Alexandria University
Faculty of Engineering
Specialized Scientific Programs

SSP

جامعة الإسكندرية
كلية الهندسة
البرامج العلمية المتخصصة

June , 2009

June, 2008

Course title Number:organic chemistry 2 GP(204).....

اسم المقرر والرقم الكودى له:كمياء عضوية ... GP(204).....

Time allowed:3 hs.....

الزمن :.....3 ساعات.

Answer All Questions

Question one:

A-State whether the following statements are false or true and correct the false ones:

1-UV has a higher frequency than IR.

2-IR gives more information about the organic compound than mass spectrum.

3-In IR the organic compound is fragmented into smaller charged bodies..

4-Mass spectrum has a different principle of operation than IR.

5-Conjugation may cause absorbance shift in IR.

6-Cis-and trans-isomers give IR absorbance at different wave numbers.

7-IR absorbance for primary, secondary and tertiary alcohols is at the same wave number.

8-Aromatic compounds give a clear absorbance at high wave numbers.

9-There is no problems at all with IR analysis.

10-UV causes less excitation to electrons than IR.

11-As the concentration of organic compound increases, UV absorbance at λ_{max} increases.

12-UV calibration curve is always a straight line.

13-UV can be used to detect functional groups in the organic compound.

14-UV analysis can be used for colored organic compounds.

15-All UV measurement should be done at λ_{min}.

16-IR charts are the same as mass spectrum charts.

(16x1/2=8points)

B-Discuss the main differences between UV and IR analysis?

(2points)

Exam Committee: Lecturer Name , Dr. Taghreed M.Z. , Prof.Dr.H. A. A.Farag

Question two:

A-State whether the following statements are false or true and correct the false ones:

1-Polyethylene used for the production of beach chairs is made by free-radical polymerization.

2-Polysubstitution in sulfonation of benzene can be avoided by using oleum instead of concentrated sulfuric acid.

3-Anoinic polymerization is an effective method of polymerizing $CH_2=CH(CH_3)$ but not effective for $CH_2=CH_2$

4-In F.C alkylation the actual electrophile is the carbocation.

5-In isotactic polypropylene molecules are held together by dipole-dipole attractions.

6-Acrylonitrile can polymerize well on the presence of BF_3 as a catalyst.

7- Copolymers can be made by any of the polymerization methods.

8-P-xylene has a lower melting point than O-xylene.

9-Aromatic compounds are separated from coal tar and synthesized from alkenes of petroleum.

10-A double bond that is separated from a benzene ring by two single bond is said to be conjugated with the ring.

11- The great size of polymer has high effect on both physical and chemical characteristic of polymers.

12- An electrophilie is an electron seeking reagent and it may have a positive charge or neutral.

13-The presence of aromatic benzene ring as a side chain in aliphatic compound may affect both reactivity and orientation of the aliphatic compound.

14- In halogenations of alkylbenzene, there may be competition between benzene ring and the aliphatic side chain for the attacking reagent. .

15-Anthracene can undergo F.C alkylation.

B-Describe a simple chemical reaction that would enable you to distinguish between the compounds of each of the following sets:

1-Bromobenzene and bromocyclohexane.

2-P-xylene and O-xylene.

3-Bromobenzene and 3-bromo-1-hexene.

4-Nylon 6,6 and polyethylene.

C- Devise a synthesis of Dacron polyester beginning with petroleum raw materials?

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D-Write all steps in the most likely mechanism for the reaction of benzene with propene in the presence of H_3PO_4 to form isopropyl benzene. Indicate the rate determining step.

E-What are the main limitations of F.C reactions?

F-Compare between each of the following sets:

1-HDPE and LDPE

2-Isotactic polypropylene and atactic polypropylene

2-Fibers and elastomers

4-Arenes and both aliphatic and aromatic compounds

Question three:

A-For each of the following, state whether or not you would expect reaction to occur to any significant extent. Write equation for the reactions you think will occur and naming all products:

1-n-propylbenzene +boiling NaOH (aq)

2-p-nitrotoluene + acidified potassium dichromate, heat.

3-tans-1-phenyl-1-propene+ Br_2, in CCl_4

4-acetophenone + ethyl chloride in presence of $AlCl_3$ as a catalyst.

5-cis--1-phenyl-1-propene+H_2, Ni, 200 C, 100 atm.

B-Explain the following with writing equation whenever possible:

1-The presence of methanol during the polymerization of ethylene oxide by sodium methoxide tends to lower the molecular weight of the product

2-Polystyrene is particularly susceptible to branching at the carbon atom bonded directly to the phenyl group.

3-Spilling aqueous base on a polyester T-shirt quickly makes a hole.

4-Certain precautions must be considered in F.C reaction.

D -Begin either with benzene or toluene, outline all steps in the laboratory synthesis of the following compounds using any needed aliphatic or inorganic reagents:

1-1, 2-diphenylethane

2-p-nitro-isopropylbenzene

3-P-nitrostyrene

4-branched polystyrene

E-Draw a mechanism for a cationic polymerization of isobutylene. Show all steps involved and the rate determining step.

F-Define the following scientific terms:

1-Degree of crystallinity, 2-syndiotactic polypropylene, 3-resins, 4-vulcanization of rubber, 5-graft-co-polymer, 6-catalytic reforming

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جامعة الإسكندرية
كلية الهندسة
البرامج العلمية المتخصصة

June, 2009

يونيو ٢٠٠٩

Course title Number: Engineering *Metallurgy*

اسم المقرر والرقم الكودى ل:هندسة الفلزات.

Time allowed: 3 hours

الزمن :ثلاث ساعات

Answer all the following questions and indicate the final numerical value with its units' in a box.

Answer the questions in their respective order.

Write using a blue or a black pen, No pencils except for drawing.

Do not answer the same question more than once.

Total points of this exam=75*2/3=50 pt

Question 1:State right or false: [15 pt]

1. The larger the ASTM grain size number, the larger is the grain size.
2. The direction of motion of a screw dislocation's line is perpendicular to the direction of an applied shear stress.
3. Increased hindering of dislocation motion makes a metallic material harder.
4. As the impurity concentration (in solid solution) of a metal is increased, the tensile and yield strengths increase
5. A eutectic is a chemical compound that has a constant composition.
6. Polygonized subgrain structure is formed during the process of stress relief anneal.
7. When the concentration of solute in a solid solution exceeds the solubility limit, the formation of a new solid solution or phase that has a composition similar to that of the original solid solution.
8. During the recovery of a cold-worked material, there is a reduction in the number of dislocations.
9. The driving force for steady-state diffusion is the temperature.
10. A eutectic has the lowest freezing point of all alloys belonging to the system
11. Manganese should not exceed 0.3% in high carbon steels because of tendency to induce quench cracks particularly during water quenching.
12. The driving force for the recrystalization process is the decrease in the free energy resulting from the reduction of the grains boundary area.
13. Melting is considered an incongruent transformation
14. Sulfur should be kept low in steel because of its tendency to render cementite unstable and liable to decompose into graphite and ferrite.
15. For edge dislocations, Burger Vector is parallel to the dislocation line.

Question 2: [20pt]

1. What are the advantages and disadvantages of cold work? [4 pt]
2. Discuss the factors that affect the diffusivity value in metals? [4pt]
3. Define cored structure, why does it happen, why is it a problem and suggest a way to eliminate it. [4pt]
4. Discuss the rules that will control the substitutional solid solubility of two metals. [4pt]
5. Cite two reasons why interstitial diffusion is normally more rapid than vacancy diffusion. [4pt]

Question 3: [40pt]

1. Gold forms a substitutional solid solution with silver. Calculate the number of gold atoms per cubic centimeter (in atoms/cm3) for a silver-gold alloy that contains 21 wt% Au and 79 wt% Ag. The densities of pure gold and silver are 19.32 and 10.49 g/cm^3, respectively, and their respective atomic weights are 196.97 and 107.87 g/atom [4pt]

2. A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 700°C. If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 2 and 10 mm beneath the carburizing surface are 1.6 and 0.94 kg/m^3, respectively. Assume a diffusion coefficient of $3 * 10^{-11}$ m^2/s at this temperature. [4pt]

3. Consider 6 kg of austenite containing 0.45 wt% C, cooled to below 727°C.
   (a) How many kilograms each of total ferrite and cementite form?
   (b) How many kilograms each of pearlite and the proeutectoid phase form?
   The atomic weight of carbon is 12.01 and of iron is 55.85 g/atom. [4pt]

4. The microstructure of an iron–carbon alloy consists of proeutectoid ferrite and pearlite; the mass fractions of these two microconstituents are 0.174 and 0.826, respectively. Determine the concentration of carbon in this alloy. [4pt]

5. Determine the Miller indices of the cubic crystal plane which intersects the following position coordinates: (1,0,0); (1/2,0,1/4); (0,1,1/3). [4pt]

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June, 2009

يونيو ٢٠٠٩

Course title Number: Engineering
Metallurgy
Time allowed: 3 hours

اسم المقرر والرقم الكودى ل:هندسة الفلزات.

الزمن :ثلاث ساعات

Answer all the following questions and indicate the final numerical value with its units' in a box.

Answer the questions in their respective order.

Write using a blue or a black pen, No pencils except for drawing.

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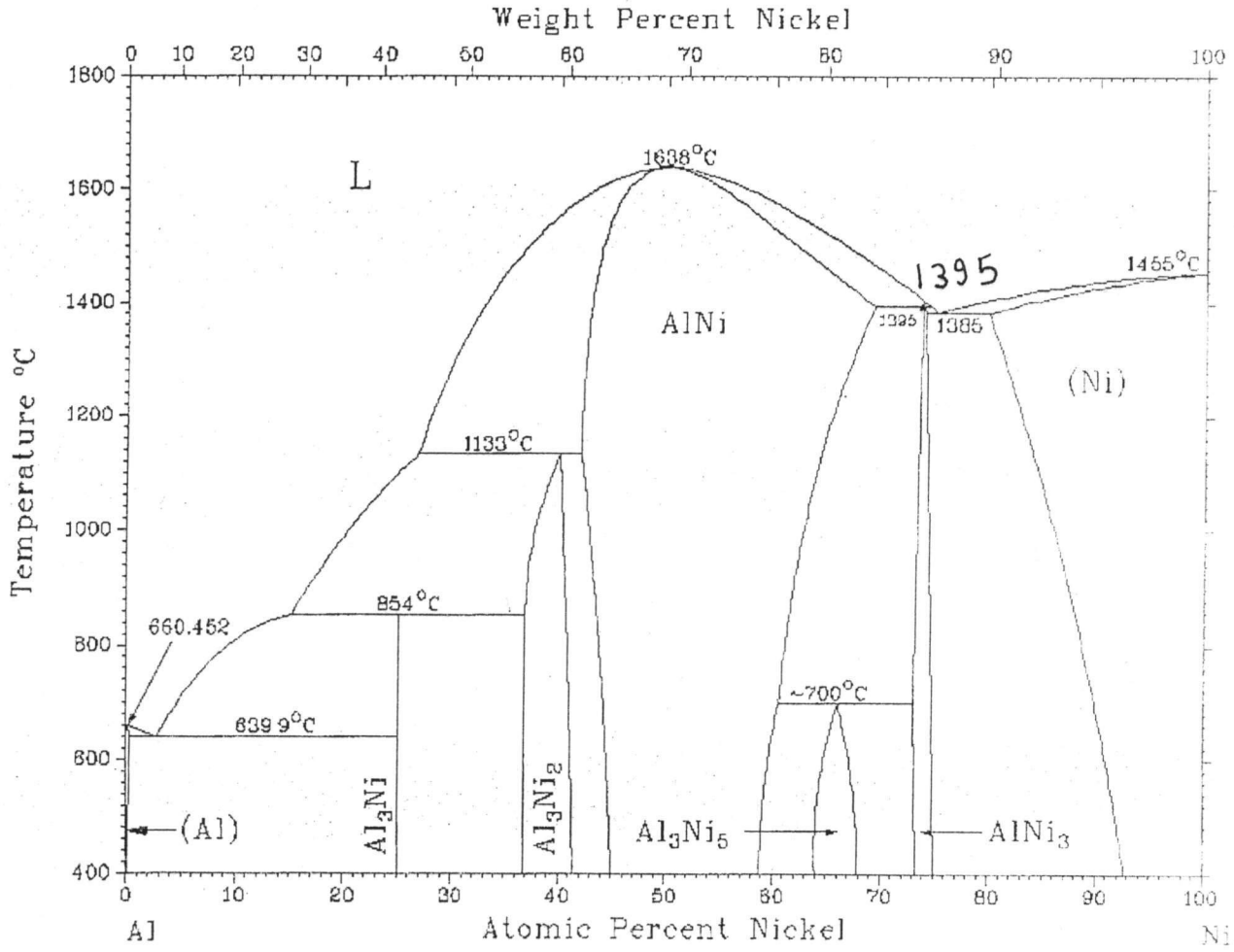
13. Melting is considered an incongruent transformation
14. Sulfur should be kept low in steel because of its tendency to render cementite unstable and liable to decompose into graphite and ferrite.
15. For edge dislocations, Burger Vector is parallel to the dislocation line.

7. Consider the aluminum-nickel phase diagram in the next figure and specify temperature-composition points at which all eutectics, eutectoids , and peritectics. transformations occur. Also, for each, write the reaction upon cooling with mentioning the composition of the reactants and products. [10pt]

Put your answer in the form of a table in this sort.

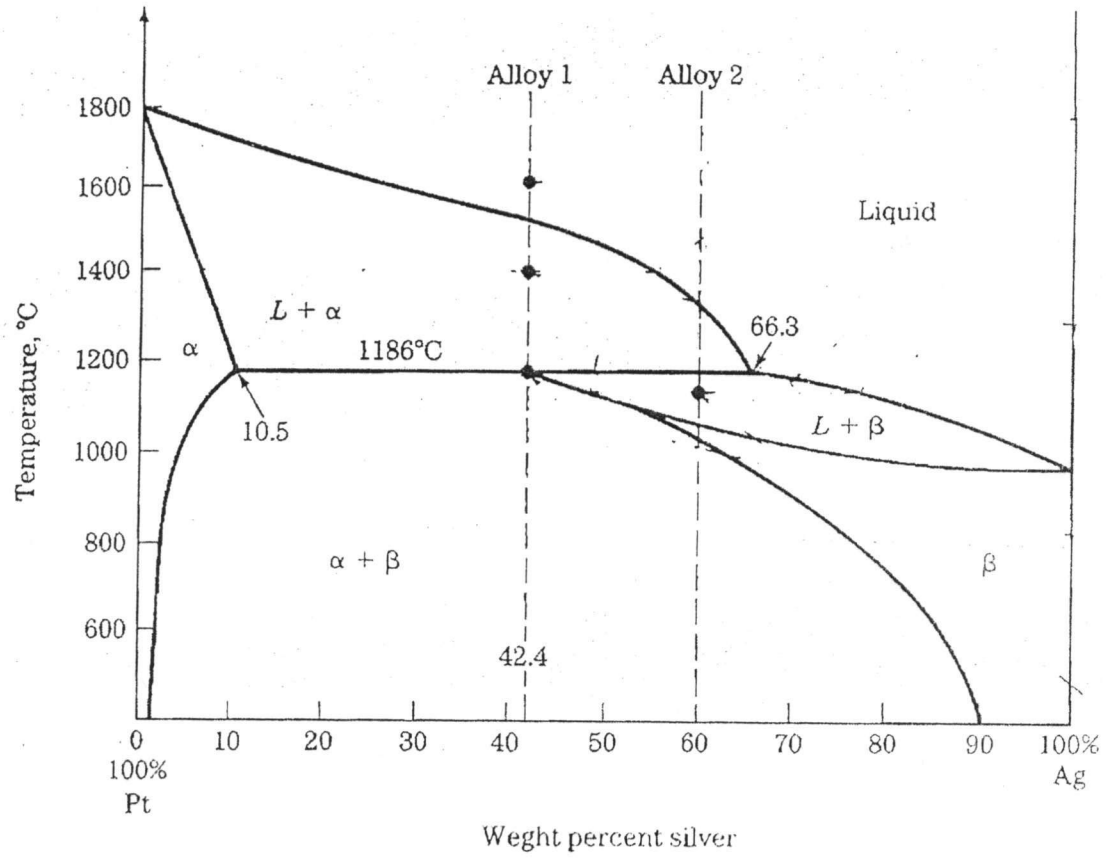
Type of reaction	temperature	% Ni	Reaction (specify the composition of the reactants and products in terms of % Ni)



6. Make phase analyses at the following points in the platinum silver equilibrium phase diagram.
   a) The point at 42.4% Ag and 1400 ^{0}C.
   b) The point at 42.4% Ag and 1186 ^{0}C +ΔT
   c) The point at 42.4% Ag and 1186 ^{0}C - ΔT
   d) The point at 60% Ag and 1150 ^{0}C.

Arrange your answers in the following table i (ΔT means a small change in temperature) [10pt]

	Point	Phases present	Composition of each phase	Amount of each phase
a	42.4% Ag and 1400 ^{0}C			
b	42.4% Ag and 1186 ^{0}C +ΔT			
c	42.4% Ag and 1186 ^{0}C - ΔT			
d	60% Ag and 1150 ^{0}C.			



4. (a) Find the linear approximation of $f(x)=\cos x$ at $x=\pi$. Use your result to approximate $\cos(3)$. [3 *marks*]

(b) Use Newton's method to approximate the root of $e^{-x}=\sqrt{x}$ using $x_0=1$. Compute only x_1 and x_2. [3 *marks*]

(c) Explain why the following function is discontinuous at $x=2$ by indicating which of the three conditions of continuity are not met: [3 *marks*]

$$f(x)=\begin{cases} x^2, & x<2 \\ 3, & x=2 \\ 3x-2, & x>2 \end{cases}$$

(d) Evaluate the following limits: [3 *marks*]

i) $\lim\limits_{x\to 0}\dfrac{x\cos x-\sin x}{x\sin^2 x}$ ii) $\lim\limits_{x\to 0^+}(\cos x)^{1/x}$

Best wishes

Exam Committee Dr Hussein Tablia

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جامعة الإسكندرية
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البرامج العلمية المتخصصة

June 2009 — يونيو 2009

Mathematics (1) MP 101 — رياضيات 1

Time allowed: 3 hours — الزمن : 3 ساعات

Answer all questions (*Start each question in a new sheet*)

1. (a) Identify the amplitude and period of $f(x) = 3\cos(2x - \pi/2)$ and sketch the function. [3 *marks*]

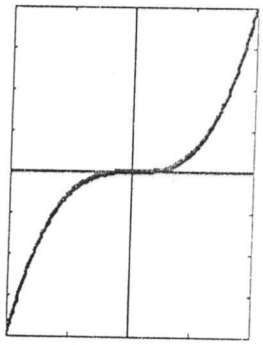
   (b) Solve the following equations:

   i) $\sin^2 x + \cos x - 1 = 0$ ii) $e^{2\ln x} = 4$ [3 *marks*]

   (c) Evaluate $\lim_{x\to 0}\left(\frac{2}{x} - \frac{2}{|x|}\right)$. [3 *marks*]

2. (a) Determine all vertical and slant asymptotes of $f(x) = \frac{x^3+1}{x^2-2x-3}$. For each vertical asymptotes, determine whether $f(x) \to \infty$ or $f(x) \to -\infty$ on either side of the asymptote. [3 *marks*]

   (b) For the shown f(x), sketch the graph of f '(x). [3 *marks*]

   Question 2. (b)

   (c) Find an equation of the tangent line to $f(x) = e^x$ at $x = 1$. [3 *marks*]

   (d) Prove that $\frac{d}{dx}\sin^{-1} x = \frac{1}{\sqrt{1-x^2}}$ [3 *marks*]

3. (a) Find $\frac{dy}{dx}$ for the following functions: [12 *marks*]

   i) $y = \sin\left(\tan^{-1} x^2\right)$ ii) $y = \sec\sqrt{x^2 + \sqrt{x}}$

   iii) $y = \left(\sin\sqrt{x}\right)^x$ iv) $xe^y - 3y\sin x = 1$

   v) $y = \tan\cos e^x$ vi) $y = 4\sec^{-1}\left(x^4\right)$

   (b) Find the locations of all horizontal and vertical tangents of $x^2 + y^2 - 3y = 0$. [3 *marks*]

   (c) Starting from the definition of $\frac{dy}{dx}$, prove that $\frac{d}{dx}x^2 = 2x$. [3 *marks*]

Please turn over

Question Four:

a) Solve the following initial value problem: $2x^3y' = y(3y - x^2), y(1) = 1$

b) Solve $y' = 1 + 3y \tan x$

c) Using a suitable substitution, solve $\frac{dy}{dx} = \frac{3x - y + 3}{3x - y - 1}$

Question Five:

Find the general solution of the following differential equations:

a) $y'' - 6y' + 9y = 12e^{3x}$

b) $y'' + y = \operatorname{cosec} x + x$

c) $y''' - 2y'' - 3y' = 2\cosh 2x$

Question Six:

Solve the following differential equations with variable coefficients:

a) $x^2 y'' - 4xy' + 6y = x \ln x$

b) $x^2 y'' + 4xy' + 2y = 10 \sin \ln x$

c) Given $y = e^{2x}$ is a solution of the homogeneous equation $(x - 2)y'' - (4x - 7)y' + (4x - 6)y = 0$, find its general solution.

Alexandria University
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Math III Final Exam
May 2009
Duration: 3 hours

Question One:

a) If $z = f(u,v)$, $u = x\cosh y$, $v = x\sinh y$, then show that:

$$\left(\frac{\partial z}{\partial x}\right)^2 - \left(\frac{1}{x}\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial u}\right)^2 - \left(\frac{\partial z}{\partial v}\right)^2$$

b) Find a reduction formula for $I_n = \int_0^{\pi/4} \sec^n x\,dx$ and hence or otherwise evaluate $\int_0^{\pi/4} \sec^5 x\,dx$.

c) Evaluate the following two limits:

(i) $\lim_{x\to\infty} \frac{x^2}{e^{x^2}}$ (ii) $\lim_{x\to\pi/2} (\tan x)^{\cos x}$

Question Two:

a) Evaluate $\iint_R \frac{1}{x^2+y^2}\,dA$, where R is the region enclosed between $x^2+y^2=1$ and $x^2+y^2=4$ in the first quadrant.

b) Find the area of the region bounded by the graphs of $y=0$, $x=0$ and $y=4-x^2$.

c) By reversing the order of integration, evaluate $\int_0^4\int_x^4 e^{y^2}\,dy\,dx$

Question Three:

a) Show that the line integral $\int_C (e^x \ln y - \frac{e^y}{x})\,dx + (\frac{e^x}{y} - e^y \ln x)\,dy$ is independent of the path and hence find its value from the point $P_1(1,1)$ to the point $P_2(3,2)$.

b) Evaluate $\int_C 2xy\,dx + 4y^2\,dy$ along the path consisting of the line segments from $(0,0)$ to $(-1,1)$ and then from $(-1,1)$ to $(2,1)$.

c) Using the Gamma function, evaluate:

(i) $\int_0^\infty x^4 e^{-x}\,dx$ (ii) $\int_0^\infty \sqrt{x}\, e^{-x^3}\,dx$

Alexandria University
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Math IV Final Exam
May 2009
Duration: 3 hours

Question One:

a) Find the Laplace transform of the following functions:

(i) $(\sin 4t + t)^2$ (ii) $\int_0^t \frac{e^{-x}\sin 3x}{x}\,dx$ (iii) $t^2\,u(t-2)$

b) Express the function

$$f(t) = \begin{cases} 8, & t < 2 \\ 6, & t \geq 2 \end{cases}$$

in terms of unit step functions and hence find its Laplace transform.

c) Find the inverse Laplace transform of the following function:

$$\frac{2}{(s-1)(s^2 - 2s + 5)}$$

d) Using Laplace transform, solve the following integral equation:

$$y(t) = \sin t + 2\int_0^t y(x)\cos(t-x)\,dx$$

Question Two:

a) Given the temperature field $T(x,y,z) = \frac{x}{y} - \frac{4y}{z}$,

(i) Find the angle between the direction grad T at the point P(0,1,2) and the z-axis.

(ii) Find the rate of change of temperature at the point P in the direction $\bar{s} = \bar{j} + 2\bar{k}$.

(iii) If heat flows in the direction of grad T at the point P, find the rate of change of T in this direction.

b) If u(x,y,z) is a scalar function with continuous partial derivatives, show that curl(grad u) = 0

Question Three:

a) Show that the following vector field is solenoidal

$$\bar{F} = (\cos xy)\,\bar{i} - (\sin xy)\,\bar{j} + (y\,z\sin xy + z\,x\cos xy)\,\bar{k}$$

b) Determine whether or not the vector $\bar{v}$ is irrotational

$$\bar{v} = (1 + 2\,x\,y^2 + e^y)\,\bar{i} + (2x^2 y + x\,e^y)\,\bar{j} + (3\,z^2)\,\bar{k}$$

and if possible find its scalar potential function Φ. Evaluate the line integral $\int_c \bar{v} \bullet d\bar{r}$ along any path joining the points (−1,1,−1) and (1,2,1).

Question Four:

a) Find the constants a,b,c so that the force field

$$\bar{F} = (z + a\,y)\,\bar{i} + (3\,x + b\,z)\,\bar{j} + (2\,y + c\,x)\,\bar{k}$$

is conservative and hence find the work done by $\bar{F}$ to move a particle from point $P_1(0,0,0)$ to point $P_2(1,1,1)$.

b) Verify Green's theorem for $\oint_c y^2\,dx + x\,y\,dy$ where C is the closed curve bounding the region between $y = x^2$ and $y = x$ in the first quadrant.

Question Five:

a) Find the Fourier series expansion for the function $f(x) = \begin{cases} -2, & -\pi < x < 0 \\ 2, & 0 < x < \pi \end{cases}$ and hence deduce the sum of the series:

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots\cdots$$

b) Find the Fourier series expansion for the function $f(x) = \sin x, 0 < x < \pi$, in cosines only. Sketch the function for one complete period.

Q5.

Use the Gauss-Seidel method to solve the following system, make 2 iterations. If necessary, rearrange the equations to achieve convergence.

$$\begin{aligned} 2x_1 - 6x_2 - x_3 &= -38 \\ -3x_1 - x_2 + 7x_3 &= -34 \\ -8x_1 + x_2 - 2x_3 &= -20 \end{aligned}$$

Employ initial guesses of $x_2 = 0$ and $x_3 = 0$.

Q6.

(a) Use both the trapezoidal and Simpson's rules to numerically integrate the following function. For both cases, use $n = 4$. Compute percent relative errors for the numerical results,given that the correct value for the integral is 98.42768 .

$$\int_0^3 x^2 e^x dx .$$

(b) What is the value of n for the trapezoidal rule to provide the same accuracy as Simpson's rule for $n = 4$.

Good Luck **Dr. Soheir A.F. Bassiouny**

Alexandria University
Faculty of Engineering
Specialized Scientific Programs
13 June 2009

الإسكندرية
لهندسة
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نيو 2009

Numerical Methods(MP314)
6th Term Gas & Petrochemicals
Time : 3 hours

العددية
السادس غاز و بتروكيماويات
: 3 ساعات

Answer All Questions:

Q1.

(a) Given

$$f(x) = -2x^6 - 1.5x^4 + 10x + 2$$

Use bisection to determine the ***maximum*** of this function. Employ initial guesses of $x_l = 0$ and $x_u =$ and perform iterations until the approximate relative error falls below 15%, or maximum 3 iteration

(b) Compare the number of multiplication operation per iteration to find one root of polynomial of order 10, by using Newton-Raphson method and Horner's method.

Q2.

Determine one real root of

$$f(x) = 0.95x^3 - 5.9x^2 + 10.9x - 6$$

(a) Using the Newton-Raphson method (2 iterations, $x_i = 3.5$).

(b) Using the secant method (2 iterations, $x_{i-1} = 2.5$ and $x_i = 3.5$).

Q3.

Given the system of equations

$$-1.1x_1 + 10x_2 = 120$$
$$-2x_1 + 17.4x_2 = 174$$

(a) Solve analytical, and check your results by substituting them back into the equations.
(b) Solve graphically.
(c) On the basis of the graphical solution, what do you expect regarding the condition of the system?

Q4.

Determine the matrix inverse of

$$\begin{matrix} 1 & 4 & 9 \\ 4 & 9 & 16 \\ 9 & 16 & 25 \end{matrix}$$

Using Gauess Jordan for integral matrix.

b.
c.

In a turning process, it is required to cut a mild steel bar of 120 mm length, and 40 mm diameter to a final diameter of 36.4 mm. If the maximum depth of cut is 1 mm, the cutting speed is 62.83 m/min and the feed rate is 0.2. You are asked to:

a. Calculate the machining time.
b. What is the expected type of chip during machining.
c. If two tools with rake angles 20°, and 0° are available, which one do you select?

(5 Marks)

a.
b.
c.

Using neat sketches only, represent the following: **(8 Marks)**

The product life-cycle	Projection welding of sheets

Alexandria University
Faculty of Engineering
Special Programs

Manufacturing Tech.
Final Exam., 3 Hrs
8th of June, 2009

Student Name: **No**

Answer All Questions: **Total 50 Marks**

1. **Complete the following statements with suitable technical terms:** **(15 Marks)**

- The two basic types of organization structures are ....., and .....
- ..... provides the company with information about the product life cycle, whereas ..... obtains orders and contracts from customers.
- ..... is the fitness of a product for its designed purpose, while ..... is the ability to get identical repeated measurements.
- The main scale of a micrometer is shown on the ....., while the secondary scale is shown on the ..... The ..... ensures constant measuring pressure of the ..... on the measured part.
- Soldering is based on using ....., whereas brazing is based on using ..... In both, a ..... is used to protect the joint.
- The flame in oxyacetylene welding could be ..... , ..., or .....
- In metal arc welding, the ..... is coated to provide ..... to protect the molten weld pool from oxidation.
- Types of resistance welding include: spot, ... , ... , and butt welding.
- In adhesive bonding, the factors affecting the joint strength are ..... , and .....
- Twist drills and milling cutters are made of ....., whereas brazed tool tips are made of .....
- The types of abrasives used in grinding wheels are: ....., or .....
- The types of cutting fluids include water, ..., or .....
- Drilling operations include drilling, reaming, ..., and .....
- Plastic moulding processes include ....., and .....
- Pressure die casting machines include : ....., and .....

A company manufactures 2,000 refrigerators per month. If the selling price is 2,000 LE and the variable cost per unit is 1,500 LE. If the break even volume was 1000 refrigerators per month, you are asked to calculate the following:

a. The fixed cost.
b. The net profit per month and percentage profit.
c. Is it recommended to reduce the selling price by 10 % if the selling volume will be increased by 20 %

(6 Marks)

a.

b.

c.

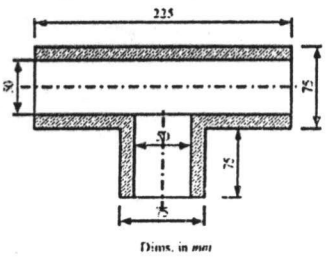
d.

e.

Suggest a suitable material (showing its constituents), and the manufacturing process for the following products: **(8 Marks)**

Product	Material	Constituents	Manufacturing process
Car body panels			
Car crankshaft			
Milling machine frame			
Electric Wire			
Bearing bushes			
Boats and yachts			
Stellite tool tips			
Soldering wire			

With best wishes,

Orthogonal and oblique cutting in a turning process	
Tube drawing using floating mandrel(plug)	Closed die forging process
The pattern for the given cast product 	

5. In a rolling process for an aluminum strip having initial thickness 20 mm, the roll diameter is 250 mm, and the coefficient of friction is 0.18. You are asked to:
   a. Calculate the minimum thickness that can be produced in one operation.
   b. Estimate the percentage reduction.
   c. Calculate the entry velocity if the strip exit velocity is 4 m/min.
   d. How to measure the final strip thickness? Illustrate the reading on the scales of the used measuring instrument.
   e. Illustrate graphically the rolling process showing all directions of motion.

(8 Marks)

a.