconductor occurs when

(a) $\kappa_{GL} \geq 0.419$ **(b) $\kappa_{GL} < 0.419$** **(c) $\kappa_{GL} > 0.319$**

16- The G-L parameter of type (II) superconductors is

(a) $\kappa_{GL} < 0.707$ **(b) $\kappa_{GL} \geq 0.707$** **(c) $\kappa_{GL} = 0.607$**

17- If $Hc_2(0) = 20$ T and $\rho_n = 5\times10^{-5}$ (Ω.m), then γ for Hg:1223 under pressure equals

(a) 0.088 (J/Kg.K) **(b) 0.078 (J/Kg.K)** **(c) 0.069 (J/Kg.K)**

18- If $H_{c2} = 4.1$ T, then Hc_3 equals

(a) 6.937 T **(b) 6.949 T** **(c) 6.967 T**

19- If $H_c(0) = 5$ T and $T_c = 150$ K, then $H_c(100\ K)$ equals

(a) 2.877 T **(b) 2.778 T** **(c) 2.768 T**

20- According to the London equation, the field at London depth equals

(a) B(a) **(b) (1/e) B(a)** **(c) Zero**

21- The T_c of La :214 is nearly similar to the T_c of

(a) Ti:2223 **(b) Y:123** **(c) MgB_2**

22-The T_c of a superconductor is obtained when

(a) I = 0 **(b) T= 0** **(c) V= 0**

23- If $T_c = 110$ K for a superconductor and $\gamma = 0.0125$, then $H_c(0)$ of BCS equals

(a) 14.569 T **(b) 14.780 T** **(c) 14.699 T**

24- The crystal structure of La: 214 is

(a) orthorhombic **(b) tetragonal** **(c) orthorhombic or tetragonal**

25- The upper critical field of the SmFeAsO superconductor equals

(a) 10 T **(b) 8 T** **(c) 120 T**

26- Superconductors can be used in the devices of

(a) SQUID **(b) power cable** **(c) both of them**

Q4 (26 marks) Chose the correct answer (MCQ: (دون أختياراتك في الجدول التالي)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26				

1- Onset of diamagnetism of a superconductor occurs when

(a) χ'' is maximum **(b) χ' is zero** **(c) χ' is maximum**

2- Peak temperature occurs when;

(a) χ' is zero **(b) χ'' is maximum** **(c) χ' is maximum**

3- For a superconductor, thermopower is

(a) negative **(b) positive** **(c) none of them**

4- If $E_c = 0.112$ J and $f_s(T) = 0.958$ J , then $f_n(T)$ equals

(a) 1.061 J **(b) 1.07 J** **(c) 1.081 J**

5- If the G-L parameter $\kappa_{GL} = 0.511$ and $H_c = 0.21$ T, then Hc_2 equals

(a) 0.149 T **(b) 0.152 T** **(c) 0.137 T**

6- A rapid change of the C_{en} at T_c is ascribed to;

(a) energy gap **(b) electron pairs** **(c) both of them**

7- If $T_c = 110$ K for a superconductor and $\gamma = 0.0125$ (J/Kg.K), then $H_c(0)$ of BCS equals

(a) 14.569 T **(b) 14.780 T** **(c) 14.699 T**

8- The T_c of $HgBa_2Ca_{n-1}Cu_nO_{2n+2}$ is 134 K when

(a) n=2 **(b) n=1** **(c) n=3**

9- Copper pairs occur as a result of interaction between;

(a) Electron-lattice **(b) Electron- phonon** **(c) Electron-electron**

10- The specific heat at T_c of a superconductor was enhanced to about

(a) 1.5 C_{en} **(b) 2 C_{en}** **(c) 3 C_{en}**

11-If $n(0) = 12.16 \times 10^{21}$ /cm^3 and $T_c = 150$ K , then n (100 K) equals

(a) 9.758×10^{21} /cm^3 **(b) 9.558×10^{21} /cm^3** **(c) 9.798×10^{21} /cm^3**

7V

Q3 (8 marks)

(a) Explain with drawings and equations the phenomenon of flux flow in superconductors, and then clarify in detail how you can determine the activation energy of flux bundles.

(b) Explain with drawings and equations how you can determine the flux flow resistance along a flat strip of type II superconductor in a mixed state.

Q2 (8 marks)

(a) Describe with drawings and equations how the Cooper pair and energy gap are formed in superconductors.

(b) Calculate surface and condensation energies at the upper critical magnetic field for a type II superconductor if $\lambda_L = 1.2$ nm and $\xi = 0.5$ nm.

جامعة أسيوط - كلية العلوم – قسم الفيزياء

Final Exam- Second Term (2024/2025)

Low temperature physics and superconductivity- Code P 422- Time: 3 h-

Prof. Dr. Ahmed Sedky

Answer the following questions:

Q1 (8 marks)

(a) With drawing, write a short account about

I- Mixed state **II-** Meissner effect

(b) Calculate the energy gap at 0 K and then determine the London penetration depth at 250 K for the Ti: 2223 superconductor in which $H_c(0) = 4500$ mT, $\lambda(0) = 0.51$ μm, and $T_c = 125$ K.

5) **While walking, the arms swing under the force of gravity. Compute the period of the swing. How does this period compare with the period of the eg swing? Assume arm length of 90 cm.**

Solution:

END OF EXAM

4) **A stress-strain curve for a dental polymer shows a linear elastic region up to 2% strain (50 MPa) and plastic deformation until fracture at 10% strain (80 MPa). Calculate:**

(a) Resilience

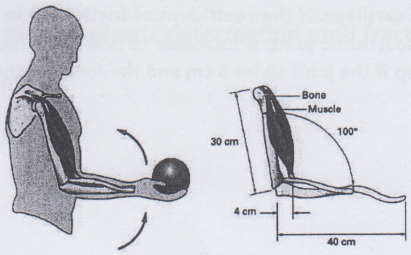
(b) Toughness

Solution:

3) **A patient with osteoarthritis experiences increased friction in their hip joint due to the degradation of cartilage. If the coefficient of friction (μ) in a healthy hip joint is 0.003, and in the osteoarthritic joint, it increases to 0.03, how much more work is expended during each step if the joint slides 3 cm and the force on the joint is 2.4 times the body weight (W)?**

Solution:

2) **Consider the attachment Figure. Now let the 14-kg weight hang from the middle of the lower arm (20cm from the fulcrum). Calculate the biceps force and the reaction force at the joint.**

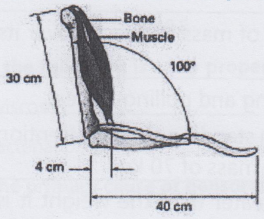


Solution:

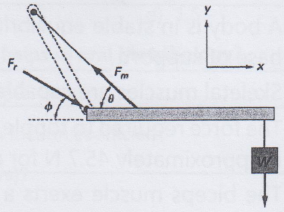
C. Work Problems (30 Points)

Show all your work and explain each major step to receive full credit.

1) Calculate the force applied by the biceps and the reaction force (F_r) at the joint as a result of a 14-kg weight held in hand when the elbow is at (a) 160° and (b) 60°. Dimensions are as in Fig. a. Assume that the upper part of the arm remains fixed as in Fig. b . Note that under these conditions the lower part of the arm is no longer horizontal.



a)



b)

Solution:

B. True/False Questions (5 Points)

State whether the statement is true or false

no	Statements	TRUE	FALSE
1.	The study of mechanics in biology began with Isaac Newton's work in the 17th century.		
2.	A body is in stable equilibrium if its center of mass is directly over its base of support.		
3.	Skeletal muscles are capable of both pushing and pulling forces.		
4.	The force required to topple an erect person standing at rigid attention is approximately 45.7 N for a person with a mass of 70 kg.		
5.	The biceps muscle exerts a force much greater than the weight it is holding when lifting an object.		
6.	The maximum force a muscle can exert is proportional to its cross-sectional area.		
7.	Hydrogels are hydrophobic polymers used in contact lenses.		
8.	The shape of an implant can influence the tissue response due to stress concentrations.		
9.	All biomaterials are designed to be chemically inert in the body.		
10.	The term "biocompatible" can be universally applied to any material without considering the specific application.		
11.	Fatigue failure is a significant concern for metallic implants subjected to repeated loading.		
12.	Metals are generally more resistant to corrosion than ceramics.		
13.	The Young's modulus is a measure of a material's stiffness.		
14.	Polymers always exhibit linear elastic behavior under stress.		
15.	A low contact angle indicates poor wettability.		
16.	Thermoplastic polymers can be reshaped upon heating.		
17.	The glass transition temperature (Tg) is the same as the melting point.		
18.	Dental amalgam is an example of a composite material.		
19.	The critical surface energy is the surface tension of a liquid that just spreads on a solid.		
20.	In elastic strain (temporary)(elastic deformation) the body returns to the original size and shape with removal of stresses.		
21.	Resilience is the amount of energy needed to deform the material elastically.		
22.	The period of a simple pendulum is independent of the mass of the bob.		

41, Which of the following factors does NOT affect the frictional force between two surfaces?

a) Normal force (F_n)
b) Coefficient of friction (μ)
c) Surface area of contact
d) Nature of the surfaces

42. What is the approximate coefficient of friction for rubber on dry concrete?

a) 0.02
b) 0.5
c) 0.9
d) 1.5

43. Which of the following is a key property of saliva that helps in oral biotribology?

a) High viscosity
b) Low pH
c) Antibacterial properties
d) High friction coefficient

44. What is the primary cause of bedsores (decubitus ulcers)?

a) High humidity
b) Prolonged pressure and friction on the skin
c) Lack of exercise
d) High temperature

45. Which of the following is NOT a major category of biomaterials?

a) Metals
b) Polymers
c) Ceramics
d) Glass

46. What is the main reason for using alloys in medical implants instead of pure metals?

a) Lower cost
b) Improved mechanical properties
c) Easier sterilization
d) Reduced weight

47. Which type of bond is the strongest in biological materials?

a) Ionic bond
b) Covalent bond
c) Hydrogen bond
d) Van der Waals bond

48. What is the primary cause of metallic implant failure due to corrosion?

a) High temperatures
b) Electrochemical reactions in the physiological environment
c) Exposure to UV light
d) Mechanical stress alone

49. Which of the following is a resorbable ceramic used as a bone substitute?

a) Alumina
b) Calcium phosphate
c) Pyrolytic carbon
d) Diamond-like carbon

32. Which of the following is true about the coefficient of friction (μ)?

A) It depends on the size of the contact area.

B) It is higher for kinetic friction than static friction.

C) It is a dimensionless quantity.

D) It is independent of the nature of the surfaces.

33. In the hip joint, what reduces the coefficient of friction to a very low value?

a) Bone density
b) Synovial fluid
c) Cartilage thickness
d) Muscle tension

34. What is the approximate coefficient of friction for a lubricated bone-on-bone joint?

a) 0.01 b) 0.1 c) 0.5 d) 1.0

35. Which of the following is an example of biotribology?

a) Friction in car engines
b) Friction in the hip joint
c) Friction between gears
d) Friction in rolling motion

36. What is the primary role of saliva in oral biotribology?

a) To increase friction between teeth
b) To act as a lubricant and reduce friction
c) To increase the wear of teeth
d) To neutralize alkaline conditions

37. What is the approximate thickness of the saliva layer in the oral cavity?

a) 0.1 mm b) 1 mm c) 10 mm d) 0.01 mm

38. Which of the following is a common problem caused by friction between skin and textiles?

a) Hair loss b) Blisters c) Tooth decay d) Joint wear

39. What is the primary function of synovial fluid in joints?

a) To increase friction
b) To reduce friction and lubricate the joint
c) To strengthen bones
d) To increase joint stiffness

40. In the catfish spine fin mechanism, what is the purpose of high friction between the fin bone and the skeleton?

a) To allow easy movement of the fin
b) To lock the fin in place as a defense mechanism
c) To reduce wear and tear
d) To increase flexibility

23. What is the approximate force exerted by the triceps muscle during a one-arm push-up with the elbow bent at a 100° angle?

a) 500 N b) 1000 N c) 1500 N d) 2000 N

24. In the context of the hip joint, what is the approximate angle of the resultant muscle force F_m with respect to the horizon when a person is standing erect?

a) 45° b) 60° c) 71° d) 90°

25. What is the approximate force on the tibia when a person stands tip-toe on one foot?

a) 1.5 times the person's weight b) 2.5 times the person's weight

c) 3.5 times the person's weight d) 4.5 times the person's weight

26. In the lever model of the elbow, if the biceps muscle exerts a force of 1440 N to hold a 14-kg weight, what is the approximate reaction force F_r at the joint?

a) 430 N b) 1320 N c) 1440 N d) 2000 N

27. What is the approximate angle ϕ of the reaction force F_r at the elbow joint when the biceps muscle exerts a force of 1440 N?

a) 45° b) 60° c) 70.9° d) 90°

28. In the context of the hip joint, what is the approximate force F_m exerted by the muscles when a person is limping to reduce the force on the injured hip?

a) 0.47 times the person's weight b) 1.28 times the person's weight

c) 1.59 times the person's weight d) 2.37 times the person's weight

29. What is the approximate force on the hip joint when a person is limping to reduce the force on the injured hip?

a) 0.47 times the person's weight b) 1.28 times the person's weight

c) 1.59 times the person's weight d) 2.37 times the person's weight

30. In the context of the lever model of the elbow, what is the approximate velocity of the weight held in the hand if the biceps muscle contracts uniformly over 0.5 seconds?

a) 0.5 cm/s b) 1 cm/s c) 2 cm/s d) 4 cm/s

31. What is the primary cause of friction between two surfaces?

a) Magnetic forces b) Intermeshing of surface irregularities

c) Gravitational pull d) Electrostatic forces

14. What is the compressional force on the fifth lumbar vertebra when a person bends forward at 60° from the vertical?

a) 686 N b) 2000 N c) 2230 N d) 3000 N

15. What is the tension force on the Achilles tendon when standing tip-toe on one foot?

a) Equal to the person's weight b) 1.5 times the person's weight

c) 2.5 times the person's weight d) 3.5 times the person's weight

16. In the context of levers, what is the relationship between the distances d_1 and d_2 for a Class 3 lever?

a) $d_1 < d_2$ b) $d_1 > d_2$ c) $d_1 = d_2$ d) None of these

17. If a person with a mass of 70 kg is standing on one foot, what is the approximate force exerted on the hip joint?

a) 686 N b) 1000 N c) 1625 N d) 2000 N

18. What is the primary reason that skeletal muscles in the human body typically have a mechanical advantage of less than one?

a) To increase the force exerted by the muscles

b) To increase the speed and range of motion of the limbs

c) To reduce the energy consumption of the muscles

d) To decrease the load on the joints

19. When a person bends forward at 60° from the vertical, what is the approximate force exerted by the erector spinae muscle to maintain the position?

a) 686 N b) 2000 N c) 3200 N d) 4000 N

20. In the lever model of the elbow, if the biceps muscle contracts by 2 cm, what is the approximate upward displacement of the weight held in the hand?

a) 0.5 cm b) 1 cm c) 2 cm d) 4 cm

21. What is the approximate angle θ of the biceps muscle force in the lever model of the elbow when the elbow is bent at a 100° angle?

a) 45° b) 60° c) 72.6° d) 90°

22. If a person holds a 20-kg weight in their hand while bending forward at 60° from the vertical, what is the approximate compressional force on the fifth lumbar vertebra?

a) 2230 N b) 3490 N c) 4000 N d) 5000 N

5. What is the approximate location of the center of gravity in an erect person with arms at the side?

a) 40% of the person's height from the soles of the feet

b) 56% of the person's height from the soles of the feet

c) 70% of the person's height from the soles of the feet

d) 80% of the person's height from the soles of the feet

6. What is the primary function of skeletal muscles?

a) To push bones apart
b) To pull bones together
c) To generate electrical signals
d) To store energy

7. Which class of lever has the fulcrum located between the applied force and the load?

a) Class 1 lever
b) Class 2 lever
c) Class 3 lever
d) Class 4 lever

8. What is the mechanical advantage of a lever defined as?

a) The ratio of the load to the applied force
b) The ratio of the applied force to the load
c) The ratio of the distance of the load to the fulcrum
d) The ratio of the distance of the applied force to the fulcrum

9. In the human body, which type of lever is most commonly used for limb movements?

a) Class 1 lever
b) Class 2 lever
c) Class 3 lever
d) Class 4 lever

10. What is the force required to topple an erect person standing at rigid attention, assuming the person has a mass of 70 kg?

a) 10.3 N
b) 45.7 N
c) 68.6 N
d) 100 N

11. What is the approximate force exerted by the biceps muscle when holding a 14-kg weight in the hand with the elbow bent at a 100° angle?

a) 686 N
b) 1440 N
c) 2000 N
d) 3000 N

12. What is the force on the hip joint when a person is standing erect on one foot?

a) Equal to the person's weight
b) 1.5 times the person's weight
c) 2.37 times the person's weight
d) 3 times the person's weight

13. What is the primary reason for limping when a person has an injured hip?

a) To increase the force on the hip joint
b) To decrease the force on the hip joint
c) To increase the speed of walking
d) To reduce pain in the leg

FINAL TERM EXAMINATION-50 MARKS

Selective Course(1) in Medical Physics PHYS 491

THIS TEST HAS TWELVE PAGES

DURATION OF TEST: 3 HOURS

Date: 24th May 2025.

Examiner: Dr. Ahmed Mostafa Amry

Attempt all questions on answer sheet.

A. Multiple Choice: Identify the choice that answers the question. **[15 marks]**

1. What is the primary focus of mechanics in the context of biology and medicine?

a) The study of electricity in the human body

b) The effect of forces on the motion of bodies

c) The study of chemical reactions in cells

d) The effect of temperature on biological systems

2. Who formulated the present concepts of mechanics?

a) Aristotle

b) Leonardo da Vinci

c) Isaac Newton

d) Galileo Galilei

3. What is the condition for a body to be in static equilibrium?

a) The sum of forces acting on the body must be zero

b) The sum of torques acting on the body must be zero

c) Both the sum of forces and the sum of torques must be zero

d) The body must be in motion

4. What determines the stability of a body under the action of gravity?

a) The mass of the body

b) The position of the center of mass with respect to the base of support

c) The height of the body

d) The shape of the body

5. **Compare and contrast direct and indirect plasma sources in terms of their design principles, interaction mechanisms with biological tissues, and clinical advantages/disadvantages. Provide examples of medical devices for each type and discuss their suitability for specific therapeutic applications.**

Answer:

END OF EXAM

4. **Discuss the dual role of reactive oxygen and nitrogen species (ROS/RNS) in plasma medicine, emphasizing their physiological significance, therapeutic applications, and potential risks. How does the concept of hormesis apply to CAP treatment, and what are the implications for clinical use?**

Answer:

8. **Describe the potential applications of plasma medicine beyond wound healing, such as in cancer treatment and dentistry.**

Answer:

2. **Discuss the role of reactive oxygen and nitrogen species (ROS, RNS/RONS) i plasma medicine, including their physiological and therapeutic significance.**

Answer

C. Work Problems (30 Points)

Show all your work and explain each major step to receive full credit.:

1. **Explain the concept of plasma-supported wound healing and describe the mechanisms by which cold atmospheric plasma (CAP) promotes wound healing.**

Answer:

no	Statements		
36.	The term "biocompatible" can be universally applied to any material without considering the specific application.		
37.	Fatigue failure is a significant concern for metallic implants subjected to repeated loading.		
38.	Plasma medicine exclusively uses thermal plasmas for medical applications.		
39.	Reactive oxygen species (ROS) generated by CAP are identical to those in normal cell metabolism.		
40.	CAP can selectively kill cancer cells while sparing healthy cells.		
41.	Plasma-treated water has no biological activity.		
42.	CAP has been shown to cause genotoxicity in clinical studies.		
43.	Plasma poration refers to irreversible cell membrane damage.		
44.	Argon plasma coagulation (APC) is a non-thermal plasma technique.		
45.	CAP accelerates wound healing by suppressing all inflammatory responses.		
46.	Plasma medicine is already used clinically for chronic wound treatment.		
47.	CAP is ineffective against antibiotic-resistant pathogens		
48.	Plasma-treated liquids can retain antibacterial properties.		
49.	Plasmas are the most abundant state of visible matter in the universe.		
50.	Non-equilibrium plasmas have equal electron and ion temperatures.		
51.	CAP devices typically operate at gas temperatures >1000°C.		
52.	Plasma jets require direct contact with tissue to function.		
53.	Plasma torches are unsuitable for biomedical applications due to high heat.		
54.	Surface DBDs are a type of indirect plasma source.		
55.	The PlasmaDerm® uses ambient air as its working gas		
56.	Plasma bullets" travel at speeds up to 10^5 m/s.		
57.	The SteriPlas device is powered by microwaves.		
58.	The aim of plasma medicine is the use of physical plasmas for medical applications		

no	Statements	TRUE	FALSE
17.	The force required to topple a person increases if the person spreads their legs wider apart.		
18.	The biceps muscle exerts a force of approximately 10.5 times the weight it is holding when the elbow is bent at a 100° angle.		
19.	The reaction force at the elbow joint is always directed vertically upward.		
20.	The force on the hip joint during a normal one-legged stance is approximately 1.5 times the person's weight.		
21.	When a person limps, the force on the injured hip joint decreases because the center of gravity shifts closer to the injured side.		
22.	The Achilles tendon experiences a tension force of approximately 2.5 times the person's weight when standing tip-toe on one foot.		
23.	The force exerted by the triceps muscle is greater than the force exerted by the biceps muscle for the same load because the triceps operates with a mechanical advantage greater than one.		
24.	The force on the tibia when standing tip-toe on one foot is approximately 3.5 times the person's weight.		
25.	The nervous system uses information from vision, the vestibular system, and the somatosensory system to maintain balance.		
26.	The force on the fifth lumbar vertebra increases significantly when a person bends forward and holds a weight in their hands.		
27.	The human body maintains balance while standing by keeping the center of gravity perfectly still over the base of support.		
28.	Biocompatibility means that a material elicits no response from the host tissue.		
29.	Titanium alloys are preferred over stainless steel in orthopaedic implants due to their lower modulus of elasticity.		
30.	The photoelectric effect is the dominant absorption mechanism for high-energy gamma rays.		
31.	Polyethylene is used for acetabular cups in artificial hip joints.		
32.	Crevice corrosion is a common issue in metallic implants due to anaerobic conditions.		
33.	Hydrogels are hydrophobic polymers used in contact lenses.		
34.	The shape of an implant can influence the tissue response due to stress concentrations.		
35.	All biomaterials are designed to be chemically inert in the body.		

B. True/False Questions (5 Points)

State whether the statement is true or false:

no	Statements	TRUE	FALSE
1.	Plasma medicine involves the use of the liquid part of blood for medical applications.		
2.	Cold atmospheric plasmas (CAP) are widely used for therapeutic applications because they operate at tissue-compatible temperatures.		
3.	Resistance of microorganisms to plasma treatment has been commonly observed.		
4.	Reactive oxygen and nitrogen species (ROS, RNS/RONS) generated by plasma are also involved in regular physiological processes.		
5.	Plasma treatment always results in cell death, regardless of the treatment intensity.		
6.	Cold atmospheric plasma (CAP) can only induce lethal effects in cells, with no stimulatory or non-lethal outcomes.		
7.	Plasma-treated liquids (e.g., saline) can retain transient biological activity, such as antibacterial or anticancer effects.		
8.	Nrf2 activation by CAP leads to downregulation of antioxidant genes, exacerbating oxidative stress.		
9.	Endoscopic applications of CAP are limited to thermal plasmas like argon plasma coagulation (APC).		
10.	In direct plasma sources like volume DBD, the object being treated (e.g., tissue) must be part of the electrical circuit.		
11.	Non-equilibrium plasmas cannot be sustained at atmospheric pressure due to excessive particle collisions.		
12.	The Plasma Derm® system requires a separate noble gas supply for operation.		
13.	Cold atmospheric plasma (CAP) sources must comply with medical device regulations to be used clinically.		
14.	UV radiation from CAP devices has no mutagenic or cytotoxic effects on human tissue.		
15.	Resistance buildup in bacteria against CAP treatment has been widely observed.		
16.	The thermal impact of CAP on human tissue must not exceed 40°C to avoid cell damage.		

30. Which of the following is a key characteristic of non-equilibrium (cold) plasmas?

A) Uniform temperatures among electrons, ions, and neutral particles.
B) Electron temperatures much higher than ion/neutral particle temperatures.
C) Dominance of thermal energy transfer to the target.
D) Exclusive use in high-pressure industrial applications.

31. What distinguishes direct plasma sources from indirect plasma sources?

A) Direct sources require a separate gas supply, while indirect sources do not.
B) Direct sources involve the treated object as part of the electrical circuit.
C) Indirect sources produce higher gas temperatures than direct sources.
D) Indirect sources are unsuitable for biomedical applications.

32. Which plasma source is classified as a "hybrid" due to its combination of direct and indirect properties?

A) Corona discharge
B) Plasma bullet jet
C) Dielectric Barrier Discharge (DBD)
D) Plasma torch

33. Why is the dielectric barrier in a DBD critical for biomedical applications?

A) It prevents any electrical current from reaching the tissue.
B) It limits current flow and gas heating, enabling non-thermal plasma.
C) It increases the production of ozone for sterilization.
D) It allows DC voltage operation for deeper tissue penetration.

34. Which reactive species are predominantly generated in air-based plasmas for biomedical use?

A) Noble gas ions
B) Reactive oxygen and nitrogen species (ROS/RNS)
C) Carbon dioxide and water vapor
D) Pure atomic hydrogen

35. What is the primary mode of action for spark discharges in surgical applications?

A) Delivering cold plasma for cell regeneration.
B) Cutting tissue and coagulating blood via thermal effects.
C) Generating UV light for disinfection.
D) Producing nitric oxide for wound healing.

22. Which of the following is a potential cancer therapy application of CAP?

A) Inducing apoptosis in tumor cells
B) Increasing tumor cell proliferation
C) Enhancing metastasis
D) Blocking immune responses

23. What is "plasma pharmacy"?

A) Use of plasma to sterilize pharmaceuticals
B) Generation of therapeutic liquids via plasma treatment
C) Plasma-based drug delivery systems
D) None of the above

24. _____ is a CAP-generated RNS involved in blood vessel dilation.

a) Hydrogen peroxide (H_2O_2)
b) Nitric oxide (•NO)
c) Ozone (O_3)
d) Argon

25. The _____ effect describes low-dose stimulation and high-dose inhibition by CAP.

a) Placebo
b) Hormesis
c) Hypoxia
d) Ozone

26. _____ is a CAP application in dentistry for biofilm removal.

a) Plasma brushing
b) Plasma-activated water
c) Plasma skin resurfacing
d) Plasma diagnostic

27. What is the role of reactive oxygen and nitrogen species (RONS) in plasma medicine?

a) They are solely harmful and must be minimized.
b) They contribute to antimicrobial effects but can cause side effects if overproduced.
c) They have no significant impact on biomedical applications.
d) They are only relevant for thermal plasmas.

28. Which reactive species are predominantly generated in air-based plasmas for biomedical use?

A) Noble gas ions
B) Reactive oxygen and nitrogen species (ROS/RNS)
C) Carbon dioxide and water vapor
D) Pure atomic hydrogen

29. What is the primary reason plasmas are referred to as the "4th state of matter"?

A) They are denser than solids.
B) They consist of electrically charged particles created by ionization.
C) They are only found in outer space.
D) They cannot interact with electromagnetic fields.

13. What is the primary focus of the chapter "Relevant Plasma Parameters for Certification"?

a) Development of new plasma sources
b) Safety and efficacy parameters for medical plasma devices
c) Clinical trials of plasma therapy
d) Historical overview of plasma medicine

14. Which of the following is NOT a component of cold atmospheric plasma (CAP) relevant for biomedical applications?

a) Reactive oxygen species (ROS) b) Ultraviolet (UV) radiation
c) Magnetic fields d) Charged particles

15. Which diagnostic method is used to measure the electron density in atmospheric pressure plasmas?

a) Optical emission spectroscopy. b) Stark broadening of hydrogen lines
c) Mass spectrometry d)) Calorimetry

16. What is the primary safety concern associated with high-voltage operation in plasma devices?

a) Thermal denaturation of proteins
b) Electrical current flow through the body
c) Production of ozone
d) UV radiation exposure

17. Which of the following is NOT a component of cold atmospheric plasma (CAP)?

a) Reactive oxygen species (ROS) b) UV radiation
c) Electromagnetic fields d) Thermal neutrons

18. What is the primary mechanism by which cold atmospheric plasma (CAP) exerts biological effects?

A) Thermal tissue destruction
B) Generation of reactive oxygen/nitrogen species (RONS)
C) Mechanical ablation
D) Magnetic field disruption

19. Which reactive species is NOT typically produced by CAP?

a) Ozone (O_3) b) Hydroxyl radical (•OH)
c) Glucose ($C_6H_{12}O_6$) d) Nitric oxide (•NO)

20. What is a key application of plasma in medicine?

a) Blood transfusion b) Wound healing and antisepsis
c) Bone fracture repair d) Neural synapse modulation

21. Which cell type is most sensitive to CAP treatment according to exploratory studies?

a) Fibroblasts b) Keratinocytes c) Jurkat cells d) Neurons

5. **What is the primary mechanism by which cold atmospheric plasma (CAP) influences cellular redox signaling?**
   a) Direct physical disruption of cell membranes.
   b) Generation of reactive oxygen and nitrogen species (ROS/RNS) in the liquid cell environment.
   c) Thermal denaturation of cellular proteins.
   d) Permanent alteration of DNA structure via UV radiation..

6. **In plasma medicine, why has resistance of microorganisms to plasma treatment not been observed?**
   a) Plasma selectively targets eukaryotic cells only.
   b) The multi-component nature of plasma (ROS, RNS, UV, etc.) makes resistance evolution unlikely.
   c) Plasma treatment is always lethal to all cell types.
   d) Microorganisms can easily detoxify plasma-generated reactive species.

7. **Which of the following is a key challenge in standardizing plasma treatment for clinical applications?**
   a) Lack of biological effects in mammalian cells.
   b) Difficulty in defining a universal "dose" metric due to device and parameter variability.
   c) Inability to generate reactive species in liquids.
   d) Excessive heat production during plasma generation.

10. **Which of the following is a key advantage of cold atmospheric plasmas (CAP) for biomedical applications?**
    a) They generate extreme heat, making them suitable for surgical cutting.
    b) They maintain high reactivity while minimizing thermal damage to tissues.
    c) They exclusively produce inert noble gas species with no reactive components.
    d) They operate only under low-pressure conditions.

11. **Which plasma source is classified as an *indirect* plasma source due to its self-contained electrical circuit?**
    a) Volume DBD where tissue acts as an electrode.
    b) Plasma jet with guided gas flow and no direct current through the target.
    c) Corona discharge with point-to-plane electrode configuration.
    d) Spark discharge with tissue as the counter electrode.

12. **What is the primary challenge in scaling up plasma jets for large-area wound treatment?**
    a) Ensuring uniform gas and power supply across multiple jets.
    b) Avoiding any emission of electromagnetic radiation.
    c) Eliminating all reactive oxygen and nitrogen species (ROS/RNS).
    d) Operating at temperatures exceeding 1000°C.

FINAL TERM EXAMINATION-50 MARKS

Selective Course(2) in Medical Physics PHYS 492

THIS TEST HAS THIRTEEN PAGES

DURATION OF TEST: 3 HOURS

***Date*: 24th May 2025.**

Examiner: Dr. Ahmed Mostafa Amry

***Attempt all questions on answer sheet*.**

A. Multiple Choice: Identify the choice that answers the question. **[15 marks]**

1. **What is plasma in the context of plasma medicine?**
   a) The liquid part of blood
   b) A special excited gas, the fourth state of matter
   c) A type of cell in the human body
   d) A form of electromagnetic radiation

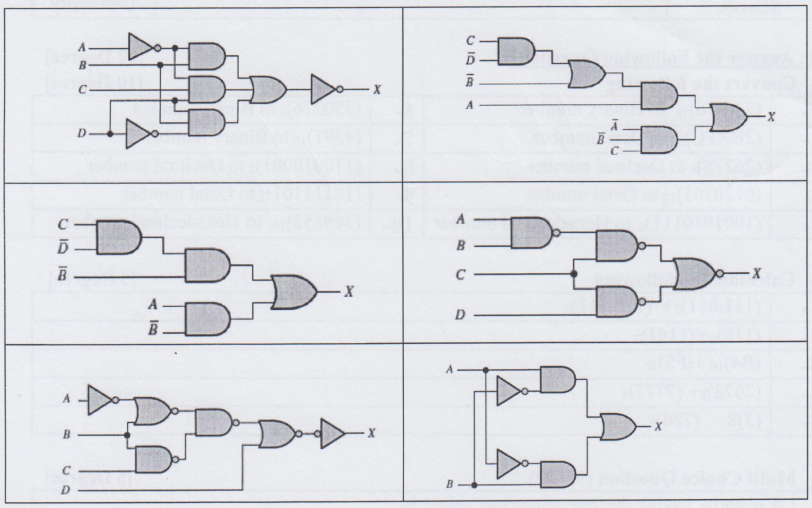
2. **Which of the following is NOT a field of biomedical applications of physical plasma?**
   a) Surface modification
   b) Therapeutic applications
   c) Biological decontamination
   d) Blood transfusion

3. **What are the main active compounds in cold atmospheric plasma (CAP) that influence cellular functions?**
   a) Reactive oxygen and nitrogen species (ROS, RNS/RONS)
   b) Proteins and lipids
   c) Carbohydrates and nucleic acids
   d) Heavy metals

4. **What is the primary focus of plasma-supported wound healing?**
   a) Complete removal of the wound
   b) Combining cleaning/antisepsis with stimulation of tissue regeneration
   c) Using thermal plasma to cauterize the wound
   d) Replacing all immune cells in the wound.

3- X= (A+B+C+D)(AB CD)
4- X= $\overline{\overline{ABC} + D + E}$.
5- X= $A\overline{B} + A(\overline{B + C}) + B(\overline{B + C})$.

2- **Write** the Boolean expression for each of the logic circuits in Figure **[9 Degrees]**



Q3: Answer the Following Questions: **[15 Degrees]**

1- Develop a truth table for the standard SOP expression: **[5 Degrees]**

$$\overline{A}\overline{B}C + A\overline{B}\overline{C} + ABC.$$

2- Convert the following expressions to product-of-sum (POS) forms: **[5 Degrees]**

$$(A + \overline{B} + C)(\overline{B} + C + \overline{D})(A + \overline{B} + \overline{C} + D)$$

3- Using Boolean algebra techniques, simplify the following expressions as much as possible, with Draw circuit before and after simplify: **[5 Degrees]**

$$\overline{AB + A\overline{C}} + \overline{A}\overline{B}C$$

Best wishes,,,,,,
Dr. Ghada Salaheldin

Faculty of Science	Undergraduate Final Exam 2nd Semester 2024_2025 Course: Physical Measurements Using Computers Code: (P462) Time: 3 hours Date: 26-5-2025	Assiut University

Q1: Answer the Following Questions: **[20 Degree]**

1- Convert the following **[10 Degree]**

1-	$(2AB76)_{16}$ to Binary number	**6-**	$(350276)_8$ to Binary number
2-	$(2BAFC)_{16}$ to Octal number	**7-**	$(4391)_{10}$ to Binary number
3-	$(26775)_8$ to Decimal number	**8-**	$(110010001)_2$ to Decimal number
4-	$(9120305)_{10}$ to Octal number	**9-**	$(10111101)_2$ to Octal number
5-	$(1001010111)_2$ to Hexadecimal number	**10-**	$(369852)_{10}$ to Hexadecimal number

2- Calculate the following **[5 Degree]**

1-	$(111.011)_2 + (110.111)_2$
2-	$(110)_2 \times (1101)_2$
3-	$(B4)_{16} + (F5)_{16}$
4-	$(2673)_8 + (7777)_8$
5-	$(3)8 \quad (726)_8$

3- Multi Choice Question (MCQ). **[5 Degree]**

	A quantity having discrete numerical values is (a) an analog quantity (b) a digital quantity (c) a binary quantity (d) a natural quantity
	The term bit means (a) a small amount of data (b) a 1 or a 0 (c) binary digit (d) both answers (b) and (c)
	The 2's complement of 1000 is (a) 0111 (b) 1000 (c) 1001 (d)1010
	A pulse in a certain waveform has a frequency of 50 Hz. It repeats itself every (a) 1 ms (b) 20 ms (c) 50 ms (d) 100 ms
	In a certain digital waveform, the period is four times the pulse width. The duty cycle is (a) 25% (b) 50% (c) 75% (d) 100%

Q2: Answer the Following Questions: **[15 Degrees]**

1- Draw the logic circuit represented by each of the following expressions **[6 Degrees]**

1- X=ACD(BC)E+BEF
2- X= ACF+BEF