

Assiut University	Final Exam	Term: 1 st 2014-2015
Faculty of Science	(50 Marks)	Date: Jan 3 th , 2015
Department of Physics		Time: 2 hours
Course: Electricity and AC Current- P226		pages (5)
Constants:		

Part I: Choose the correct answer

(18 Marks)

1. Consider the circuit in Figure 1 and assume that the battery has no internal resistance.

1.1 Just after the switch is closed, the current in the battery is:

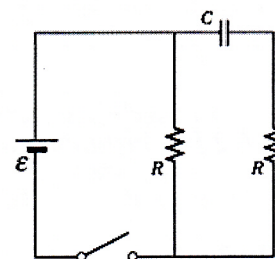
- (a) zero (b) $\varepsilon/2R$ (c) $2\varepsilon/R$ (d) ε/R (e) impossible to determine

Why?

1.2 After a very long time, the current in the battery is:

- (a) zero (b) $\varepsilon/2R$ (c) $2\varepsilon/R$ (d) ε/R (e) impossible to determine

Why?



2. For a sinusoidal applied voltage on an capacitor,

- (a) the current and voltage across the inductor are in phase
 (b) the current lags behind the voltage by 90°
 (c) the voltage lags behind the current by 90°

Figure 1

3. At an instant of time during the oscillations of an LC circuit, the current is at its maximum value. At this instant, the voltage across the capacitor

- (a) is different from that across the inductor (b) is zero
 (c) has its maximum value (d) is impossible to determine

Why?

(2)

4. The total energy in a circuit contains a resistor, inductor and capacitor... with time.

(a) is constant

(b) decreases

(c) increases

Why?

5. The energy is stored in the capacitor as a ...

(a) magnetic field

(b) electric field

(c) electromagnetic waves

6. An uncharged capacitor (C) and resistor are connected in series to a battery (ϵ) as shown in Figure 2, if the switch (S) is just closed

6.1. The instantaneous charge on the capacitor is ...

(a) ϵC

(b) Zero

(c) infinity

Why?

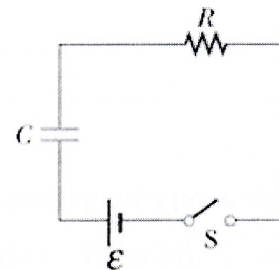


Figure 2

6.2 The instantaneous current in the circuit is ...

(a) ϵ/R

(b) Zero

(c) infinity

Why?

6.3 The voltage across the capacitor after a long time is ...

(a) Zero

(b) infinity

(c) ϵ

Why?

(3)

Part II: Answer the following:

(32 marks)

P1. A coil has an inductance of 3 mH, and the current in it changes from 0.2 A to 1.5 A in a time of 0.2 s. Find the magnitude of the average induced emf in the coil during this time.

(4 marks)

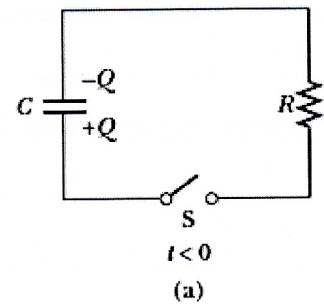
P2. Calculate the resistance in an RL circuit in which $L = 2.5$ H and the current increases to 90% of its final value in 3 s.

(4 marks)

(4)

P3. Consider the circuit shown in Figure 3, which consists of a capacitor carrying an initial charge Q , a resistor, and a switch. When the switch is open, a potential difference Q/C exists across the capacitor and there is zero potential difference across the resistor because $I = 0$. If the switch is closed at $t = 0$, the capacitor begins to discharge through the resistor. (8 marks)

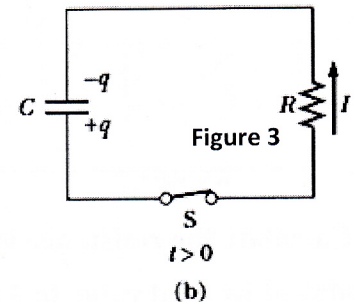
(a) derive the instantaneous charge on the capacitor as function of time.



(b) find the charge on the capacitor at time equals the time constant of the circuit.

(c) drive the instantaneous current in the circuit as a function of time.

(d) find the current in the circuit at time equals the time constant of the circuit.



(5)

P4. Compute the quality factor for the circuits described below.

(8 marks)

Circuit 1. A sinusoidal voltage $v(t) = (40.0 \text{ V}) \sin(100t)$ is applied to a series RLC circuit with $L = 160 \text{ mH}$, $C = 99.0 \text{ }\mu\text{F}$, and $R = 68.0 \text{ }\Omega$.

Circuit 2. An RLC circuit consists of a $150\text{-}\Omega$ resistor, a $21.0\text{-}\mu\text{F}$ capacitor, and a 460-mH inductor, connected in series with a 120-V , 60.0-Hz power supply.

Which circuit has the sharper resonance?

(6)

P5. Consider the circuit shown in Figure 4, taking $\varepsilon = 6.00 \text{ V}$, $L = 8.00 \text{ mH}$, and $R = 4.00 \Omega$. (8 marks)

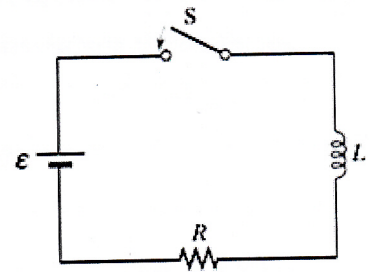
- (a) What is the inductive time constant of the circuit?

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- (b) Calculate the current in the circuit $250 \mu\text{s}$ after the switch is closed

Figure 4

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- (c) What is the value of the final steady-state current?

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- (d) How long does it take the current to reach 80.0% of its maximum value?

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GOOD LUCK

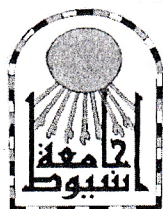
Nagih Shaalan

Assiut University

Faculty of Science

Department of Physics

Course Title: Vibrations and Waves – Code P212 – Final Exam. (50%)



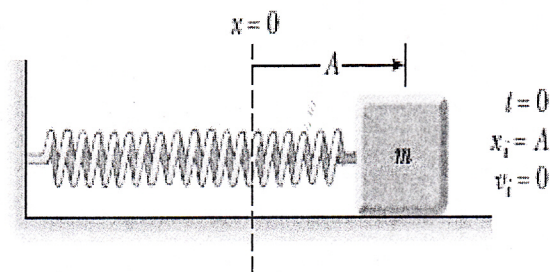
Term: Fall 2014 - 2015

Date : 4 January 2015

Time: 3 hours

Answer the following questions

1-A 200-g block connected to a light spring for which the force constant is 5.00 N/m is free to oscillate on a horizontal, frictionless surface. The block is displaced 5.00 cm from equilibrium and released from rest, as in the figure.



- Find the period of its motion.
- Determine the maximum speed of the block.
- What is the maximum acceleration of the block?
- Express the position, speed, and acceleration as functions of time.

2- Find an expression of the : kinetic energy, potential energy, and total energy of a simple harmonic oscillator.

- Plot the variations of K and U with the position x .

3-A 0.500-kg cart connected to a light spring for which the force constant is 20.0 N/m oscillates on a horizontal, frictionless air track.

- Calculate the total energy of the system and the maximum speed of the cart if the amplitude of the motion is 3.00 cm.
- What is the velocity of the cart when the position is 2.00 cm?
- Compute the kinetic and potential energies of the system when the position is 2.00 cm.

4-A particle rotates counterclockwise in a circle of radius 3.00 m with a constant angular speed of 8.00 rad/s. At $t = 0$, the particle has an x coordinate of 2.00 m and is moving to the right.

- Determine the x coordinate as a function of time, and evaluate the phase angle ϕ .
- Find the x components of the particle's velocity and acceleration at any time t .
- What is the maximum velocity and maximum acceleration of the particle?

5- The angular position of a pendulum is represented by the equation:

$$\theta = (0.320 \text{ rad}) \cos \omega t, \text{ where } \theta \text{ is in radians and } \omega = 4.43 \text{ rad/s.}$$

Determine the period and length of the pendulum.

****Good Luck****

Answer the following questions:

- 1 a) - i- Deduce the relation between the average kinetic energy of the gas molecules which press the wall of gas container and the absolute temperature of this gas.
ii- Prove that the number of gas molecules per unit volume decreases by increasing the altitude from the ground surface.
- b) -i- Give an expression for the following:-
- The molecular distribution function according to the molecules velocity components at any altitude. Explain on the diagram the properties of this function.
- The total number of gas molecules per unit volume according to their velocity components along the three Cartesian axes
- ii- Prove that the molecular velocity distribution function depends on the average kinetic energy of molecules and the gas absolute temperature. Explain by the draw the effect of this temperature on this function.
- c) -i- Calculate the average kinetic energy of the gas molecules at the absolute zero temperature (in electron - volt units)
- ii- The root mean square velocity $\bar{C}$, the average velocity $\bar{C}$ and the most probable velocity C_m of the gas molecules where the gas density is $142 \times 10^{-2} \text{ kgm}^{-3}$, the number of molecules per unit volume is $2.7 \times 10^{25} \text{ m}^{-3}$ and the gas temperature is 172°C (using $k = 1.38 \times 10^{-23} \text{ J/K}^\circ$)
- 2 a) - Write an expression for the first law of thermodynamics in case of the isothermal and adiabatic variations of the gas , and prove that $C_p > C_v$ for this gas.
- b) - Put the relations govern the gas adiabatic variation, and prove that $C_p/C_v = \gamma$ for the gas
- c) - If 2.7 mole of a diatomic ideal gas occupies an initial volume $V_i = 8$ liter at 307K° and the gas is adiabatically expanded to a final volume $V_f = 20$ liter, calculate the work done by this gas during this adiabatic process. Prove that this work is approximately equal to the change of gas internal energy du where $du = n C_v(T_f - T_i)$ and T_i , T_f are the initial and final gas temperatures respectively. Show that: the gas temperature is decreased or increased and give the reason (using $\gamma = 1.4$, $R = 8.314 \text{ J/mol.K}^\circ$ and $C_v = \frac{5}{2}R$)

Look the Back Page

(2)

- 3 a) - Prove that the mean free path of the gas molecule is inversely proportional to the gas molecules density and directly proportional to the gas viscosity coefficient.
- b) -i- By draw prove that the Van der Vaal's equation of the real gas can describe this gas in its gaseous, liquid states and during the change between these two states
- ii- Write an expression for the critical volume, critical pressure and critical temperature of the real gas. Deduce an expression for the temperature at which the real gas behaves as an ideal gas.
- c) - A gas molecule of diameter $2 \times 10^{-10}m$, calculate the following:
- i – The mean free path of this molecule at the atmospheric pressure and zero absolute temperature and the molecule collision frequency.
- ii- The gas viscosity coefficient where the mass of the gas molecule is $46.23 \times 10^{-27}kg$
- 4 a) -i- On the diagram explain how the heat engine can complete Carnot cycle.
- ii- Deduce an expression for the total work done during this cycle and for efficiency of the heat engine
- b) -i- Give an expression for the Maxwell's equations in thermodynamics and deduce an expression for the entropy change (dS) in terms of C_p and C_v of the gas
- ii- Derive an expression for $(C_p - C_v)$ in terms of the isothermal elastic coefficient λ_T and the thermal expansion coefficient α_p and prove that this expression is applicable for the real and ideal gases
- c) - Calculate the entropy change during the gas isothermal expansion from an initial volume V_i to a final volume $V_f = 4 V_i$ where $= 8.314 J/mol.K^o$

With my best wishes
Prof. Dr. Abd-elhaleem Turkey

Assiut University
Faculty of Science
Department of Physics

First term 2014/2015
Date: 11-1-2015
Time allowed: 2 hour

Course title : Principle of Modern Physics Cod :225

Answer the following questions

Question 1 (5 marks)

1-Write True (T) or False (F) in the following:

- 1- The speed of light is not the same in all reference frames ().
- 2- Proper time is the longest time interval between two events ().
- 3- The light year is a unit of distance ().
- 4- A particle can be accelerated to a speed greater than the speed of light in vacuum ().
- 5- Length contraction occurs in the direction normal to the direction of motion ().
- 6- The density of material does n't change at high speeds comparable to light velocity ().
- 7- Pair production can occurs in free space().
- 8- Compton effect can be considered as an elastic collision. ().
- 9- photo -electric current appears after some time delay following light interaction.()
- 10- The speed of light remains invariant with respect to relative motion of inertial reference frames.()

2- From the relativistic concept of mass and energy show that the kinetic energy of the mass with velocity v is $\frac{m_0 v^2}{2}$ where $v \ll c$. (5 marks)

3- Write down the relativistic kinetic energy and momentum expressions of a relativistic particle, then prove that:

$$E^2 = p^2 c^2 + m_0^2 c^4 . \quad (5 \text{ marks})$$

(2)

4- If the total energy of a particle is two times its rest mass energy, what is the speed of the particles in terms of C ? (5 marks)

5- A galaxy is receding from the earth at speed $15 \times 10^3 \text{ Km/s}$. If one of the emitted light wavelengths is **550 nm**, what is the corresponding wavelength measured by astronomer on the earth? (5 mark)

6- A cubical box of side L_0 as measured by an observer O' at rest with it, moves with velocity v parallel to one side relative to another observer O . prove that the volume measured by O is $L_0^3 \sqrt{1 - v^2 / c^2}$. (5 mark).

7- A beam of UV light of wavelength 350 nm and intensity 1.0 watt/m^2 incident on potassium surface. (a) find The maximum kinetic energy of the photo electrons. (b) If 50% of the incident photons ejects photoelectrons, how many photo electron are emitted /sec if the area of this surface is 1 m^2 , and potassium work function is 2.2 eV. (5 marks).

(3)

8- Calculate the wavelength of x-rays emitted when the potential difference is 12,4 Kv. (5 marks).

9- An electron is trapped (confined) in a box of length 10^{-8} cm in the x-direction. For motion in the x-direction only: (a) what is the ground state energy in eV? (b) what wavelength light is emitted in the transition from $n=2$ state to the $n=1$ state? (5marks).

10- show how De Broglie hypothesis is related to Bohr atomic model .(5 markes).

$$h = 6.626 \times 10^{-34} \text{ J.s}$$
$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{Rydberg constant } R = 1.097 \times 10^7 \text{ m}^{-1},$$
$$\text{electron charge} = 1.6 \times 10^{-19} \text{ C}$$

With my best wishes/ Prof.dr. Aly Othman



Assiut University
Faculty of Science
Department of Physics

Undergraduate
Final Exam (50%)

First semester 2014-2015

Course : Modern Physics
Code : P225
Section : Petroleum Geology
Time : 2 Hours
Date : 11/1/2015

Answer the following question:

Question (1):

(10 Mark)

Write number of each statement and put [$\checkmark$] or [$\times$], then discuss your answer (if $\checkmark$ or $\times$):

- 1- The relativistic γ depends on position x of a moving body.
- 2- Proper time can occur in inertial frames that are at rest or moving with constant velocity.
- 3- Spacetime diagram (in two dimensions) is drawing between ct and x .
- 4- According to EM classical theory, electron will emit from metal with higher energy by increasing intensity of incident light.
- 5- In Photoelectric effect, when the voltage V between emitter and collector is zero, there is a measured value for photocurrent I .
- 6- The Photoelectric effect can occur at any incident wavelength.
- 7- In blackbody radiation, as the temperature increases, the maximum of the curve shifts toward higher frequencies. (draw and discuss)
- 8- Thermal radiation wave is electromagnetic wave.
- 9- Length of an object is invariant under Lorentz transformation.
- 10- In photoelectric, by applying positive voltage to emitter the photocurrent increases with increasing intensity of incident EM waves.

Answer two (2) only of the following questions:

Question (2):

(20 Mark)

- a) Write Lorentz position and time transformation equations and show how these equations will be reduced to Galileo transformation at small velocities. (6 points)
- b) Discuss the conditions of relativistic factor γ and discuss the graph of γ vs β . (6 points)
- c) Define the proper length and proper time. (2 points)
- d) Derive expression for time dilation under Lorentz transformation. (6 points)

Question (3):**(20 Mark)**

- a) Write equation of spacetime interval in X- axis and Show (with draw) how spacetime interval can determine the causality between two events. (8 points)
- b) A spaceship is measured to be 100 m long while it is at rest with respect to an observer. If this spaceship now flies by the observer with a speed of $0.99c$, what length will the observer find for the spaceship? (4 points)
- c) Discuss the success of classical theories in explaining some of experimental results of blackbody radiation. (8 point)

Question (4):**(20 Mark)**

- a) Define the photoelectric effect and discuss it from the following points: (7 points)
- 1- Experiment 2- Parameters of photocurrent 3- Characteristic curve
- b) Discuss the experimental facts of photoelectric effect. (7 points)
- c) Event 1 occurs at $x_1 = 30 \text{ m}$, $t_1 = 2 \times 10^{-8} \text{ s}$ and event 2 occurs at $x_2 = 50 \text{ m}$, $t_2 = 3 \times 10^{-8} \text{ s}$ in frame S . A frame S' moves relative to S with velocity $v = 0.6 c$ m/s along the $X-X'$.
- (i) What is the separation of two events in frame S and S' ? (3 points)
- (ii) What is the time interval between two events in frame S and S' ? (3 points)



(1)
Assiut University
Faculty of Science – Physics Department
Final Exam., Jan. 17, 2015
Course: Physical Optics & Optical Fibers (271P)
Programs: Physics and Physics/Chemistry
Time: Three hours - Total mark: 50 marks



Note: Define all symbols used in your answer. (Questions are presented in two pages)

PART I: (14 marks)

Answer the following questions as shown between brackets:

- 1- The equation: $y=5 \sin(6x-30t)$ (x, y in **m** and t in **sec**) represents a wave motion with a velocity equals to travelling in a medium of refractive index equals to (Fill in spaces) (2 marks)
- 2- The unit of wave intensity is: **J/m².sec, J.m²/sec, W/m or J/m.sec.**
(Choose the correct unit) (1 mark)
- 3- If a wave motion propagates with velocity equals to **5 $\mu\text{m/s}$** in a medium of density **12 Kg/m³**. Then the elasticity of the medium equals to (Fill in spaces)
(2 marks)
- 4- In standing waves, if λ is the wavelength, we get antinodes at distances
a) $x=n\lambda/2$ b) $x=(2n+1)\lambda$ c) $x=(2n+1)\lambda/2$ d) $x=(2n+1)\lambda/4$ e) $x=(2n+1)\lambda/3$
($n= 0, 1, 2, \dots$) (Choose the correct answer and draw a standing wave) (2 marks)
- 5- The phasor addition can be used to obtain the resultant of the superposition of four electromagnetic waves with constant phase difference ϕ .
(Draw this addition and extract the resultant wave when $\phi = \pi/3$) (3 marks)
- 6- The group velocity v_g is expressed in terms of the phase velocity v and wavelength λ .
(Extract this expression) (1.5 marks)
- 7- A light beam is composed of two (electric and magnetic) components. (Draw these components and state the wave equations of them and relations between them in terms of the speed of light in free space).
(2.5 marks)

Follow questions of part II in the next page

(2)

PART II: (36 marks, 9 marks for each question)

Answer only four questions from the following:

- 1- a) Describe how the Fresnel mirrors are used as an interferometer to determine the wavelength. (4 marks)
b) Extract the relation between the refractive index (n) and polarization angle (θ_p). Explain why θ_p is always greater than 45° . (5 marks)
- 2- a) Show how the Nicol prism is used as a polarizer. (4 marks)
b) Explain the physical concept of the population inversion and find its critical value required to produce the laser beam. (5 marks)
- 3- a) Determine the principal components of the communication system. Sketch a diagram showing the constituents of each component. (5 marks)
b) Derive a relation to express the numerical aperture of optical fiber in terms of the refractive indices of its core and cladding. (4 marks)
- 4- a) Draw the profile of the multimode step index (SI) optical fiber. (5 marks)
b) The orders of a diffraction grating monochromatic light from a helium–neon laser of wavelength equals to **480 nm** is incident normally on a diffraction grating containing **6000** grooves per centimeter. Find the angles at which the first, second and third order maxima are observed. (4 marks)
- 5- a) Light of wavelength **580 nm** is incident on a slit having a width of **0.2 mm**. The viewing screen is **2.0 m** from the slit. Find the positions of the first dark fringes and the width of the central bright fringe. What if the slit width is increased by an order of magnitude to **2 mm**? What happens to the diffraction pattern? (5 marks)
b) State four differences between metal wires and optical fibers in communication systems. (4 marks)

♥ My best wishes ♥

Prof. Dr. Mohamed El-Azab Farid

Part I: Choose the correct answer, justify your answer .

(10 Marks)

1. For a sinusoidal applied voltage on an inductor,

- (a) the current and voltage across the inductor are in phase
- (b) the current lags behind the voltage by 90°
- (c) the voltage lags behind the current by 90°

2. At an instant of time during the oscillations of an LC circuit, the current is at its maximum value. At this instant, the voltage across the capacitor

- (a) is different from that across the inductor
- (b) is zero
- (c) has its maximum value
- (d) is impossible to determine

Why?

3. The total energy in a circuit contains a resistor, inductor and capacitor.....with time.

- (a) is constant
- (b) decreases
- (c) increases

Why?

4. An uncharged capacitor (C) and resistor are connected in series to a battery (ϵ) as shown in the Figure, if the switch (S) is just closed

4.1 The instantaneous charge on the capacitor is ...

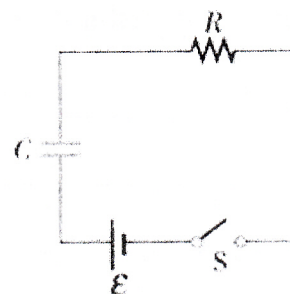
- (a) ϵC
- (b) Zero
- (c) infinity

Why?

4.2 The instantaneous current in the circuit is ...

- (a) ϵ/R
- (b) Zero
- (c) infinity

Why?



(2)

Part II: answer the following,

(15 marks)

P1. Consider the circuit shown in the Figure, which consists of a battery, an uncharged capacitor, a resistor, and a switch. When the switch is open, the potential difference across the capacitor is zero. If the switch is closed at $t = 0$, the capacitor begins to charge.

(8 marks)

(a) derive the instantaneous charge on the capacitor as function of time.

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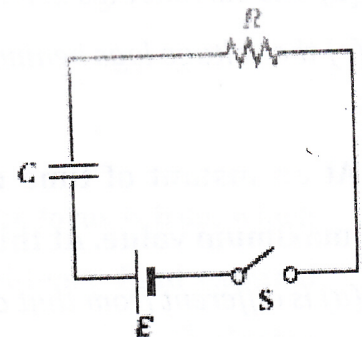
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(b) find the charge on the capacitor at time equals the time constant of the circuit.

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(c) drive the instantaneous current in the circuit as a function of time.

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(d) find the current in the circuit at time equals the time constant of the circuit.

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(3)

P2. The tuning circuit of an AM radio contains an LC combination. The inductance is 0.2mH, and the capacitor is variable, so that the circuit can resonate at any frequency between 550 kHz and 1650 kHz. Find the range of values required for capacitor. (4 marks)

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P3. Compute the quality factor for the circuits described below. (3 marks)

C1. A sinusoidal voltage $v(t) = (40 \text{ V}) \sin(100t)$ is applied to a series RLC circuit with $L=160\text{mH}$, $C=99 \mu\text{F}$, and $R=68 \Omega$.

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C2. An RLC circuit consists of a 150- Ω resistor, a 21- μF capacitor, and a 460-mH inductor, connected in series with a 120-V, 60-Hz power supply.

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Which circuit has the sharp resonance?

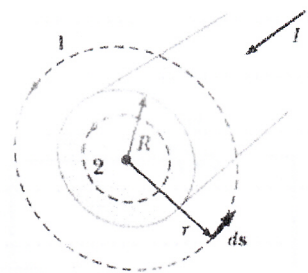
Part III: answer the following,

(25 marks)

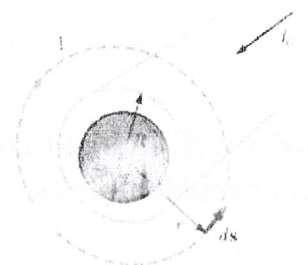
P1. A long, straight wire of radius R carries a steady current I that is uniformly distributed through the cross section of the wire. Calculate the magnetic field a distance r from the center of the wire in the regions:

(8 Marks)

(1) $r > R$



(2) and $r < R$.



(5)

P2. A loop of wire enclosing an area A is placed in a region where the magnetic field is perpendicular to the plane of the loop. The magnitude of B varies in time according to the expression $B = B_{\max}e^{at}$, where a is some constant. That is, at $t = 0$ the field is $B_{\max}$, and for $t > 0$, the field decreases exponentially. Find the induced *emf* in the loop as a function of time. (4 Marks)

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P3. An AC generator consists of 8 turns of wire, each of area $A = 0.09 \text{ m}^2$, and the total resistance of the wire is 12Ω . The loop rotates in a 0.5-T magnetic field at a constant frequency of 60 Hz. (4 Marks)

(a) Find the maximum induced emf.

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(b) What is the maximum induced current when the output terminals are connected to a low-resistance conductor?

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(6)

P4. Assume that a motor in which the coil has a total resistance of $10\ \Omega$ is supplied by a voltage of 120 V. When the motor is running at its maximum speed, the back emf is 70 V. Find the current in the coil. (4 Marks)

(a) when the motor is turned on and

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(b) when it has reached maximum speed.

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P5. A toroid wound with 60 turns/m of wire carries a current of 5 A. The torus is iron, which has a magnetic permeability of $\mu_m = 5000\mu_0$ under the given conditions. Find external magnetic field (H) and total magnetic field B inside the iron. (3 Marks)

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P6. A sinusoidally varying voltage is applied across $20\ \mu\text{F}$ capacitor. The frequency of the voltage is 3 kHz, and the voltage amplitude is 30 V. Find the displacement current in the capacitor. (2 Marks)

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GOOD LUCK

Nagih Shaalan