Unit 1 Biomedical Engineering

1.1 Text: Biomedical Engineering

Many of the problems the health professionals confronting today are of extreme importance to the engineer because they involve the fundamental aspects of device and systems analysis, design, and practical application—all of which lie at the heart of processes that are fundamental to engineering practice.[1] These medically relevant design problems can range from very complex large-scale constructs, such as the design and implementation of automated clinical laboratories, multiphasic screening facilities (i.e. centers that permit many tests to be conducted), and hospital information systems, to the creation of relatively small and simple devices, such as recording electrodes and transducers that may be used to monitor the activity of specific physiological processes in either a research or clinical setting. They encompass the many complexities of remote monitoring and telemetry and include the requirements of emergency vehicles, operating rooms， and intensive care units.

Biomedical engineering involves applying the concepts, knowledge, and approaches of virtually all engineering disciplines (e.g. electrical, mechanical, and chemical engineering) to solve specific health care related problems. Because human health is multifaceted—involving not only our physical bodies but also the things that we put in our bodies (such as foods, pharmaceuticals, and medical devices) and the things that we put on our bodies (such as protective clothing and contact lenses)—the opportunities for interaction between engineers and health care professionals are many and varied.

Biomedical Engineering is thus an interdisciplinary branch of engineering heavily based both in engineering and in the life sciences ranging from theoretical, nonexperimental undertakings to state-of-the-art applications. It can encompass research, development, implementation, and operation. Accordingly, like medical practice itself, it is unlikely that any single person can acquire expertise that encompasses the entire field.[2] As a result, there has been an explosion of biomedical engineering specialists to cover this broad spectrum of activity. Yet, because of the interdisciplinary nature of this activity, there is considerable interplay and overlapping of interest and effort between them. For example, biomedical engineers engaged in the development of biosensors may interact with those interested in prosthetic devices to develop a means to detect and use the same bioelectric signal to power a prosthetic device.[3] Those engaged in automating the clinical chemistry laboratory may collaborate with those developing expert systems to assist clinicians in making clinical decisions based on specific laboratory data.[4] The possibilities are endless.

◆ *Source: Introduction to Biomedical Engineering—What is Biomedical Engineering?*

Glossary

professional [prəˈfeʃənəl]	*n.* 专业人员
telemetry [təˈlɛmətri]	*n.* 遥测技术；遥感勘测
multifaceted [ˌmʌltiˈfæsɪtɪd]	*adj.* 多层面的
transducer [trænzˈdusə]	*n.* 传感器
pharmaceuticals [ˌfɑ:məˈsju:tɪkəlz]	*n.* 药物
interdisciplinary [ˌɪntəˌdɪsəˈplɪnəri]	*adj.* 跨学科的
biosensor [ˈbaɪoˌsɛnsə]	*n.* 生物传感器
power [ˈpaʊə]	*vt.* 使……运转

Technical Terms

biomedical engineering	生物医学工程
multiphasic screening facilities	多相筛检设施
recording electrode	记录电极
ambulance	急救车
operating room	手术室
intensive care units	重症监护病房
engineering discipline	工程学科
health care	医疗保健
protective clothing	防护服
contact lenses	隐形眼镜
state-of-the-art	最新式的
bioelectric signal	生物电信号
prosthetic device	假肢

Notes

1. Many of the problems health professionals confronting today are of extreme importance to the engineer because they involve the fundamental aspects of device and systems analysis, design, and practical application—all of which lie at the heart of processes that are fundamental to engineering practice.

今天，健康专业人士面对的很多问题对工程师来说都极其重要，因为这些问题涉及设备和系统的分析、设计与实际应用，而这又是工程实践基础程序的核心。

分析：which lie at the heart…为非限定性定语从句，修饰 the fundamental aspects of…。

2. Accordingly, like medical practice itself, it is unlikely that any single person can acquire expertise that encompasses the entire field.

因此，与医疗实践一样，任何一个人不可能获得包含整个领域的专业知识。

分析：that 引导限定性定语从句，修饰 expertise。

3. For example, biomedical engineers engaged in the development of biosensors may interact

with those interested in prosthetic devices to develop a means to detect and use the same bioelectric signal to power a prosthetic device.

例如，参与开发生物传感器的生物医学工程师们，可以与那些对假肢感兴趣的工程师们合作，共同开发能检测生物电信号并同时用该信号驱动的假肢。

分析：engaged 前省略连接词 that，engaged in the development 修饰 biomedical engineers。

4. Those engaged in automating the clinical chemistry laboratory may collaborate with those developing expert systems to assist clinicians in making clinical decisions based on specific laboratory data.

那些投身于建设自动化临床化学实验室的工程师们，与需要专业实验数据来开发专家系统（在临床诊断中评估患者）的工程师们可以相互合作。

Translation Skills：生物医学工程各个领域名称

Biomechanics	生物力学	Biosensors	生物传感器
Medical Imaging	医学影像	Biomaterials	生物材料
Biotechnology	生物技术	Bioinformatics	生物信息学
Neural Engineering	神经工程	Tissue Engineering	组织工程
Physiological Modeling	生理建模	Biomedical Instrumentation	生物医学仪器
Clinical Engineering	临床工程	Rehabilitation Engineering	康复工程
Prosthesis	假体	Bionanotechnology	生物纳米技术
Biomedical Optics	生物医学光学	Artificial Organ	人工器官
Genetic Engineering	基因工程	Pharmaceutical Engineering	制药工程

1.2 Listening: Biomedical Engineering

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Section 1

Biomedical engineering (BME), also known as bioengineering, is the application of engineering principles and design concepts to medicine and biology for healthcare purposes (e.g. diagnostic or therapeutic). This field seeks to close the gap between engineering and medicine, combining the design and problem solving skills of engineering with medical biological sciences to advance health care treatment, including diagnosis, monitoring and therapy. Also included under the scope of a biomedical engineer is the management of current medical equipment within hospitals while adhering to relevant industry standards. This involves equipment recommendations, procurement, routine testing and preventative maintenance, through decommissioning and disposal. This role is also known as a Biomedical Equipment Technician (BMET) or clinical engineering.

Biomedical engineering has only recently emerged as a new study, as compared to many other engineering fields. Such an evolution is common as a new field transitions from being an

① 本书各个单元听力部分的音频可扫描二维码获取。

interdisciplinary specialization among already-established fields, to being considered a field in itself. Much of the work in biomedical engineering consists of research and development, spanning a broad array of subfields. Prominent biomedical engineering applications include the development of biocompatible prostheses, various diagnostic and therapeutic medical devices ranging from clinical equipment to micro-implants, common imaging equipment such as MRIs and EKG/ECGs, regenerative tissue growth, pharmaceutical drugs and therapeutic biologicals.

Section 2

Some of the subfields of biomedical engineering are:

- Bioinformatics. Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data. As an interdisciplinary field of science, bioinformatics combines computer science, statistics, mathematics and engineering to analyze and interpret biological data.
- Biomechanics. Biomechanics is the study of the structure and function of the mechanical aspects of biological systems, at any level from whole organisms to organs, cells and cell organelles, using the methods of mechanics.
- Biomaterials. A biomaterial is any matter, surface or construct that interacts with living systems.
- Biomedical optics. Biomedical optics refers to the interaction of biological tissue and light, and how this can be exploited for sensing, imaging and treatment.
- Tissue engineering. One of the goals of tissue engineering is to create artificial organs (via biological material) for patients that need organ transplants. Biomedical engineers are currently exploring methods of creating such organs. Researchers have grown solid jawbones and tracheas from human stem cells towards this end. Several artificial urinary bladders have been grown in laboratories and transplanted successfully into human patients. Bioartificial organs, which use both synthetic and biological component, are also a focus area in research, such as with hepatic assist devices that use liver cells within an artificial bioreactor construct.

Section 3

- Genetic engineering.
- Neural engineering.
- Pharmaceutical engineering. This is an extremely broad category—essentially covering all health care products that do not achieve their intended results through predominantly chemical (e.g. pharmaceuticals) or biological (e.g. vaccines) means, and do not involve metabolism.
- Medical devices.

  A medical device is intended for use in:

  - the diagnosis of disease or other conditions, or

- in the cure, mitigation, treatment or prevention of disease.

Some examples include pacemakers, infusion pumps, the heart-lung machine, dialysis machines, artificial organs, implants, artificial limbs, corrective lenses, cochlear implants, ocular prosthetics, facial prosthetics, somato prosthetics and dental implants.

- Medical imaging.
- Implants.
- Bionics.
- Clinical engineering. Clinical engineering is the branch of biomedical engineering dealing with the actual implementation of medical equipment and technologies in hospitals or other clinical settings.
- Rehabilitation engineering. Rehabilitation engineering is the systematic application of engineering sciences to design, develop, adapt, test, evaluate, apply and distribute technological solutions to problems confronted by individuals with disabilities.

◆ *Source: https://en.wikipedia.org/wiki/Biomedical_engineering.*

Listening Exercises

Listen to each section twice, and as you are listening, (a) number the words or expressions in the list on the work sheet by order of their first appearance in the passage you are listening to; (b) check if your numbering is correct—if incorrect, listen to the section again; (c) orally answer the questions about the content of each section.

Unit 1, Section 1

bioengineering	monitoring	regenerative
decommissioning	procurement	spanning
interdisciplinary	prostheses	therapeutic

1. What is a diagnosis? Explain the term in your own words and give one concrete example of a diagnosis.
2. Give an example of a medical condition that needs to be monitored over a longer time period.
3. Name three tasks that need to be carried out by a biomedical equipment technician.

Unit 1, Section 2

bioartificial	hepatic	tracheas
bioinformatics	organelles	transplants
construct	sensing	via

1. What do you need to study and be good at for a specialization in bioinformatics?
2. What is an organelle?
3. What is needed for growing an artificial urinary bladder?

Unit 1, Section 3

category	dialysis	mitigation
confronted	implementation	predominantly
diagnosis	infusion	somato

1. What is the difference between cure and mitigation?
2. Where does a cochlear implant go?
3. When does a person need a dialysis machine?

1.3 Writing: Why Do You Have to Write English Scientific Papers?

撰写科技论文的目的有很多种。例如，与其他学者分享新的研究结果，发现了新的研究问题，介绍自己的研究成果等。著名学者 Faraday 曾经写道：“There are three necessary steps in useful research: the first to begin it, the second to end it, and the third to publish it.” 此外，发表科技论文的目的也可能是为了职称晋升或者申请科研经费。研究生可能需要发表几篇论文才能毕业。论文的数量和质量是学生和导师事业发展的敲门砖。“不成文，便成仁”（publish or perish）是学术生涯的写照。

上述目的虽然都是很重要的动机，然而就撰写科技论文而言，首要的目的是一种更狭义、更具体的目的，即把某些信息传达给某个读者群。

因此，在撰写科技论文时应记住，能否准确清晰地将论文内容有效地传达给读者群，是作者的责任，而不是读者的责任。一个研究结果只有在被别人使用时才有意义。而想被别人使用，论文必须能引起其他科学家的兴趣，而且要保证其他人能看懂并可以重复和再现研究结果。只有可以被理解的研究才会被重复，也只有可以被再现的作品才能被关注和引用。而论文被引用的数量常常用来衡量研究的影响力。从某种角度看，写作就像是把工作成果推销给其他科学家。因此，加强沟通技巧，学习科技论文标准的写作风格，无疑是研究人员科研训练中很重要的一部分。唯有通过这方面的训练，科学家和工程师才能更有效地将报告内容传达给读者群，才能更好地达到撰写报告的基本目的，即“有效的沟通”。

撰写科技论文的同时也培养了研究人员严谨思考的习惯。研究人员需要学习科技论文写作的另一个理由是，只有论文写得清楚、简洁、准确，才能反映出作者严谨、清晰的思维。相应地，如果研究人员无法清楚地表达自己的想法，那么就表明研究人员的思路不够清晰。撰写科技论文时千万不要以为有很好的想法或实验结果是最重要的事情，从而忽略了准确、清晰、简洁的表达方式。事实上，如果研究人员不知道如何表达自己的想法或者觉得自己表达得不好，通常问题不是表达能力不足，而是思维还有些模糊和粗糙。此时应对论文的写作思路和主题思想做进一步的分析，然后使用清楚、准确的言辞来表达自己的想法。此外，由于思考和语言的使用之间具有密切的联系，因此训练自己写出思路更清晰、结构更严谨的论文，同时也培养了自己严谨思考的习惯。

如何写出好的英文科技论文

- 好的科技论文需要创新性。在已沉寂的研究领域提出新的思想，在十分活跃的研究领域取得重大的进展，或者将原来彼此无联系的研究领域融合在一起，都是论文创新性的表现。一篇科技论文一定要提供新的信息，新的信息包括新的学术思想、新的实验方法或者新的发现。
- 好的科技论文要做到可读性强。结构严谨、环环相扣、首尾呼应的论文可读性更强。同时论文要有充分的论证和通顺的行文逻辑，以合理的方式再现作者的思路，使读者最终能得出与作者相同的结论。论文的语言表达应做到深入浅出、言简意赅。专业术语使用准确且前后一致，图表使用要合理规范，恰到好处。
- 在撰写英文科技论文时，应尽量把每个句子的意思都表达清晰，避免造成读者的误解。一篇好论文能使读者（特别是编辑与审稿人）在最短时间内准确地掌握作者的研究工作中最重大的科学价值。作者要明确地传达论文的结论和相关信息，对重要观点直接表述，防止语义含糊使读者推测论文观点。小说的写作需要埋伏笔、隐藏线索，但是英文科技论文的写作需要清晰明确地引导读者追随你的逻辑与观点。
- 英文科技论文的写作应尽量简洁。当论文中有复杂的长句时，应将其改写为简短、直接的句子，同时删掉句子中可有可无的词语。

英文科技论文写作重要的三个原则——“the three Cs”

“the three Cs”是英文科技论文写作重要的原则，在撰写科技论文时，应谨记于心。

- 正确（Correct）：句子的语法必须正确，而且论文的内容也要正确。
- 清楚（Clear）：作者的意图要表达清楚并且准确，使读者能够迅速读懂。
- 简洁（Concise）：论文的语言应简洁、明了，避免重复和冗长。每个句子中的每个单词都应是句子不可或缺的部分。

1.4 Speaking: English Conference Presentation

科研人员常常需要参加国际学术会议（international conference）或讨论会（seminar），并以做报告的方式讲解自己最近的研究成果。此外，各领域中的专业人员，如工业界的工程师与经理常常需要和同事开会，介绍研发计划、技术报告、市场分析报告或新产品数据等。本节将讨论如何准备英语会议报告，以及如何在会议中陈述自己的报告。

表示会议的单词

会议的英语表达方式有很多，包括 meeting、conference、congress、symposium、seminar、workshop、forum 等，这些词语的区别如下。

- Meeting：会议，最一般的用词，规模可大可小，层次可高可低。可以是正式或者是非正式的聚会，如首脑会议、紧急会议、告别会议等。
- Conference：大会，较为正式的用词，使用范围较广泛，多数国际会议使用该词语，如 International Conference on Biomedical Engineering。

- Congress：代表大会，由正式代表出席的会议，一般规模较大，如国际生物医学代表大会、全国人民代表大会（The National People’s Congress）。
- Symposium：研讨会，主要指专题性的学术会议，尤其是参与者既为听众，又为报告人的会议。研讨会通常范围较窄，主题较突出，如 International Symposium on Biomaterials。
- Seminar：讨论会、组会，包括教授定期与学生讨论研究报告和发现的组会、研究生的专题讨论会，如 research seminar 等。
- Workshop：经验交流会、讨论会，强调信息（包括知识和经验）通常在较少的参与者之间的交流与交换，强调实际操作，如 workshop on gait analysis（步态分析经验交流会）。
- Forum：论坛、公众会议、讨论大众关心问题的集会，如 World Economic Forum （世界经济论坛）。