

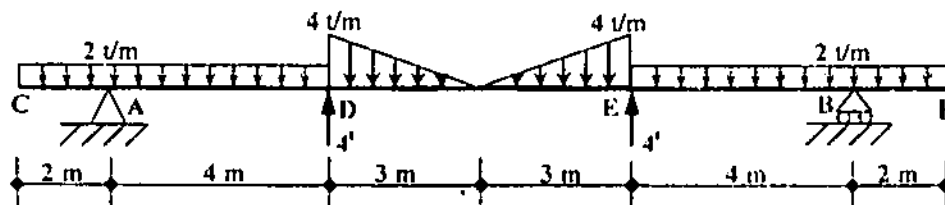


ملحوظة: يجب أن يبدأ كل سؤال في صفحة منفصلة مع مراعاة ترتيب الحل (يتم الحل في ورقة منفصلة خاصة بالمادة)

**ANSWER ALL QUESTIONS** (Total Marks = 50 marks)

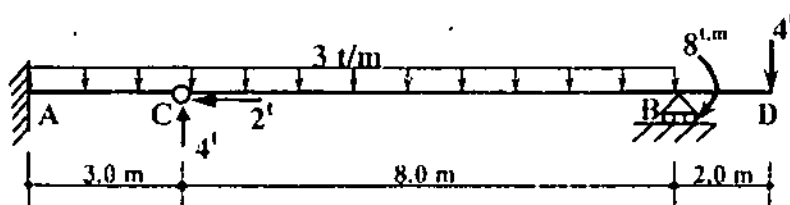
**QUESTION (1)** (14 marks)

For the shown beam, draw the diagrams of internal forces.



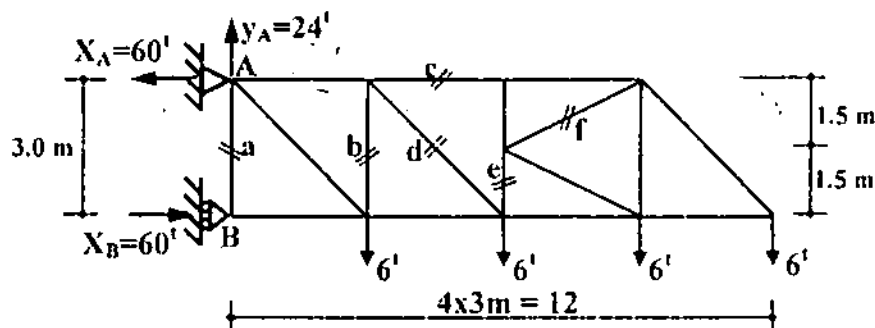
**QUESTION (2)** (13 marks)

For the shown compound beam, draw the N.F.D, S.F.D. and B.M.D. Find the maximum values of the negative and positive bending moments ( $M_{max}^{+ve}$ ).



**QUESTION (3)** (12 marks)

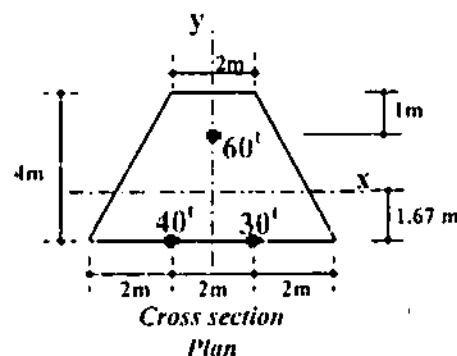
For the shown truss, Calculate the forces in the marked members a, b, c, d, e, f and g.



**QUESTION (4)** (13 marks)

For the shown footing carrying the shown column loads, the footing area properties are: ( $A = 16 \text{ m}^2$ ,  $I_x = 19.5520 \text{ m}^4$ ,  $I_y = 26.6755 \text{ m}^4$ ). It is required to:

- 1) Calculate and draw the normal stress distribution under the footing.
- 2) Check (recalculate) the given values of A,  $I_x$  and  $I_y$ .





Answer All the Following Questions:

- 1) For the circuit shown in Figure 1, find the value of  $k$  so that the output voltage  $V_o = 2V$ .

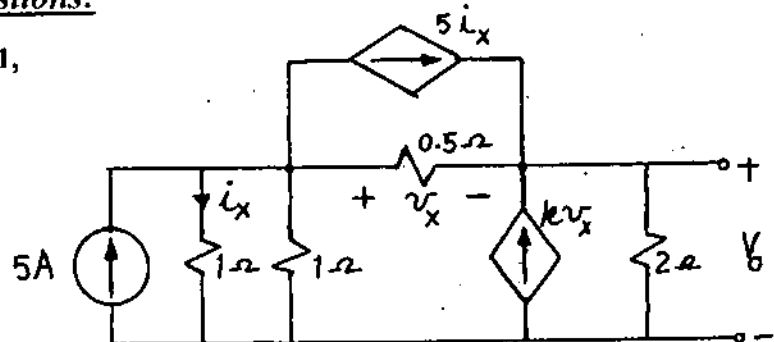


Fig. 1

- 2) For the circuit shown in Figure 2, the load resistance  $R_L$  is adjusted to receive maximum power. Find the value of  $R_L$  and the maximum power.

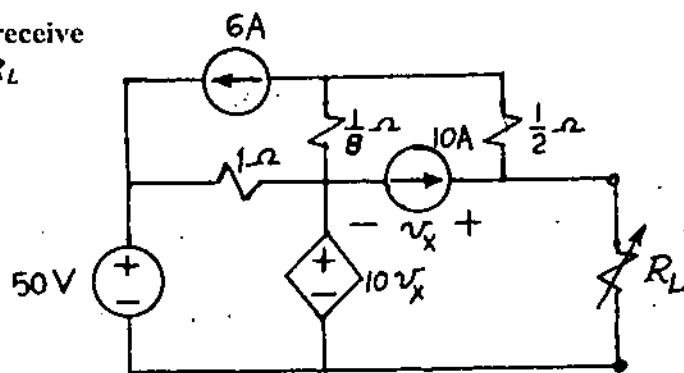


Fig. 2

- 3) Find the steady state voltage  $v_x(t)$  for the circuit shown in Figure 3.

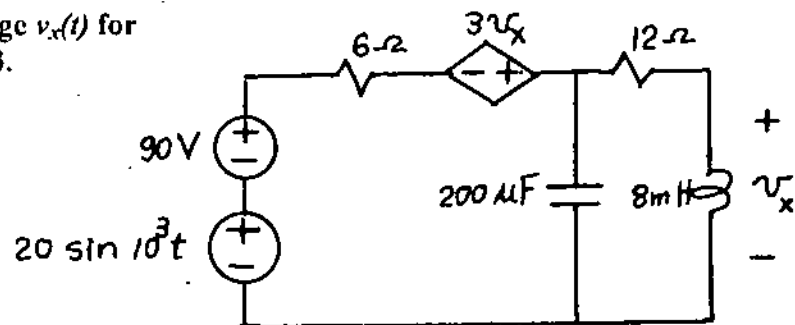


Fig. 3

- 4) Use source transformation to find  $i_x$  in the circuit shown in Figure 4. Then find the power of each source.

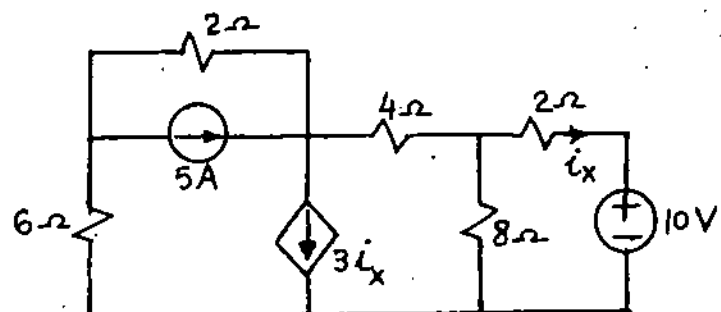


Fig. 4

### PART(II) A.C

5.a. The current through a series circuit R L C (  $R = 1 \Omega$ ,  $L = 1$  Henry , and  $C = 0.5$  Farad) is given by

$$i(t) = e^{-t} \sin(t) \text{ Ampere for } \pi > t > 0 .$$

Find expressions for  $V_R(t)$ ,  $V_L(t)$ ,  $V_C(t)$ , and  $V_{\text{total}}(t)$ .

- i) Draw the waveform of  $i(t)$  and  $V_{\text{total}}(t)$  ( compute three values only ,at 0 , at  $\pi$  and maximum)
  - ii) Compute the value of the time at which current is maximum, and the stored energy in L at that time in Joules. use the following :  $\int e^{-t} \sin(t). dt = -0.5 e^{-t} [\sin(t) + \cos(t)]$
- b. Two impedances  $Z_1$  and  $Z_2$  are connected in parallel,  $Z_1$  consists of R in series with L and  $Z_2$  consists of R in series of C. If ,  $L = R^2 C$  , prove that the equivalent impedance is constant and equals to R for all frequencies.
- Find i) the value of the equivalent Impedance when  $L = 0.04$  Henry and  $C = 100 \mu F$  .
- ii) the resonance frequency .

6.a. A source of 2400 V(rms) at 50 Hz is applied across three parallel loads L1 ,L2 and L3 as follows:

L1 absorbs 18 kW and 24 kVAR.

L2 absorbs 60 KVA at 0.6 leading power factor.

L3 absorbs 18 kW at unity power factor.

Compute: i) the equivalent impedance of the parallel loads as seen from the supply.

ii) the total active , reactive and apparent power.

iii) the current from the supply and its power factor.

b) The current source in the circuit shown in Fig.(1) is 10 A. Use source transformation and Thevinin'theorem , consider  $\omega = 1000$  rad/sec. Compute:

i) the value of resistance R for maximum dissipated power in it. Then calculate the value of this maximum dissipated power.

ii) the value of resistance R for maximum dissipated power in the whole circuit. Then calculate the value of this maximum dissipated power in the whole circuit.

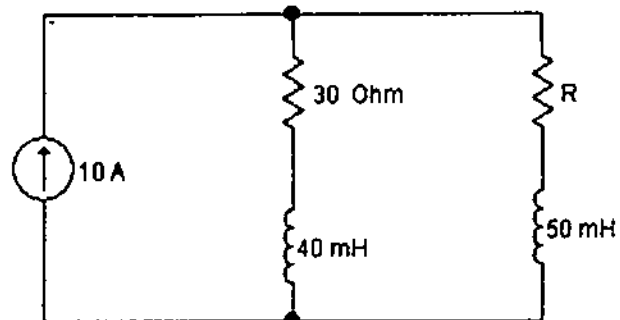


Fig.(1)

7.a Find the equivalent parallel resonance circuit for the circuit shown in Fig.(2). Then , find the resonance frequency , band width , quality factor and cutoff frequencies.

IF the supply voltage is 200 volt rms , calculate the stored energies in L and in C at resonance.

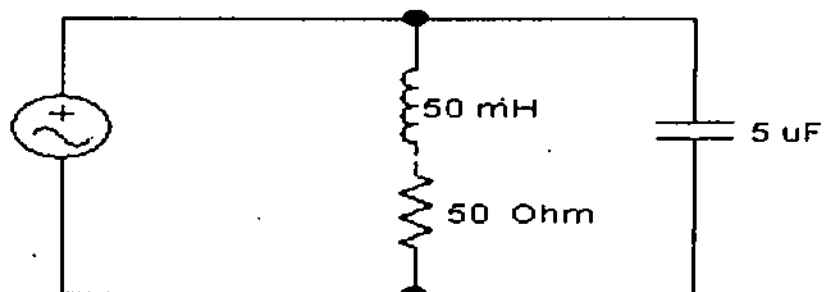


Fig.(2)

b. For Fig.(3), a three phase supply of  $V_{AN} = 200 \angle 0^\circ$ ,  $V_{BN} = 200 \angle -120^\circ$ ,  $V_{CN} = 200 \angle +120^\circ$  with sequence abc, is applied across a three phase load star connection in parallel with delta connection as follows:

$$Z_1 = 10 + j0 \, \Omega, \quad Z_2 = 20 + j0 \, \Omega, \quad Z_3 = 20 + j0 \, \Omega$$

$$Z_4 = Z_5 = Z_6 = 6 + j8 \, \Omega$$

where N and n are the star points of the supply and the load,

Derive an expression for the voltage between n and N in terms of the given parameters

Compute : i) the currents from supply in each phase

ii) the total active, reactive and apparent power to the loads.

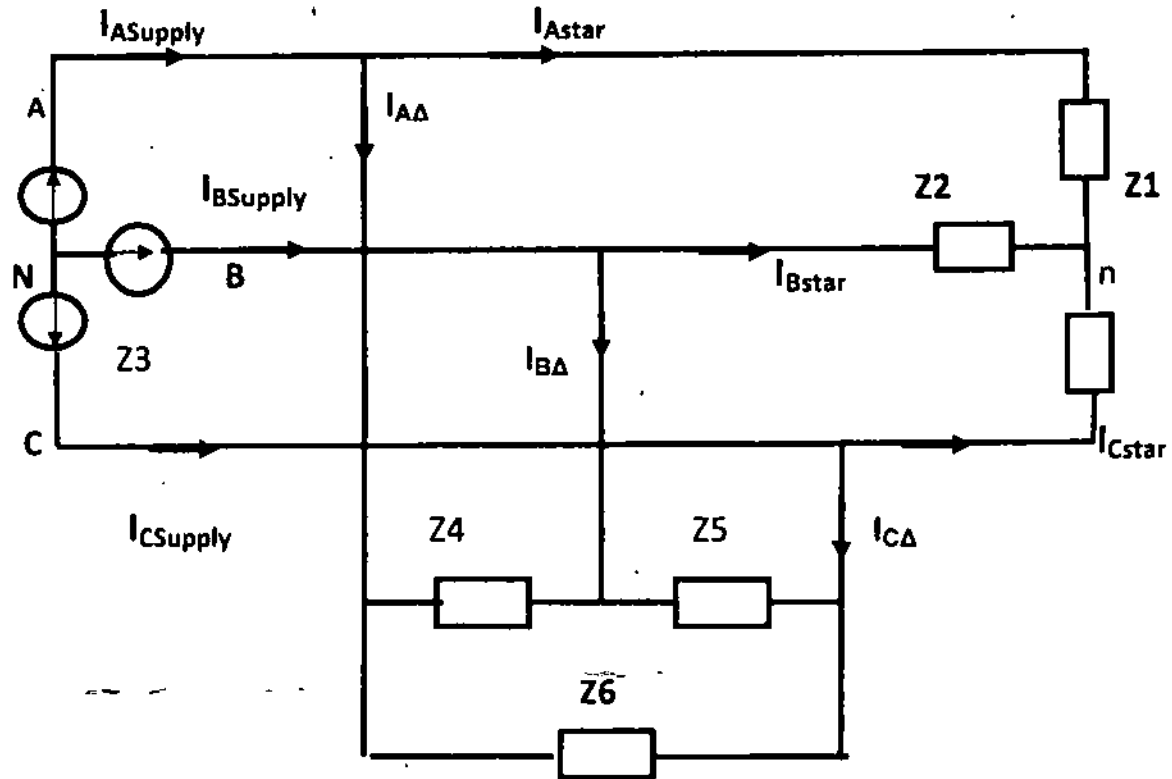


Fig.(3)

prof. Dr. M. Zakaria - Prof. Dr. F. Mabrouk .



Mathematics (3)  
First year  
Time allowed: Three Hours

رياضيات - 3  
السنة الأولى  
الزمن: ثلاث ساعات

يرجاء بداية أجابة كل سؤال في صفحة جديدة - الجزء الخاص بذكور هشام من جهة والدكتور عمرو من الجهة الاخرى

Part One:

i. i. Solve the following D.E  $\left(\frac{dy}{dx} + (1 - \sec x)y^2\right) \tan x = y$  (4 marks)

ii. Solve the following D.E  $ye^x \frac{dy}{dx} = e^{-x} + e^{-(2x+y)}$  (4 marks)

iii. Solve the following D.E  $2x \frac{dy}{dx} + x^2 \left(\frac{dy}{dx}\right)^4 - y = 0$  (5 marks)

iv. Solve the following D.E  $y''' + 4y' + 4y = \sinh^2 x$  (5 marks)

v. Solve the following D.E  $y''' - 10y' + 25y = e^{5x} / \cos^2 x$  (5 marks)

2 i. Given the differential equation  $a \frac{d^2 y}{dx^2} + b \frac{dy}{dx} + c y = f(x)$  if the function  $f(x)$  is not one of the standard forms and the solution of homogeneous equations can be obtained, then prove how can you get the particular solution in general form (4 marks)

ii. Solve the following D.E  $y'' - 2y' + y = x e^x \ln x$  (6 marks)

iii. Solve the following D.E  $x \frac{d^2 y}{dx^2} + \frac{dy}{dx} + \frac{1}{x} y - \frac{5}{x} \sin \ln x^4 = 0$  (6 marks)

3.i. Show that if  $y = e^x$  or  $e^{2x}$  or  $\sin x/x$  is a solution for the homogeneous differential equation of  $y'' + (1+2x \cot x - 2/x^2) y = x \cos x$  then find the total solution (8 marks)

ii. By using the series solution find to the three terms the solution of the differential equation.  $(x^2 + 2) y'' + 3x y' - y = 0$  (8 marks)

P.T.O  $\Rightarrow$

Part Two

4) a) Derive a recurrence relation for the integral  $I_n = \int \sinh^n x \, dx$ . then Evaluate  $I_4$

b) Evaluate  $\lim_{x \rightarrow \pi} (1 + \cos x)^{\sin x}$

5) a) If  $z = f(x^2 - y^2) + g(\frac{x}{y})$  evaluate  $y \frac{\partial z}{\partial x} + x \frac{\partial z}{\partial y}$

b) Evaluate the stationary points of the function  $z = 2x^3 + xy^2 + 5x^2 + y^2$  hence determine their types.

c) Using differentiation under the integration sign evaluate  $\int_0^{\infty} \frac{1 - e^{-ax}}{xe^x} dx \quad a \geq 0$

6) a) Evaluate  $\int_0^1 \int_{\sin^{-1} y}^{\pi/2} \sec^2(\cos x) dA$

b) Show that  $\int_0^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$

Evaluate

i)  $\Gamma(0.5)$

ii)  $\int_0^1 \frac{dx}{\sqrt{-\ln x}}$

*Good Luck*

105/150



MTH.3 (EMP113)

First Year

Duration: 3 hours

رياضيات  
السنة الدراسية: الأولى  
الزمن: ثلاث ساعات

**Answer all questions:**

**Question (1)**

- a) If  $2x + r^2 + t^2 = 0$  and  $y = rt$ , find  $\frac{\partial r}{\partial x}$  and  $\frac{\partial r}{\partial y}$
- b) A lamina has the shape of the region bounded by the graphs:  $x^2 + y^2 = a^2$ ,  $y = x + a$  and  $y \geq 0$ .  
If the density of mass is given by  $\rho(x, y) = yx^2 \text{ gm/cm}^2$ , find its mass.
- c) Prove that the integral  $I = \int_0^{\infty} e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$ , and hence or otherwise evaluate the following integrals:

i)  $\int_0^{\infty} \int_0^{\infty} xy e^{-(x^2+y^2)} dx dy$

ii)  $\int_{-\infty}^{\infty} e^{-(ax)^2} dx$

[ Hint: Note that the integrals are convergent ]

**Question (2)**

- a) Solve the differential equation  $x^2 y'' + xy' + y = \sec(\ln x)$
- b) Consider the differential equation  $xy'' - 2y' + 9x^5 y = 18x^8$ . Show that the transformation  $t = x^3$  transforms the equation to  $\frac{d^2 y}{dt^2} + y = 2t$ , and hence find the general solution of the original equation.

**Question (3)**

- a) Given the differential equation  $y'' + 4xy' + (4x^2 + 2)y = 0$ .
- i) Find the constant "a" such that  $y_1 = e^{ax^2}$  be a solution.
- ii) Discuss the possible methods to find the general solution and hence use only one method to solve.
- b) Check the convergence or divergence of the given integral. If it converges, find its value.

$$\int_{-\infty}^{\infty} \frac{dx}{x^2 - 2x + 2}$$

**Question (4)**

- a) Find the solution of the following initial-value-problem :

$$(x+1)y'' + y' = 2x, \quad y(0) = y'(0) = 1$$

- b) Find the general solution of the equation

$$D(D^4 - 16)y = \cos x + 2x + e^{2x}$$

**Question (5)**

- a) Use the power series method, near  $x = 0$ , to solve the differential equation

$$(1+x^2)y'' - 4xy' + 6y = 0. \quad \text{What is your comment on the obtained solution?}$$

- b) Evaluate the following

i)  $\lim_{x \rightarrow \infty} \frac{x + \cos x}{x - \sin 2x},$

ii)  $\lim_{x \rightarrow \infty} \frac{1 + \sin x}{1 + \cos x}$

**Question (6)**

- a) The charge  $Q$  on the capacitor in a R- C series circuit is given by the equation

$$R \frac{dQ}{dt} + \frac{Q}{C} = E, \quad Q(0) = 0.015 \text{ coulombs}$$

Let  $R = 10 \, \Omega$ ,  $E = 50 \text{ V}$ , and  $C = 4 \times 10^{-4} \text{ farad}$ . Find the following:

$Q(t)$ ,  $I(t)$ ,  $I(0)$  and the current after a long time.

- b) Solve the following system of differential equations:

$$x'(t) = t - y(t), \quad \text{and} \quad y'(t) = x(t) - t, \quad \text{with the initial conditions } x(0) = 3, y(0) = 0.$$



جامعة الاسكندرية

كلية الهندسة

قسم الهندسة الكهربائية

السنة الدراسية الأولى

اسم المقرر: القوانين و التشريعات

مدة الامتحان: ساعتين

( ٢٠ درجة )

السؤال الأول - ضع علامة / أو x و صحح العبارات الخاطئة:

١. تفتقد القوانين التي تحدد سلطات رئيس الجمهورية صفة العمومية و التجريد لأنها تطبق على فرد واحد فقط
٢. لا يجوز اجتماع أكثر من صورتين من صور الجزاء كعقوبة لمخالفة قاعدة قانونية واحدة
٣. يعتبر القانون التجارى أحد فروع القانون الخاص
٤. تفتقد القواعد المكملة لصفة الإلزام
٥. تعتبر قاعدة "مصاريف عقد البيع تكون على المشتري ما لم يوجد اتفاق يقضى بغير ذلك" قاعدة مكملة
٦. تختص السلطة التشريعية باصدار التشريع الأساسى
٧. إن عدم تطبيق التشريع لمدة طويلة يؤدي إلى إلغائه
٨. عند إبرام العقد ، يمكن اعتبار السكوت قبولا
٩. يجب أن تكون العادة شاملة لكل إقليم الدولة حتى تعتبر عرفا
١٠. يفتقد العرف لصفة الإلزام كأحد خصائص القاعدة القانونية
١١. تعتبر التصرفات الدائرة بين النفع و الضرر الصادرة من الصبى المميز تصرفات باطلة بطلان مطلق
١٢. الأشياء المثلية هي التي يقوم بعضها مقام بعض عند الوفاء بالإلتزام
١٣. تأخذ تصرفات المجنون حكم تصرفات الصبى المميز بشرط صدور حكم بالحجر عليه
١٤. فى المسئولية التقصيرية ، لا يسأل صاحب الخطأ عن الضرر غير المباشر إلا فى حالتى الغش و الإهمال الجسيم
١٥. تعتبر قرابة الشخص لعمه من الدرجة الثالثة
١٦. الجريدة الرسمية للدولة هي جريدة الأهرام
١٧. تعتبر الغرامة أحد صور الجزاء الإدارى
١٨. يحق للقاضى إلغاء الشروط التعسفية فى عقود الإذعان
١٩. لا يجوز تطبيق القانون على شخص لم يعلم بصدوره تطبيقا لقواعد العدالة
٢٠. لا يملك القاصر موطن عام اختياري

( ١٥ درجة )

السؤال الثانى - أجب إجابات مباشرة و مختصرة عن الأسئلة التالية:

١. ما الفرق بين القانون العام و القانون الخاص؟
٢. ما الفرق بين الموطن الاختياري و الموطن المختار؟
٣. ما هي جهات تأديب المهندسين المنتمية إلى مجلس الدولة؟



[Answer all the following questions]

1. If the kinetic energy of a proton is four times its rest energy, with what velocity is the proton moving? (5 pts)
2. A spacecraft is launched from the surface of the Earth with a velocity of  $(0.8c)$  at an angle of  $(30.0^\circ)$  above the horizontal positive  $x$  axis. Another spacecraft is moving past, with a velocity of  $(0.6c)$  in the negative  $x$  direction. Determine the magnitude and direction of the velocity of the first spacecraft as measured by the pilot of the second spacecraft. (15 pts)
3. Photoelectrons are emitted from a metallic surface with maximum velocity of  $3.86 \times 10^5$  m/s when a light with wavelength of 425 nm is used.
  - a. What is the work function of the surface in eV?
  - b. What is the cutoff frequency for this metallic surface?
  - c. What will happen if a light with a wavelength of 650 nm is used? (10 pts)
4. A photon of energy 600 keV (and moving in the  $+x$  direction) is scattered from a free electron (initially at rest). The scattered photon makes an angle of  $39.7^\circ$  with the  $x$ -axis, and the scattered electron makes an angle of  $-51.8^\circ$  with the  $x$ -axis. Calculate:
  - a. The energy of the scattered photon.
  - b. The energy of the recoil electron.
  - c. The momentum of the recoil electron.
  - d. The de Broglie wavelength of the recoil electron. (15 pts)
5. The longest wavelength in the Lyman series ( $n_f = 1$ ) for Hydrogen is 121.5 nm. Calculate the value of the Rydberg constant. (5 pts)
6. In a transition to a state having energy of -3.41 eV, a hydrogen atom emits a photon with a wavelength of 489 nm.
  - a. Determine the binding energy of the initial state.
  - b. Determine the quantum numbers of the initial and final states. (10 pts)
7. An alternative development of the Bohr theory for the Hydrogen atom begins by assuming that the angular momentum of an orbital electron must be an integral multiple of  $h/2\pi$ . Show that this assumption leads to



## EE131: Modern Physics

First Year

Time allowed: 3 hours

الفيزياء الحديثة

السنة الدراسية : الأولى

الزمن : ثلاث ساعات

$$r_n = \frac{n^2 h^2 \epsilon_0}{\pi m e^2}$$

knowing that the attractive force between the electron and the nucleus of the atom is

$$F_e = \frac{1}{4\pi\epsilon_0} \frac{e^2}{r^2}$$

the centripetal force is

$$F_c = \frac{mv^2}{r}$$

and the potential energy of the electron is

$$PE = - \frac{1}{4\pi\epsilon_0} \frac{e^2}{r}$$

(15 pts)

Electron mass  $m = 9.1 \times 10^{-31}$  kg.

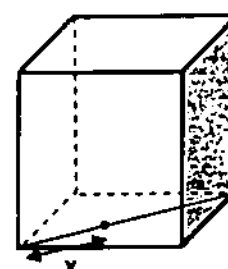


- 1- a- Mention the different types of light control. (1 mark)  
b- Explain the importance of CRI and CCT in determining the light quality. (3 marks)  
c- What is meant by:  
i. SPD,  
ii. IP (1 mark)  
d- Explain how the following lamps can produce light:  
i. Fluorescent  
ii. LEDs  
iii. Tungsten Halogen Lamps

(8 marks)

e- Four 500-W metal halide lamps are suspended 12-m above the ground at the corner of a square 10-m wide. If each lamp has an efficacy 95 lm/W:

- i. Calculate the illumination on the ground in lux at any point located along the diagonal with distance  $x$  from the corner.  
ii. Sketch with scale the illumination as function of  $x$ .  
iii. Indicate the point along the diagonal at which the illumination is minimum. (8 marks)



- 2- The following table includes data for the top half of a symmetric 50-Hz hysteresis loop for a specimen of magnetic steel:

B (Tesla)	0	0.2	0.4	0.6	0.7	0.8	0.9	1	0.95	0.9	0.8	0.7	0.6	0.4	0.2	0
H (AT/m)	48	52	58	73	85	103	135	193	80	42	2	18	29	40	45	48

If  $H(t) = 48 \sin 314t$ , draw  $B(t)$  (5 marks)

- 3- a- Explain how to determine the transformer parameters using no-load and short circuit tests. How can the percentage voltage drop of the transformer and its efficiency be estimated using these tests? (4 marks)

b- Draw the approximate phasor diagram of a single phase transformer for leading power factor and show how the voltage drop can be estimated. At which power factor can the secondary voltage be equal to the no load voltage? Justify. (4 marks)

c- A 16 kVA, 2400/240 V transformer was tested to by open-circuit and short-circuit tests. Each test was performed at the rated values. The following data was obtained:

$$P_{OC} = 140 \text{ W}$$

$$P_{SC} = 150 \text{ W}$$

- i. Plot with scale the transformer efficiency at upf as function of percentage loading ( $n$ ).  
ii. Determine the percentage loading range at which the transformer efficiency is greater than 96%.  
iii. Plot with scale the transformer efficiency at full load as function of the load power factor.  
iv. Determine the power factor range at which the transformer efficiency at full load is greater than 92%. (5 marks)

d- A 12 kVA, 2500/250 V transformer has the following parameters referred to the primary side:

$R_{eq} = 1 \Omega$   $X_{eq} = 2 \Omega$   $X_m$  and  $R_c$  are neglected.

- i. Plot with scale the percentage voltage regulation as function of load power factor at full load.  
ii. At which power factor the secondary voltage is equal to 250V at full load?  
iii. Plot with scale the percentage voltage drop at 0.8 pf lag as function of percentage loading ( $n$ ).  
iv. Determine the percentage loading range at which the percentage voltage drop at 0.8 pf lag is less than 4%. Comment on your answer. (7 marks)

Alexandria University  
Faculty of Engineering  
First Year - Final Exam, 16 Jan. 2014

Electrical Engineering Department.  
Introduction to Energy Systems-Part I  
Time allowed: 3 Hours (2 Parts)

- This exam will be graded out of 30 Marks.
- Solve only 3 questions. All questions are equally weighted.
- In your answer sheet, only the first three 'uncut' questions will be graded.

- 1- a- Sketch the layout of a combined cycle steam power station showing all relevant components. Describe the principle functions and advantages of such power stations. **(2 marks)**
  - b- Environmental impacts of steam power stations represent a worldwide major concern. List different types of possible emissions of thermal power plant, showing how these emissions would be formed and describe a technology that aims to eliminate such emissions. **(3 marks)**
  - c- A diesel engine power plant has one 700 kW and two 500 kW generating units. The fuel consumption is 0.28 kg per kWh and the calorific value of fuel oil is 10200 kcal/kg.  
Estimate:
    - i. The fuel oil required for a month of 30 days and
    - ii. the overall efficiency. Plant capacity factor = 40% **(5 marks)**
- 
- 2- a- Describe the basic principle of operation of a hydraulic Pumped storage system. **(4 marks)**
  - b- A hydro-electric power station has a reservoir area of 2.4 square kilometers and capacity  $5 \times 10^6 \text{ m}^3$ . The effective head of water is 100 m. the penstock, turbine, and generation efficiencies are 95%, 90% and 85% respectively.
    - i. Calculate the total electrical energy that can be generated from the power station.
    - ii. If a load of 15,000 kW has been supplied for 3 hours find the fall (reduction) in reservoir level. **(6 marks)**
- 
- 3- a- The fission of Uranium235 ( $\text{U}^{235}$ ) nucleus yields about 220 Mev on the average. Knowing that Avogadro's number is  $6.0225 \times 10^{23}$  molecules per gm molecular weight and 1 eV equals  $1.6021 \times 10^{-19} \text{ J}$ , determine:
    - i- the heat energy generation rate in MW-day of 1gm  $\text{U}^{235}$  fuel burnt,
    - ii- If the calorific value of coal is 7.5 kWh/kg, find the coal consumption in tons to produce the same amount of heat energy of 1 kg  $\text{U}^{235}$  burn up.
    - iii- If the thermal efficiency is 80% and that of the generator is 90%, what is the net output electric energy produced by the burn of 1 kg  $\text{U}^{235}$ ? **(5 marks)**
  - b- A central reservoir solar thermal power plant uses 1000 heliostats that have  $50 \text{ m}^2$  of reflecting surface area. The average solar incident radiation energy during 10 h operation on clean sunny day is  $750 \text{ W/m}^2$ . The overall efficiency of the plant is 5%. The efficiency of the steam power plant is

30%. A constant 20% of the incident energy of the reservoir is assumed to go to storage during operation. Estimate the power plant output in MW, at peak condition and at shut down. Assume the efficiencies are constant during the day. **(5 marks)**

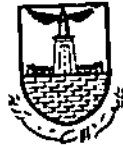
- 4- a- Define the term cut-in and cut-out wind speeds. Explain briefly the different control techniques of wind turbine speed to deliver as much power as it is designed for. **(4 marks)**
- b- Suppose that a NEG Micon 750/48 wind turbine is mounted on 50-m tower in an area with 5 m/s average wind speed at 10-m height (all heights are referred to sea level). Assume standard air density ( $1.225 \text{ kg/m}^3$ ), with roughly cultivated area of low crops and obstacles. Consider the surface roughness table given below. Assume an overall efficiency of 30%.
- Calculate the Specific Rate Capacity (SRC) of the turbine.
  - Estimate the annual energy delivered by the plant. **(6 marks)**

**Table1 Surface Roughness Coefficients**

class		roughness	landscape features
no.	name	length: m	
1	sea	0.0002	open water, tidal flat, snow with fetch above 3 km
2	smooth	0.005	featureless land, ice
3	open	0.03	flat terrain with grass or very low vegetation, airport runway
4	roughly open	0.10	cultivated area, low crops, obstacles of height H separated by at least 20 H
5	rough	0.25	open landscape, scattered shelter belts, obstacles separated by 15 H or so
6	very rough	0.5	landscape with bushes, young dense forest etc separated by 10 H or so
7	closed	1.0	open spaces comparable with H, eg mature forest, low-rise built-up area
8	chaotic	over 2.0	irregular distribution of large elements, eg city centre, large forest with clearings

*Good Luck*

*Dr. Nabil Abbasy*



**اولى حاميات مادة [فيزياء حديثة]**

الاجابة بالقلم الجاف والرسم بالقلم الرصاص

Physical constants:  $e=1.6 \times 10^{-19}$  Coulomb,  $m_0=9.1 \times 10^{-31}$  kg,  $h=6.62 \times 10^{-34}$  Joule-sec  $=4.15 \times 10^{-15}$  e.V-sec  
 $c=3 \times 10^8$  meter/sec,  $m(v) = m(0)/(1-\beta^2)^{1/2}$  where  $\beta = v/c$

**SOLVE THE FOLLOWING QUESTIONS:**

- 1-a- Find an expression for the particle momentum in terms of its energy at rest or  $E(0)$  and its total energy when moving with a velocity  $E(v)$ . [10 points]
- b- An electron moves in a potential of  $10^6$  volt .What is the value of its momentum.? [10 points]
- 2- a-b Explain the photo-electric effect.  
 b-A photon of wavelength  $\lambda = 0.3 \mu$  meter. It falls on a surface of work function  $\phi = 1$  e volt. What is the value of the emitted electron energy in e.V.? [10 points]
- 3-The single electron model was based on the force equation :  $mv^2/R = e^2/4\pi\epsilon_0 R^2$  and the quantum mechanics law  $mvR = nh$ . Find the expression for the radius of the orbit and the electron velocity. Use the above relations to get the kinetic energy and the potential energy .Add up to get an expression for the electron total energy of the form:  $E_n = R_H/n^2$ . [15 points]
- 4- a- Explain Hund's rule for electron distribution among energy states described by the quantum numbers  $[n, l, m, s]$  in a multi-electron atom
- b- Draw a table as

[Electron NO]	[n]	[l]	[m]	[s]
1	1	—	—	—

to show the electrons distributon among the energy states for an atom with atomic number  $=Z=7$  using Hund's rule [10 points]

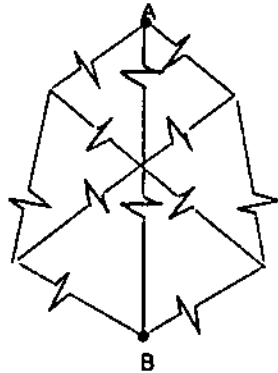
- 5-a-The nuclear binding energy per nucleon  $= -\Delta E/A$  is function of the atomic weight  $[A]$ . Sketch this curve and explain the meaning of fission and fusion of nuceii .
- b- State the terms included in the liquid drop model for the nuclear mass and show how they are related to the atomic weight  $A$  . [15 points]
- c-State the semi-emperical terms that are related to the values  $(A-Z)$  and  $(Z)$ .
- 6- a- Give an example for onc dimensional crystal.
- b- Sketch the possible shapes of a two dimentional crystal.
- c-In a single crystal a plane intersects the x-axis at lattice point=1 and it is parallel to both the y -axis and the z-axis. What are the plane~s Miller indices? [10 points]
- 7-a- What are the number of lattice points per lattice in a face cornered cubic lattice?
- b-A crystalline solid with a body centered cubic lattice has a density  $= 16$  gram/cm<sup>3</sup>. The lattice distance  $= 1.4 \text{ \AA}$  . What is the atomic weight of the material's atom? [10 points]
- 8-a-What is the meaning of an energy band diagram and the energy band gap in a solid?
- b -Use the above statements to show the difference between a conductor, a semiconductor and an insulator .[10 points]

**Answer the following questions:**

**Part 1: electrical circuits:**

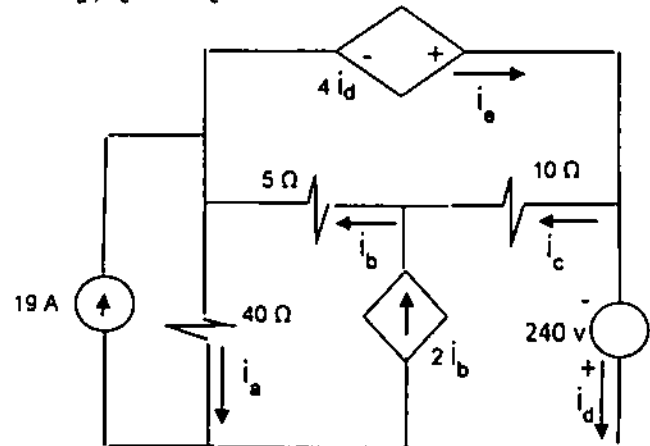
**Q-1:**

If each resistance in the circuit shown equals 1 ohm, find the equivalent resistance between



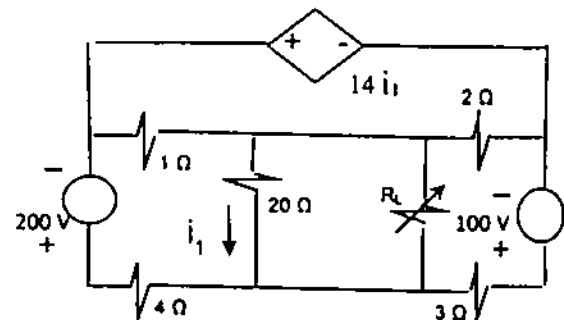
**Q-2:**

Find  $i_a$ ,  $i_c$  and  $i_e$ .



**Q-3:**

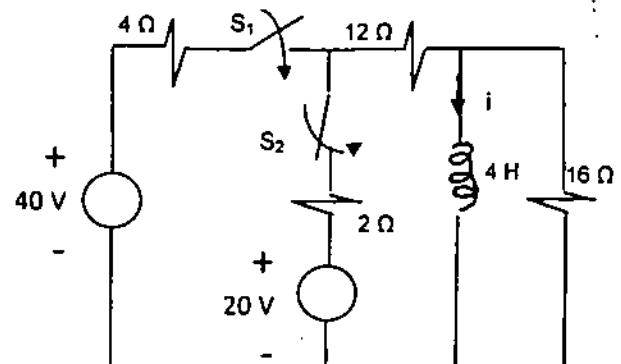
In the circuit shown, if  $R_L$  is adjusted to absorb maximum power from the circuit. Calculate The value of  $R_L$ , and its absorbed power.



**Q-4:**

At  $t = 0$ , switch  $S_1$  is closed were open. After 2 seconds, switch  $S_2$  is closed. Find :

- $i(t)$ , and for  $t > 0$ .
- calculate  $v$  at  $t = 1$  sec, and 4 sec.





## Part 2: Electromagnetics Fundamentals

### Answer ALL the following Questions:

#### Q-5

A capacitor is formed of two concentric spheres of radii  $a$  and  $b$  ( $a < b$ ). The charges on the spheres are  $Q$  and  $-Q$ , respectively. The region between the spheres is filled with a dielectric medium whose relative permittivity at a distance  $r$  from the center is

$$\epsilon = \left(\frac{a}{r}\right)^3 e^{-\left(\frac{r}{a}\right)^2}, \quad a \leq r \leq b.$$

Determine the capacitance and the energy stored in the electrostatic field.

#### Q-6

An iron bar of 20cm long and  $2\text{cm}^2$  diameter is bent into a ring, the gap between the ends being 1mm. The ring is then uniformly wound with 5000 turns of wire. Calculate the current required to produce a flux of 0.5mWb in the magnetic circuit.

The magnetization curve of the core material is given by the following table:

$H$ [AT/m]	2500	3000	3500	4000
$B$ [Wb/m <sup>2</sup> ]	1.55	1.58	1.6	1.615

#### Q-7

A rectangular loop carrying a constant current  $I$  is located in the  $x$ - $z$  plane centered at the origin as shown in Figure 5. The loop is subjected to a constant magnetic field  $\vec{B} = B_0 \vec{a}_y$ .

- Determine the net force acting on the loop.
- If the loop is oriented in such a way that the unit vector normal to its plane makes an angle  $\theta$  with  $\vec{B}$ , find the torque acting on the loop, if any.

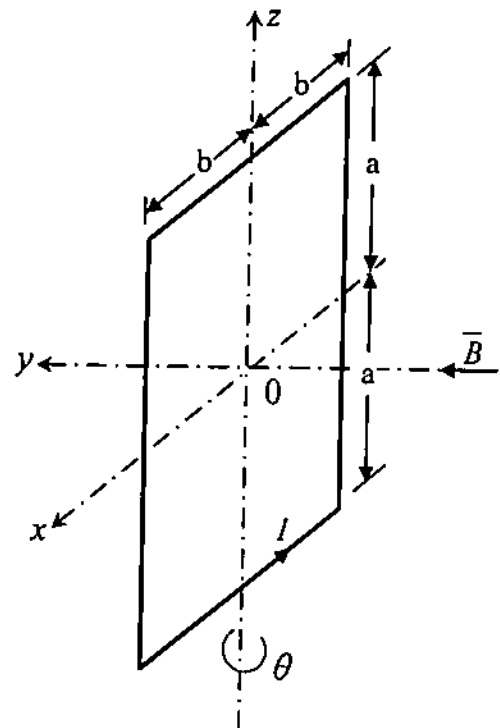


Figure 5

**Q-8**

Find the force of translation on a square loop of 4cm side and located in the  $y$ - $z$  plane when subjected to the magnetic field of a very thin wire of infinite length located on the  $z$  axis, as shown in Figure 6. Assume that  $I_1=15\text{A}$  and  $I_2=50\text{A}$ .

**Hint:** The flux density  $B$  is perpendicular to the plane of the loop.

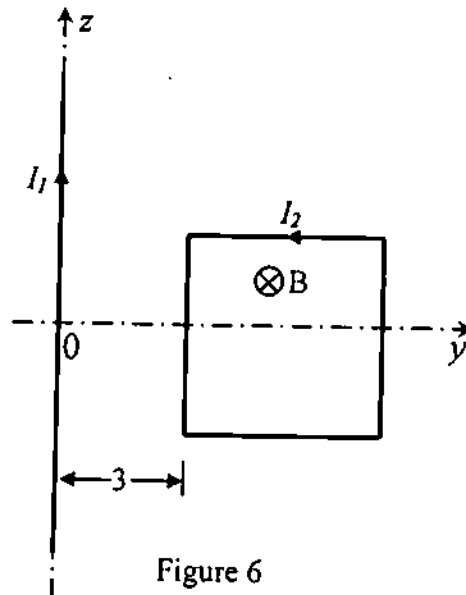


Figure 6

Best Wishēs

1/10/20