Helwan University

Faculty of Engineering at Helwan
Biomedical Engineering Department

Course Name:	Separation Processes (BME 4316) (عمليات فصل)	**Exam:**	Final
	(3rd Biomedical Eng)	**Date:** Saturday	9/1/2016
Examiner:	Dr. Ibrahim Hassan Mustafa	**Time Allowed:**	3 Hours
Semester:	Fall 2015		

Assume any missing data; Number of Questions =5
Answer the following questions:

Question 1

a. Define the following concepts:

i) Phase equilibrium ii) Crystallisation iii) Microfiltration

b. Explain the differences between filtration and centrifugation

c. Explain the main principle of distillation process as a two-phase contact process

d. Human immunoglobulin G (HIgG) is diffusing through a porous medium having a porosity of 0.5, tortuosity of 1.8 and average pore diameter of 0.45 microns. Protein samples were collected from two points within the medium separated by a distance of 20 mm and the ultraviolet light absorbance of these samples as measured with a spectrophotometer having a sample path length of 0.2 cm were found to be 0.010 and 0.012 respectively. If the specific absorbance of HIgG is known to be 15590 m^3/kg-moles.cm, calculate the steady state flux of this protein between the two points.

Given that : The diameter of HIgG is 0.011 micron; The diffusivity of HIgG is 4.3×10^{-11} m^2/s; $A = a\ C\ l$ Where A= absorbance, a = specific absorbance, l = path length, and C = concentration.

Question 2

a. Define the following concepts:

i) Nanofiltration membranes ii) Tubular membranes iii) Hollow fibers membranes

b. Explain the differences between distillation and extraction

c. Define theory and application of dialysis process

d. When an aspirin suspension was filtered through a porous glass disc having a diameter of 0.1 m at a constant rate of $4x10^{-5}$ m^3/s, the pressure drop driving filtration was found to be 10,000 Pa after 2000 seconds of filtration. If the same suspension were filtered at a rate of $4x10^{-4}$ m^3/s using another porous glass disc having a diameter of 0.25 m, what would the pressure drop be after 5000 seconds of filtration? Assume that the media resistance is negligible in both cases. Given that:

$$Q = \frac{A\Delta P(t)}{\mu\left(R_M + \frac{\alpha C_s Q t}{A}\right)}$$

Question 3

a. Define the following concepts:

i) Symmetric and asymmetric membranes

ii) porous and dense membranes iii) Fouling

b. Explain the most important membrane properties that should be characterized

c. Explain the theory and applications of ultra-filtration membranes

d. A plasmid solution (concentration = 0.1 g/1) is being concentrated by ultrafiltration in a continuous manner using a using a tubular membrane module, which gives an apparent sieving coefficient of 0.02. The feed flow rate into the membrane module is 800 ml/min and the average permeate flux obtained at the operating condition is 3×10^{-5} m/s. If the membrane surface area is 0.1 m^2 predict the concentration of the plasmid in the retentate stream. Assume that the permeate flux is same at all locations on the membrane and the concentration of the plasmid increases linearly within the membrane module.

Question 4

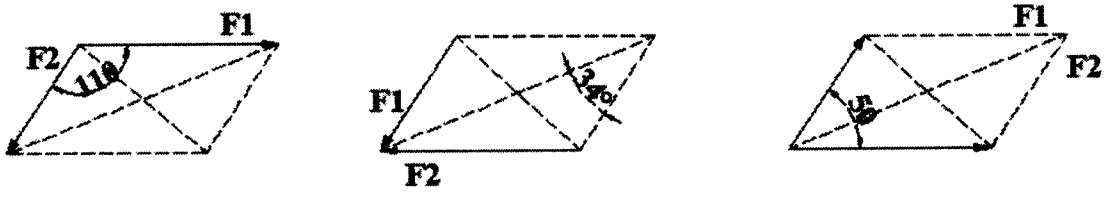
a) Define the following concepts: i) Concentration Polarization; ii) Molecular Weight Cut-off (MWCO); and iii) Diafiltration

b) Explain the effect of feed concentration on permeate flux
c) Indicate in graph multi-stage continuous concentration in ultrafiltration process
d) Mention the most important types of membrane modules

كلية الهندسة بحلوان	Dept/Division: Biomedical Eng. Dept Academic level: third year Semester: I-2015/2016 Course code & title: Biomechanics (BIO4315) Elective 1 Total mark: 100 Time allowed: 3 hrs Instructors: Prof. Moh Tarek El-Wakad, Dr. Ahmed Abdulhameed	

1. **Define** the following: (7x2 pts)
   a) Kinetics.
   b) Kinematics.
   c) Space diagram.
   d) External loads.
   e) Gravitational force.
   f) Viscoelasticity.
   g) Maxwell model.

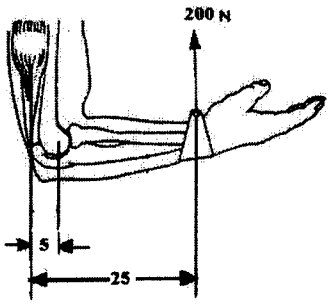
2. In the figures below F1 = 100 N and F2 = 70 N.
   a) **Redraw** the figures in your answer sheet showing the resultant direction. (3 pts)
   b) **Determine** the magnitude if the resultant. (9 pts).



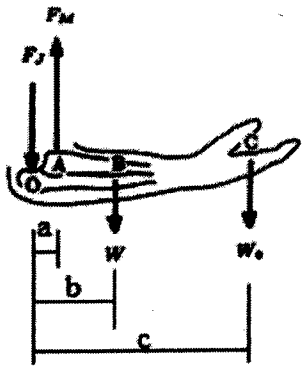
(a) (b) (c)

3. Biomechanics is interrelated to many fields and uses several types of loads in such fields.
   a) **Explain** how biomechanics relates to growth (3 pts)
   b) **Explain** how buoyancy can be used in biomechanics giving examples (3 pts)

4. In the opposite figure of the forearm **determine**:
   a) The lever class showing on a diagram the effort, resistance and the fulcrum. (4 pts)
   b) The mechanical advantage (MA) of the lever (3 pts)

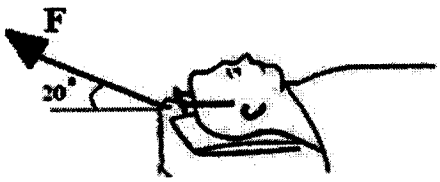


5. Consider a human arm, in which the elbow is flexed to a right angle (forearm is perpendicular on upper arm) and an object is held in the hand, as shown in the opposite figure. Answer the followings:
   a) **Draw** the free body diagram if the biceps muscle is the major acting muscle. (2 pts)
   b) **Calculate** F_M and F_J, if a=5cm; b=16cm; c=37cm; W =30N, and Wo =80N. (4 pts)
   c) **Draw** the free body diagram if the biceps, the brachialis and the brachioradialis are the primary elbow flexor muscles. (2 pts)

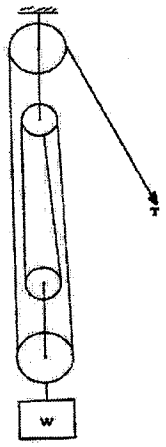


6. In the figure shown in problem 5, if the forearm makes an angle with the upper arm θ (unlike the figure, $\theta \neq 90^0$):
   (a) **Resolve** each force into 2 components on the drawing, (3 pts)
   (b) State one **rotatory** and one **non-rotatory** components. (3 pts)

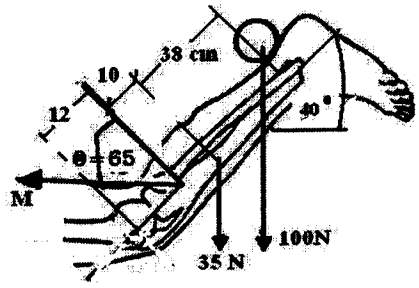
7. The opposite figure it is required to apply a traction of 10 N on a patient's head (pateint head weight = 60 N).
   a) **Draw** the free body diagram of the head (3 pts)
   b) **Determine** the value required for force (F) that will provide the required traction (neglect friction) (3 pts)
   c) **Determine** the value required for force (F) that will provide the required traction assuming friction cooffeicient of 0.15. (9 pts)



8. Using the **free body diagram** determine the **tension (T)** that can carry a weight (W) of 3000 N and the **reactions in the ceilings** in the pulley system below right. (6 pts)



9. A person is performing exercise for the leg as shown in figure.
   a) **Draw** a free body diagram of the leg with all force(s) analyzed stating one rotatory component and one non-rotatory (6 pts)
   b) **Determine** the missing force(s) (12 pts)



10. A stress relaxation test is applied to a viscoelastic tissue. The applied stress was 3 MPa. After 1 day the stress decreased to 40%. **Determine** the stress after 5 days. (8 pts)

Good Luck Everyone !!!

كلية الهندسة
بحلوان

Department / Division : Biomedical Engineering Department
Academic level: Third **Semester:** First 2015-2016
Course code & title: MEC 4321, Statistics and Engineering Economy
Instructor: Dr. Araby Ibrahim
Total mark: 70 **Time allowed:** 3 hours

جامعة حلوان

يسمح باستخدام جدول مكون من 6 صفحات بدون معادلات

Question 1 (15 Marks)

1.1 A manufacturing firm has received a contract to assemble 1000 units of test equipment in the next year. The firm must decide how to organize its assembly operation. Skilled workers, at $22 per hour each, could be assigned to individually assemble the test equipment. Each worker would do all the assembly steps, and it would take 2.6 hours to complete one unit. An alternate approach would be to set up teams of four less skilled workers (at $13 per hour each) and organize the assembly tasks so that each worker does part of the assembly. The four-man team would be able to assemble a unit in one hour. Which approach would result in more economically assembly?

1.2 Lifetime Savings Accounts, known as LSAs, allow people to invest after-tax money without being taxed on any of the gains. If an engineer invests $10,000 now and then increases his deposit by $1000 each year through year 20, how much will be in the account immediately after the last deposit, if the account grows by 15% per year?

Question 2 (10 Marks)

An electrical engineer at GE is assigned the responsibility to determine how to invest up to $100,000 in none, some, or all of the following independent proposals. Use the PW analysis and a 15% per year return requirement to help this engineer make the best decision from a purely economic perspective.

Project	Initial Investment, $	Annual Net Cash Flow, $/Year	Life, Years	Salvage Value, $
A	−25,000	6,000	4	4,000
B	−20,000	9,000	4	0
C	−50,000	15,000	4	20,000

Question 3 (15 Marks)

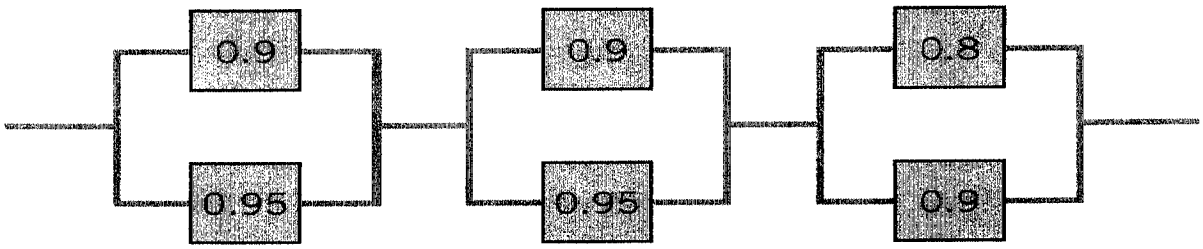
Don Gorlitz is a landscaper. He is considering the purchase of a new commercial lawn mower, either, the Atlas or the Zippy. The minimum attractive rate of return is 8%, and the following table provides all the necessary information for the two machines. Use incremental rate of return analysis to decide which machine to purchase.

من فضلك اقلب الصفحة

	Atlas	Zippy
Initial cost	$6700	$16,900
Annual operation and maintenance cost	1500	1,200
Annual benefit	4000	4,500
Salvage value	1000	3,500
Useful life, in years	3	6

Question 4 (15 Marks)

4.1 The following circuit operates if and only if there is a path of functional devices from left to right. The probability that each device functions is as shown. Assume that the probability that a device is functional does not depend on whether or not other devices are functional. What is the probability that the circuit operates?



4.2 A driver's reaction time to visual stimulus is normally distributed with a mean of 0.4 seconds and a standard deviation of 0.05 seconds. (a) What is the probability that a reaction requires more than 0.5 seconds? (b) What is the probability that a reaction requires between 0.4 and 0.5 seconds?

Question 5 (15 Marks)

5.1 Heart failure is due to either natural occurrences (87%) or outside factors (13%). Outside factors are related to induced substances or foreign objects. Natural occurrences are caused by arterial blockage, disease, and infection. Suppose that 20 patients will visit an emergency room with heart failure. Assume that causes of heart failure for the individuals are independent. (a) What is the probability that three individuals have conditions caused by outside factors? (b) What is the probability that three or more individuals have conditions caused by outside factors? (c) What are the mean and standard deviation of the number of individuals with conditions caused by outside factors?

5.2 The following are the scores of 30 college students on a statistics test. Construct a stem-and-leaf display

75 52 80 96 65 79 71 87 93 95 69 72 81 61 76
86 90 68 50 92 83 84 77 64 71 87 72 92 57 98

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Faculty of Engineering at Helwan
Biomedical Engineering Department

Course Name:	Clinical Engineering and Hospitals	**Exam:**		Final
Course Code:	GEN 4313 (3rd Biomedical)	**Date:**	Saturday	16/1/2016
Examiner:	Dr. Yehya Ghallab	**Time Allowed:**		3 Hours
Semester:	Fall 2015	**Marks:**		100 Points

Answer the following questions:

Question 1: [20 marks]

1.1 Define the following:
- i. Clinical Engineering
- ii. Technology
- iii. Biomedical Engineering
- iv. Mission of the Clinical Engineering
- v. Technology Assessment

1.2 Draw a flow chart to show the range of interactions of a Clinical Engineer.

1.3 Technology assessment is part of the clinical engineer's responsibility:
- 1.3.1 How can a clinical engineer improve his/her decisions when doing technology assessment?
- 1.3.2 What are clinical engineer roles when doing technology assessment?

1.4 Clinical engineer may help in the process of acquisition and application of technology. What is the procedure that a clinical engineer needs to follow to help in such task?

Question 2: [20 marks]

2.1 What are the key components of the strategic planning process?

2.2 Keeping both the clinical engineer and clinical staff at a high and update level of education is very important:
- 2.2.1 What a clinical engineer can do to maintain his/her education at the up-to date level?
- 2.2.2 What steps can be done to improve the education of clinical staff members?

2.3 What a clinical engineer needs to identify when helping in continuous quality improvement?

2.4 Briefly, mention the steps needed to do equipment management process.

Question 3: [20 marks]

3.1. What are the main functions of Clinical Engineering?

3.2. To improve performance and reduce costs, the delivery health care system must recognize and respond to some factors, mention these factors.

3.3. What are the main steps that a clinical engineer needs to do in the following cases:

- 3.3.1. Development of new technology
- 3.3.2. Facility planning and development
- 3.3.3. Analysis of safety and risk management

3.4. What are the major health care trends and directions?

Question 4: [20 marks]

4.1. Select **only 3 equipment** from the list bellow and describe the function and the principle of operation for each one of them:

a) MRI
b) Centrifuge
c) Computed Tomography (CT)
d) General X-Ray
e) Laryngoscope

4.2. Preventive and Corrective Maintenance are two types of Maintenance:

- 4.2.1. Define the Corrective Maintenance
- 4.2.2. Define the Preventive Maintenance
- 4.2.3. How can the clinical engineer improve the preventive and corrective maintenance process at hospital?

Question 5: [20 marks]

5.1. هناك اعتبارات اساسية يجب ان تراعي عند تصميم المستشفي:

- 5.1.1. اذكر الاعتبارات الاساسية التي يجب ان تراعي عند تصميم المستشفي ؟
- 5.1.2. اذكر مراحل تصميم المستشفي ؟
- 5.1.3. اذكر انواع المستشفيات من حيث التخصص ؟
- 5.1.4. يمكن تقسيم عناصر المستشفي وظيفيا الي أربعة أقسام أساسيه, أذكر هذة الاقسام؟

5.2. ما هي الكوادر البشرية الأساسية الواجب توافرها بقسم الأشعة التشخيصية؟

5.3. ما هو الموقع الأمثل لغرفة العمليات داخل المستشفي؟

5.4. ما هي المعايير الأساسيه الواجب مراعاتها عند تصميم مختبرات التحاليل داخل المستشفي؟

5.5. أذكر المكونات الأساسيه لمختبر التحاليل ؟

5.6. يوجد بمعمل التحاليل أجهزة معملية ثابته وأدوات وأثاثات ثابته, أذكر:

- 5.6.1. خمس أمثله للأجهزة المعملية الثابت
- 5.6.2. ثلاث أمثله للأدوات والأثاثات الثابته

Best of Luck

كلية الهندسة بطيبة

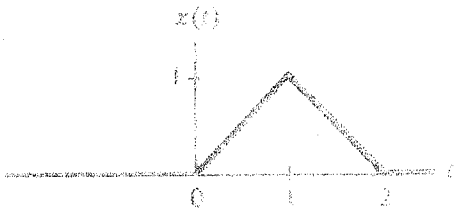
Dept/Division : Biomedical Engineering
Academic level: Third Semester: First 2015/16
Course code & title: Elc4311- Electronic Systems
Instructor: Dr. Walid Al Atabany
Total mark: 90 marks Time allowed: 3 hrs

الفرقة ٣ طبية
مادة/ منظومات الكترونية
الفصل الدراسي الأول ٢٠١٥/٢٠١٦
د/ وليد العتباني

Answer all questions: write each question number and part number ahead of your answer

Question 1: [24Marks]

a. A continuous-time signal $x(t)$ is shown below. Sketch and label carefully this signal $[x(t) + x(-t)]u(t)$



b. The following sequence represent one period of a sinusoidal sequence of $x[n] = A\cos(\omega_0 n + \varphi)$. Determine the values of the parameters A, ω_0, φ

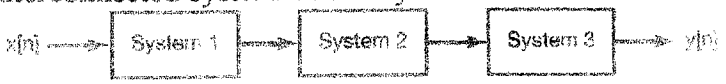
$$x[n] = \{0 \quad -\sqrt{2} \quad -2 \quad -\sqrt{2} \quad 0 \quad \sqrt{2} \quad 2 \quad \sqrt{2}\}$$

c. Consider three systems with the following input-output relationships:

System 1: $y[n] = \begin{cases} x\left[\frac{n}{2}\right] & n \text{ even} \\ 0 & n \text{ odd} \end{cases}$

System 2: $y[n] = x[n] + 2x[n-1] + 4x[n-2]$,
System 3: $y[n] = x[2n]$.

Suppose that these systems are connected in series as depicted in the figure below. Find the input-output relationship for the overall interconnected system. Is this system linear? Is it time invariant?



Question 2: [21 Marks]

a. Calculate the convolution of the following two signals:
$x(t) = e^{2t}u(-t)$, $\quad h(t) = u(t-3)$.

b. Find the impulse response for the following discrete-time system:

$y[n] + 1.2y[n-1] = 2x[n-1]$

c. Find the cross correlation r_{xy} for x={1,0,2,3} and y={4,0,1,2}

Question 3: [21 Marks]

a. Determine the inverse Laplace transform of

$$X(s) = \frac{2s^2 + 5s + 5}{(S+1)^2(S+2)}$$

b. Consider two right-sided signals x(t) and y(t) related through the differential equations

$$\frac{dx}{dt} = -2y(t) + \delta(t) \qquad \frac{dy}{dt} = 2x(t)$$

Determine Y(s) and X(s).

c. The voltage across a capacitor in an RC circuit is given by $C\frac{dV(t)}{dt} + \frac{V(t)}{R} = 0$, where $V(0) = V_0$. Find the solution of the equation V(t)

Question 4: [24 Marks]

a. Find the impulse response (by using the Fourier transform) for a stable linear time-invariant system for which the input x(t) and output y(t) satisfy the linear constant-coefficient differential equation

$$y(t) - 0.5\frac{dy}{dt} = x(t) - 0.25\frac{dx}{dt}$$

b. Consider a causal LTI system with frequency response $H\left(e^{j\omega}\right) = \frac{1}{3+j\omega}$. Determine x(t) for which this system is observed to produce the output

$$y(t) = e^{-2t}u(t) - e^{-4t}u(t)$$

c. Consider the Fourier transform

$$X(e^{j\omega}) = \begin{cases} e^{-j\omega n_0} & \omega_c \text{ choice} \\ 0 & |\omega| < \omega_c \end{cases}$$

Find X[n]

GOOD LUCK

	Function of Time	Function of s, ROC
1.	$\delta(t)$	1 whole s plane
2.	$u(t)$	$\frac{1}{s}$ $Re\{s\} > 0$
3.	$tu(t)$	$\frac{1}{s^2}$ $Re\{s\} > 0$
4.	$e^{-at}u(t)$ a real	$\frac{1}{s+a}$ $Re\{s\} > -a$
5.	$\cos(\Omega_0 t)u(t)$	$\frac{s}{s^2+\Omega_0^2}$ $Re\{s\} > 0$
6.	$\sin(\Omega_0 t)u(t)$	$\frac{\Omega_0}{s^2+\Omega_0^2}$ $Re\{s\} > 0$
7.	$e^{-at}\cos(\Omega_0 t)u(t)$ a real	$\frac{s+a}{(s+a)^2+\Omega_0^2}$ $Re\{s\} > -a$
8.	$e^{-at}\sin(\Omega_0 t)u(t)$ a real	$\frac{\Omega_0}{(s+a)^2+\Omega_0^2}$ $Re\{s\} > -a$
9.	$2Me^{-at}\cos(\Omega_0 t - \theta)u(t)$ a real	$\frac{Me^{-j\theta}}{s+a-j\Omega_0} + \frac{Me^{j\theta}}{s+a+j\Omega_0}$ $Re\{s\} > -a$
10.	$\frac{t^{N-1}}{(N-1)!}u(t)$	$\frac{1}{s^N}$ N an integer $Re\{s\} > 0$
11.	$\frac{t^{N-1}}{(N-1)!}e^{-at}u(t)$	$\frac{1}{(s+a)^N}$ N an integer $Re\{s\} > -a$
12.	$\frac{2}{(N-1)!}t^{N-1}e^{-at}\cos(\Omega_0 t + \theta)u(t)$	$\frac{Ae^{-j\theta}}{(s+a-j\Omega_0)^N} + \frac{Ae^{j\theta}}{(s+a+j\Omega_0)^N}$ $Re\{s\} > -a$

Table 3.2 Basic Properties of One-Sided Laplace Transforms

Causal functions and constants	$\alpha f(t)$, $\beta g(t)$	$\alpha F(s)$, $\beta G(s)$
Linearity	$\alpha f(t) + \beta g(t)$	$\alpha F(s) - \beta G(s)$
Time shifting	$f(t-\alpha)$	$e^{-\alpha s}F(s)$
Frequency shifting	$e^{\alpha t}f(t)$	$F(s-\alpha)$
Multiplication by t	$t\,f(t)$	$-\frac{dF(s)}{ds}$
Derivative	$\frac{df(t)}{dt}$	$sF(s) - f(0-)$
Second derivative	$\frac{d^2f(t)}{dt^2}$	$s^2F(s) - sf(0-) - f^{(1)}(0)$
Integral	$\int_{0-}^{t} f(t')dt$	$\frac{F(s)}{s}$
Expansion/contraction	$f(\alpha t)$ $\alpha \neq 0$	$\frac{1}{\lvert\alpha\rvert}F\left(\frac{s}{\alpha}\right)$
Initial value	$f(0+) = \lim_{s\to\infty} sF(s)$	
Final value	$\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s)$	

Table of Fourier Transform Pairs

Function, f(t)	Fourier Transform, F(ω)
Definition of Inverse Fourier Transform	***Definition of Fourier Transform***
$f(t)=\frac{1}{2\pi}\int_{-\infty}^{\infty}F(\omega)e^{j\omega t}\,d\omega$	$F(\omega)=\int_{-\infty}^{\infty}f(t)e^{-j\omega t}\,dt$
$f(t-t_0)$	$F(\omega)e^{-j\omega t_0}$
$f(t)e^{j\omega_0 t}$	$F(\omega-\omega_0)$
$f(\alpha t)$	$\frac{1}{\lvert\alpha\rvert}F(\frac{\omega}{\alpha})$
$F(t)$	$2\pi f(-\omega)$
$\frac{d^n f(t)}{dt^n}$	$(j\omega)^n F(\omega)$
$(-jt)^n f(t)$	$\frac{d^n F(\omega)}{d\omega^n}$
$\int_{-\infty}^{t}f(\tau)d\tau$	$\frac{F(\omega)}{j\omega}+\pi F(0)\delta(\omega)$
$\delta(t)$	1
$e^{j\omega_0 t}$	$2\pi\delta(\omega-\omega_0)$
$\mathrm{sgn}(t)$	$\frac{2}{j\omega}$
$u(t)e^{-\alpha t}\sin(\omega_0 t)$	$\frac{\omega_0}{\omega_0^2+(\alpha+j\omega)^2}$
$e^{-\alpha\lvert t\rvert}$	$\frac{2\alpha}{\alpha^2+\omega^2}$
$e^{-t^2/(2\sigma^2)}$	$\sigma\sqrt{2\pi}\,e^{-\sigma^2\omega^2/2}$
$u(t)e^{-\alpha t}$	$\frac{1}{\alpha+j\omega}$
$u(t)te^{-\alpha t}$	$\frac{1}{(\alpha+j\omega)^2}$