



PNU University

English for Biomedical Engineering Students

Fereshteh Ghasemi

«امروزه کتاب‌خوانی و علم‌آموزی، نه تنها یک وظیفه‌ی ملی، که یک واجب دینی است.»^۱

در عصر حاضر یکی از شاخصه‌های ارزیابی رشد، توسعه و پیشرفت فرهنگی هر کشوری میزان تولید کتاب، مطالعه و کتاب‌خوانی مردم آن مرز و بوم است. ایران اسلامی نیز از دیرباز تاکنون با داشتن تمدنی چندهزارساله و مراکز متعدد علمی، فرهنگی، کتابخانه‌های معتبر، علما و دانشمندان بزرگ با آثار ارزشمند تاریخی، سرآمد دولت‌ها و ملت‌های دیگر بوده و در عرصه‌ی فرهنگ و تمدن جهانی به‌سان خورشیدی تابناک همچنان می‌درخشد و با فرزندان نیک‌نهاد خویش هنرنمایی می‌کند. چه کسی است که در دنیا با دانشمندان فرزانه و نام‌آور ایرانی همچون ابوعلی سینا، ابوریحان بیرونی، فارابی، خوارزمی و ... همچنین شاعران برجسته‌ای نظیر فردوسی، سعدی، مولوی، حافظ و ... آشنا نباشد و در مقابل عظمت آنها سر تعظیم فرود نیاورد. تمامی این افتخارات ارزشمند، برگرفته از میزان عشق و علاقه فراوان ملت ما به فراگیری علم و دانش از طریق خواندن و مطالعه منابع و کتاب‌های گوناگون است. به شکرانه‌ی الهی، تاریخ و گذشته ما، همیشه درخشان و پر بار است. ولی اکنون در این زمینه در چه جایگاهی قرار داریم؟ آمار و ارقام ارائه‌شده از سوی مجامع و سازمان‌های فرهنگی در مورد سرانه‌ی مطالعه‌ی هر ایرانی، برایمان چندان امیدوارکننده نمی‌باشد.

کتاب، دروازه‌ای به سوی گستره‌ی دانش و معرفت است و کتاب خوب، یکی از بهترین ابزارهای کمال بشری است. همه‌ی دستاوردهای بشر در سراسر عمر جهان، تا آنجا که قابل کتابت بوده است، در میان دست‌نوشته‌هایی است که انسان‌ها پدید آورده و می‌آورند. در این مجموعه‌ی بی‌نظیر، تعالیم الهی، درس‌های پیامبران به بشر، و همچنین علوم مختلفی است که سعادت بشر بدون آگاهی از آنها امکان‌پذیر نیست. کسی که با دنیای زیبا و زندگی‌بخش کتاب ارتباط ندارد بی‌شک از مهم‌ترین دستاورد انسانی و نیز از بیشترین معارف الهی و بشری محروم است. با این دیدگاه، به‌روشنی می‌توان ارزش و مفهوم رمزی عمیق در این حقیقت تاریخی را دریافت که اولین خطاب خداوند متعال به پیامبر گرامی اسلام (ص) این است که «بخوان!» و در اولین

۱. پیام مقام معظم رهبری به مناسبت آغاز هفته کتاب ۷۲/۱۰/۴

سوره‌ای که بر آن فرستاده‌ی عظیم‌الشان خداوند، فرود آمده، نام «قلم» به تجلیل یاد شده‌است: «إِقْرَأْ وَ رَبُّكَ الْأَكْرَمُ. الَّذِي عَلَّمَ بِالْقَلَمِ» در اهمیت عنصر کتاب برای تکامل جامعه‌ی انسانی، همین بس که تمامی ادیان آسمانی و رجال بزرگ تاریخ بشری، از طریق کتاب جاودانه مانده‌اند.

دانشگاه پیام‌نور با گستره‌ی جغرافیایی ایران‌شمول خود با هدف آموزش برای همه، همه‌جا و همه‌وقت، به‌عنوان دانشگاهی کتاب‌محور در نظام آموزش عالی کشورمان، افتخار دارد جایگاه اندیشه‌سازی و خردورزی بخش عظیمی از جوانان جویای علم این مرز و بوم باشد. تلاش فراوانی در ایام طولانی فعالیت این دانشگاه انجام پذیرفته تا با بهره‌گیری از تجربه‌های گرانقدر استادان و صاحب‌نظران برجسته کشورمان، کتاب‌ها و منابع آموزشی درسی شاخص و خودآموز تولید شود. در آینده هم، این مهم با هدف ارتقای سطح علمی، روزآمدی و توجه بیشتر به نیازهای مخاطبان دانشگاه پیام‌نور با جدیت ادامه خواهد داشت. به‌طور قطع استفاده از نظرات استادان، صاحب‌نظران و دانشجویان محترم، ما را در انجام این وظیفه‌ی مهم و خطیر یاری‌رسان خواهد بود. پیشاپیش از تمامی عزیزانی که با نقد، تصحیح و پیشنهادهای خود ما را در انجام این وظیفه‌ی خطیر یاری می‌رسانند، سپاسگزاری می‌نماییم. لازم است از تمامی اندیشمندانی که تاکنون دانشگاه پیام‌نور را منزلگه اندیشه‌سازی خود دانسته و ما را در تولید کتاب و محتوای آموزشی درسی یاری نموده‌اند، صمیمانه قدردانی گردد. موفقیت و بهروزی تمامی دانشجویان و دانش‌پژوهان عزیز آرزوی همیشگی ما است.

دانشگاه پیام‌نور

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Preface

English for Biomedical Engineering is aimed at undergraduate Biomedical engineering students whose, first language is not English. It promotes the development of the reading, writing and language structures in variety of ways throughout one semester in eight units. Each unit in this book includes two sections described below:

Section one is named Reading comprehension and consists of three parts which is Pre-reading, Reading and Post-reading stages. In Pre-reading stages, Vocabulary preview is used for introducing new and unfamiliar words to students prior to reading or writing. Questions in many of the Pre-reading stages ask students to reflect on their prior knowledge of each chapter's topic. The aim of Reading stage is not only teaching subject matter but also developing in the reader an understanding of how this subject matter is expressed through English. In this part, every fifth line of each reading passage is numbered for easy reference. Post-reading stage include in Understanding Text, Reading skills and Building vocabulary. Following each passage, in Understanding Text, some activities give students the chance to clarify their understanding of the text. These activities are True/False/Not Given questions and comprehension questions. In True/False/Not Given parts, students must decide whether each sentence agrees with the text or contradicts it, or whether there is not information in the passage to decide. Find answer key of multiple-choice questions at the end of the book. At the beginning of each Reading skills part, students

encounter a short explanation of the skill in focus and one or more exercises. Building vocabulary part develops technical vocabulary acquisition to provide students with the opportunity to review vocabulary items they may concerned with.

Section two is named language study and consists of two parts which is Writing and Structure. The principle purpose of Structure part is not to teach more grammar, but to show students how to use the grammar they may face in technical language. Some of structure part is considered for further reading. The main point of writing parts is to familiarize students with the fundamentals of writing, especially for academic purposes.

The authors have attempted to take advantage of the latest Biomedical engineering text as well as the most up to date ones.

This book is now for your assessment and judgment. Kindly do send your feedback and queries on my email ID f_ghasemy@pnu.ac.ir

Unit 1

Section one: Reading comprehension

I. Pre-reading

A. Look at the definitions or synonyms of the new words as they appear in the reading part.

Word	Form	Definitions Or Synonyms
approaches	n	methods
awareness	n	knowledge
diagnostic	adj	used to help identify a disease
fusion	n	merger
implementing	v	applying
infused	v	stimulated
innovative	adj	featuring new methods
inspections	n	surveys
interaction	n	interplay
maintaining	v	keeping
peripheral	adj	surrounding
procurement	n	preparation
prospective	adj	futuristic
recognition	n	identification
relevant	adj	related
seemingly	adv	apparently
synthetic	adj	combinatory
therapeutic	adj	remedial
treatment	n	therapy, remedy
vast	adj	wide, broad
vital	adj	biotic

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B. Guess the answer of following comprehension questions before reading the text.

1. What are the sub-disciplines of biomedical engineering?
2. Describe the role of clinical engineer.
3. What is biomechanics engineering?
4. What does a biomedical engineer do?

II. Reading

Biomedical engineering

Today there are many more examples of *interaction* between biology and engineering, particularly in the medical and life-support fields. In addition to an increased *awareness* of the need for communication between the engineering and life sciences, there has been an increased *recognition* of the role that the engineer can play in several biological fields, including human medicine. Likewise, an **awareness** of the biological science contributions can make toward the solution of engineering problems. As recognizing the needs to assist in overcoming problems in linking medicine and engineering as well as to prepare engineers for the future, engineering schools developed courses and curricula in biomedical engineering.

Biomedical engineering (BME) is the application of engineering principles and design concepts to medicine and biology for healthcare purposes (*e.g. diagnostic or therapeutic*). Biomedical engineering seeks to close the gap between engineering and medicine: It combines the design and problem solving skills of engineering with medical sciences to advance healthcare *treatment*. Of course, it includes not only the *relevant* applications of engineering to medicine but also to the basic life sciences as well. Some of the well-established specialty areas within the field of biomedical engineering are as follows:

Bioelectrics is defined using electrical engineering principles to biology, medicine, behavior, or health, which develops *innovative*

electrical and electronic devices for the prevention, diagnosis, and treatment of disease. Bioelectric products are developed using several methods, ideas, and techniques, including bio-electromagnetic, instrumentation, robotics, etc. Bioelectrics also seeks use of bioelectronics instruments for the recording or transmission of physiological information and it has *seemingly* endless possibilities because of its *fusion* of different fields for the common purpose of developing new ways of treating disease and **disabilities**.

Biomechanics deal with the application of traditional mechanics to biological or medical problems. Better understanding of the forces and their effects on the human body is essential to get more insight into function of various body parts, the effect of load and over load on the specific structures, and the mechanics of biomaterial that could be utilized in prosthetic development. One example is the biomechanical analysis during the impact of automobiles, which can be **utilized** to develop safety devices such as airbags, seatbelts and helmets. Overall, biomechanics researches include the study of motion, material deformation, flow within the body, and transport of chemical elements across biological and *synthetic* media and membranes.

Biomaterials are synthetic and natural materials are used in the design of implantable devices. Understanding the properties and behavior of living material is *vital* in the design of implant materials. The selection of appropriate material to place in the human body may be the most difficult tasks faced by the biomedical engineer. Certain metal alloys, ceramics, polymers, and composites that are non-toxic, non-carcinogenic, and mechanically strong have been used in implantable materials.

Tissue engineering is **categorized** as a sub-field of biomaterials. It offers *vast* potential for changing traditional *approaches* to clinical treatment. Since so many tissues and organs are strong candidates for engineering reconstruction-including bone, cartilage, liver, pancreas, skin, blood vessel, and *peripheral* nerve-tissue engineering can help meet critical health care needs related to tissue and organ replacement.

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Tissue engineering systems also are being used as model systems to study cell behavior. Tissue engineering uses biomaterials and cells to produce new tissues. Stem cells have *infused* great excitement in the field as a potentially powerful cell source to **rebuild** tissues.

5 **Clinical engineering** is the other specialty within biomedical engineering responsible primarily for *implementing* medical technology to optimize healthcare delivery. Roles of clinical engineers include training and supervising biomedical equipment technicians, working with governmental regulators on hospital *inspections*, serving as
10 technological consultants for other hospital staff (*i.e.* physicians and administrators), developing and *maintaining* computer databases of medical instrumentation and equipment records. Clinical engineers also advise medical **system** producers to regard *prospective* design improvements based on clinical experiences, as well as monitor the
15 progression of the state-of-the-art¹ in order to redirect hospital *procurement* patterns. Accordingly; those who work in the rehabilitation field may deal with custom design and manufacture of **aids** such as wheelchairs or speech synthesizers and improve the quality of life for individuals with physical impairments.

20 In summary, biomedical engineers are employed in industry, in hospitals, in research facilities of educational and medical institutions, in teaching, and in government regulatory agencies. In industry, they may create designs where an in-depth understanding of living systems and of technology is essential. They may be involved in performance
25 testing of new or proposed products. Government positions often involve product testing and safety, as well as establishing safety standards for devices. In the hospital, the biomedical engineer may provide advice on the selection and use of medical **equipment**, as well as supervising its performance testing and repairs. They may also
30 build customized devices for special health care or research needs. In research institutions, biomedical engineers supervise laboratories and

1. the most up-to-date feature, modern

equipment, and participate in or direct research activities in teamwork with other researchers with such backgrounds as medicine, physiology, and nursing. Some biomedical engineers are technical advisors for marketing departments of companies and some are in management positions.

III. Post-reading

Understanding the text

A. Read each statement below and determine if each one is true, false or not given in the reading part.

TRUE (T): if the statement agrees with the information

FALSE (F): if the statement contradicts the information

NOT GIVEN (NG): if there is no information on this

1. T Biomechanics is a subset of biomedical engineering.
2. ... Tissue engineering of peripheral nerves has seen an increasing interest over the last years.
3. ... Clinical engineering is the application of technology to healthcare in hospitals.
4. ... Biomechanics is used to develop all parts of automobile.
5. ... Biomedical engineering tries to combine biology field with the medicine.
6. ... Bioelectric therapy is used to treat chronic and acute pain.
7. ... Toxic polymers can be placed in the human body.

B. Find synonyms for the following words. Use words in bold in the reading part.

- | | |
|----------------------|---------------------|
| 1. assist <u>aid</u> | 2. use |
| 3. insight | 4. device |
| 5. reconstruct..... | 6. impairment |
| 7. apparatus | 8. classify |

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C. Choose the best answer based on the reading:

1. What does the paragraph proceeding the passage most probably discuss?
 - a) difference between studying medicine and engineering
 - b) fields of biomedical engineering
 - c) connecting medicine and engineering
 - d) needs to overcome engineering problems
2. The word which in the fourth paragraph refers to
 - a) biomechanical analysis
 - b) automobiles
 - c) safety devices
 - d) one example
3. The word likewise in first paragraph is closest in meaning to
 - a) similarly
 - b) the same
 - c) also
 - d) all of the above
4. Which one is not specified in biomaterial part?
 - a) implantable material
 - b) organ replacement
 - c) stem cell
 - d) 3d bio-printing
5. According to the passage, clinical engineer is able toin hospital.
 - a) do medical device management
 - b) perform a surgery
 - c) prescribe drugs
 - d) do general examination of patient

Reading Skill

PREVIEWING

Previewing is glancing quickly through the reading passage without reading the whole things. Before you read something, it is important to look it over, or previewing it. When you preview a reading, you do three important things:

- A) Identify the topic.
- B) Think about what you already know about the topic.
- C) Ask yourself questions as you go.

Doing these three things will help you understand a reading better.

D. Follow these instructions to identify the topic of the paragraph below.

1. Look at the textbox below. (Do not read the paragraph.) Based on the *title* only, what do you think the paragraph is about?

.....
.....

Robotic Surgery

There is a new technology in surgery in which a surgeon performs surgery using a computer that remotely controls very small instruments attached to a robot. This procedure is done under general anesthesia (you are asleep and pain-free). The surgeon sits at a computer station nearby and directs the movements of a robot. Small instruments are attached to the robot's arms. The surgeon first inserts these instruments into your body through small surgical cuts. Under the surgeon's direction, the robot matches the doctor's hand movements to perform the procedure using the tiny instruments. A thin tube with a camera attached to the end of it (endoscope) allows the surgeon to view highly magnified three-dimensional images of patient body on a monitor in real time.

2. *Keywords* are words that appear several times in a paragraph. In the paragraph above, the keywords are underlined. Based on the keywords only, what do you think the paragraph is about?

- a) The history of robotic surgery
- b) How surgeon performs surgery using a robot
- c) How to use computer and robot

E. Before reading the paragraph answer to the following questions.

1. What do you already **know** about the topic?

Robotic surgery uses miniaturized surgical instruments.

.....
.....

2. What do you **want to know** about the topic?

How does robotic surgery work?

.....
.....

F. Read the paragraph and look for the answers to the questions in exercise B.

Building Vocabulary

WORD FORMATION 1

An English word can be divided into three parts: a prefix, a stem, and a suffix. The basic part of any word is the **stem**; to it, you can add a **prefix** at the beginning and/or a **suffix** at the end to change the meaning.



Example:



➤ Why should we learn English word formation?

Learning English word formation can at least provide us with three good advantages:

- **Increase your vocabulary.** Guess the meaning of the word by analyzing the known parts. Auto- means 'self': autobiography, autograph (one's own writing), automobile, and automatic. This part of knowledge also helps us to understand words without dictionaries.
- **Deepen your understanding of a word** by analyzing each part of the word so that you can not only learn about the surface meaning but also the deeper connotation of the word. '-ard' used in forming the personal nouns often has a contemptuous connotation in English. Drunkard, sluggard (someone who is very sluggish), we know they are contemptuous people who have developed very bad habits.
- **Enliven your language.** Create a lively style in your English writing. Bernard Shaw once wrote a famous sentence about the

World War II, in it, he used several compounds which have been formed in the same way as the word *outwit* is formed. This kind of formation is very accurate in depicting the condition of the defeated Germany then. “Germany was outwitted, out prepared, out-generalled, outfought, out flown, outgassed, out tanked, out bombed, and finally brought to her knees.”

Many English words and word parts can be traced back to Latin and Greek. Table1-1 lists some Latin and Greek roots from A to C.

Root Word	Meanings	Examples
Acou	hearing	acoustic
Act	do	active, interaction, react
Alg	pain	neuralgia
Ambul	walk, move	ambulance
Ampl	large	amplify
Ana	throughout	analysis , anatomy
Anim	life, spirit	animal , animation
Ann	year	anniversary
Anthrop	human	anthropology
Aqu	water	aquarium
Arthr	joint	arthroscopy
Aud	hear	audio
Bible	book	bibliography
Bio	life	biology, bioinformatics
Cardi	heart	cardiac
Cata	complete, down	catalog, catabolism
Celer	fast	accelerate
cent/i	hundred	centimeter , century
Cerebr	brain	cerebral
Chrom	color	achromatic
Cide	cut, kill	homicide
Circle	round	circuit
Circum	around	circumflex
clud, clus	close	conclusion
Cumul	mass	accumulator
Cycl	circle	bicycle
Cyt	cell	cytoplasm

Table 1. Root words from A to C

G. Study Table1 and try to find additional root words from A to C with examples. Use your dictionary if necessary.

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

H. Find some words in the reading part, containing roots of Table1.

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

I. Use the following words to fill in the blanks.

- | | | | |
|-----------------------|----------------------|--------------------|---------------------|
| <i>Bioengineering</i> | <i>Biology</i> | <i>Analyze</i> | <i>chemistry</i> |
| <i>around</i> | <i>Cardiac</i> | <i>Arthroscopy</i> | <i>bibliography</i> |
| <i>Accumulation</i> | <i>aqua-aerobics</i> | <i>Accumulator</i> | <i>achromatic</i> |
| <i>Amplifying</i> | <i>Acoustic</i> | <i>cerebral</i> | <i>Cytoplasm</i> |

1. Cardiac arrest happens when your heart stops pumping blood around the body.
2. Can you measure the circumference of this circle? The root-word *circum* means.....
3. is the examination of a joint, specifically, the inside structure.
- 4..... is an exercise is down in the swimming pool.

5. Some researchers suspect that stress hormone promotes the of abdominal fat.
6. is a register in a computer used for holding the results of a computation.
- 7.....is a list of the sources you used to get information for your report.
- 8..... Lenses are used in a variety of applications such as microscopy, inspection, or spectroscopy.
9. The B.S. degree program in provides students with fundamental knowledge of mathematics, science, and technology.
10. A step-by-step approach is the best way to decide how to biological data.
11. Biochemistry is a science that combinesand.....
12. An electronic stethoscope overcomes the low levels by electronically internal sound of lung, heart body.
13. The left hemisphere controls the right side of the body.

Vocabulary Training Exercises

J. Use the words underlined in the following passages, to fill the gaps in the blank sentences, use technical dictionary if necessary.

Graduate Program in Biomedical Engineering

Biomedical Engineering's Graduate Program provides outstanding graduate level training in several critical areas of biomedical engineering and technology including: Biomechanics; Rehabilitation Engineering; Biomedical Imaging; Neuroengineering; Physiological Systems; Bioinstrumentation; Biomaterials, Pharmaceutical engineering and Tissue Engineering. Graduates will be ideally suited to contribute directly to the biomedical and healthcare centers, armed with the skills and knowledge required working in hospitals, clinical research institutes, the medical device and medical imaging

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industries, bioinformatics, biomedical sensors industry, and regulatory agencies.

1. *Bioinformatics* is the application of computer *technology* to the management of biological information.
2. is about using scientific methods to model the nervous system.
3. is an interdisciplinary field requiring a.....? of the basic principles in digital electronic and control systems.
4. is the diagnosis, treatment, and prevention of disease, illness and injury in human beings.

Medical Flash Cards:

a) Myalgia /maɪ'æl dʒi ə, -dʒə/ = **pain in a muscle**

– The cause of **myalgia** may be acute viral respiratory disease or infection by parasites and stress.

b) Ophthalmologist /'ɒf θəl'mɒl ə dʒɪst/ = **specialist in the study of the eye**

– If your eyes are consistently red, blurry or watery, or they become sensitive to light or painful, see an **ophthalmologist**.

c) Hysterectomy /'hɪs tə'rek tə mi/ = **surgical removal of the uterus**

– Surgery is often the main treatment for endometrial cancer and consists of a **hysterectomy**.

d) Myolipoma /myo-li-pomə/ = **a tumor made up of fat and muscle**

– a kidney **myolipoma** can be detected incidentally upon survey for nonspecific abdominal pain.

e) Hepatomegaly /'hɛp ə tu:'mɛg ə li/ = **an enlargement of the liver**

– **Hepatomegaly** is often a sign that the tissue within the liver is not functioning properly.

Section Two: Language study

I. Writing

PREWRITING:

Prewriting is preparation that you can do before you actually write your paper, essay or summary. It includes:

1. **Choosing a topic:** exploring possible subject by reading, observing and thinking helps to find the right topic and naming it.
2. **Narrowing the topic:** Topic selection must be specific in the scope of an essay. For example, the topic “Internet” is a general one; in order to write on something more specific which will give a deeper and more detailed discussion of this topic, make it narrow and specific:

General subject: Internet

Narrowed topic: social networking site

Specific topic: How social networking site influence us

3. **Clustering:** This is a way to record author thoughts and observations for an essay after choosing a topic. In this section:

First draw a circle near the center of a blank piece of paper, and in that circle, write the **topic/main idea** of your essay.

Then in a ring around the main circle, write down the main parts or **subtopics** within the main topic.

Circle each of these, and then draw a line connecting them to the main circle in the middle. Then think of **details** that relate to each of the subtopics, circle these, and draw lines connecting them to the relevant part/subtopic.

Repeat this process with each new circle until you run out of ideas. This is a great way of identifying the parts within your topic, which will provide content for the paper, and it also helps you discover how these parts relate to each other.



