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THE BIOMEDICAL ENGINEERS

Healthcare

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ABSTRACT

Biomedical Sciences, as defined by the UK Quality Assurance Agency for Higher Education Benchmark Statement in 2015, includes those science disciplines whose primary focus is the biology of human health and disease and ranges from the generic study of biomedical sciences and human biology to more specialised subject areas such as pharmacology, human physiology and human nutrition. It is underpinned by relevant basic sciences including anatomy and physiology, cell biology, biochemistry, microbiology, genetics and molecular biology, immunology, mathematics and statistics, and bioinfor Biomedical Sciences, as defined by the UK Quality Assurance Agency for Higher Education Benchmark Statement in 2015, includes those science disciplines whose primary focus is the biology of human health and disease and ranges from the generic study of biomedical sciences and human biology to more specialised subject areas such as pharmacology, human physiology and human nutrition. It is underpinned by relevant basic sciences including anatomy and physiology, cell biology, biochemistry, microbiology, genetics and molecular biology, immunology, mathematics and statistics, and bioinformatics. As such the biomedical sciences have a much wider range of academic and research activities and economic significance than that defined by hospital laboratory sciences. Biomedical Sciences are the major focus of bioscience research and funding in the 21-22st century. As such the biomedical sciences have a much wider range of academic and research activities and economic significance than that defined by hospital laboratory sciences. Biomedical Sciences are the major focus of bioscience research and funding in the 21st century.

KEYWORDS

INTRODUCTION

Bioengineers create life-saving devices such as pacemakers and artificial hearts, heavy-duty equipment such as MRI and surgical robots, and biomaterials used to repair tissue damage.

Biomedical Engineering (BME) 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 and biological sciences to advance healthcare treatment, including diagnosis, monitoring, and therapy. Biomedical engineering has only recently emerged as its own study, compared to many other engineering fields. Such an evolution is common as a new field transitions from being an 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 EEGs, regenerative tissue growth, pharmaceutical drugs, and therapeutic biologicals.

Biomedical engineering is a growing discipline with broad potential job prospects, fast job growth, a high median income, and excellent quality of life. At Ole Miss, we are preparing students through a rigorous and interactive curriculum to meet the growing demand for biomedical engineers worldwide.[1]

Biomedical engineers have a wide range of job opportunities that can include a hospital based practice as a clinical engineer, an industrially based engineer designing medical devices, a technical sales engineer, or a staff engineer in a medical research laboratory. Biomedical Engineers find themselves in a wide variety of specialties which may organize around various diseases, such as cancer, or organ systems such as the cardiovascular system, or technology, such as biomaterials or imaging. A biomedical engineer may have jobs which involve the following skills and applications:

- Develop software to detect abnormal heart rhythms for use in a cardiac pacemaker.
- Design the next generation of hip implants using modern materials and mechanical design considerations.
- Investigate and perfect a novel drug delivery method to treat a chronic disease which requires constant blood levels of the particular medicine.
- Bring a product to market through the Food and Drug Administration's very involved pre-market approval process which requires extensive clinical testing.
- Manage a large hospital based group of biomedical equipment technicians and provide the hospital with engineering expertise in the evaluation of new and expensive technologies.
- Design and build a unique research device as part of a multidisciplinary research team to enable scientific discovery.
- Advance the state of the art one of the many modern imaging modalities (PET, MRI, CAT scans) either in the progression of current technology or the development of new ones.
- Develop an advanced coding/stimulation scheme for a cochlear implant which provides auditory inputs to people with significant hearing deficits.
- Analyze a special communications or mobility need of a handicapped patient and develop the appropriate enabling technology.[2],[5]

Methods

Biomedical engineers (also known as medical engineers) work with medical professionals and patients to design and develop advanced healthcare technology. Their typical duties include:

- liaising with medical and scientific staff and patients to understand their needs
- designing, developing and testing products, equipment and devices that will address medical problems cost efficiently
- designing, testing and implementing new medical procedures, such as computer-aided surgery and tissue engineering
- managing clinical trials of new devices and equipment
- working with manufacturers of devices and their marketing teams
- investigating ways to market new products
- maintaining equipment and training staff to use it safely
- responding to queries and resolving problems with devices
- writing reports and documentation
- carrying out research and publishing findings.

Graduate Salaries

If you work in the NHS as many bioengineers do, you'll start by completing the NHS scientific training programme, which comes with a starting salary of around £31,000, according to bmj.com.

Outside the NHS, starting salaries are around £22,000, according to Glassdoor, a job comparison site. Earnings in both the public and private sector will rise with experience you could earn up to £45,000 a year.[3]

Typical Employers Of Biomedical Engineers

NHS trusts
Private health organisations
Research organisations
Diagnostic/medical instrumentation manufacturers
The armed forces
Charities involved in providing medical devices.
For help with applying for engineering jobs and internships, take a look at our engineering CV and covering letter tips and our advice on filling out online applications.[3]

Qualifications And Training Required

To become a biomedical engineer, you'll need at least a 2.1 degree (or a 2.2 plus a postgraduate qualification) in a relevant subject such as biomedical engineering, biomedical science, mechanical engineering, electrical engineering or physics.

If you plan to work in the NHS, you'll need to apply for the NHS scientific training programme. This is a three-year work-based learning scheme that leads to a masters. Having completed the programme you can apply for registration with the Health Care Professions Council (HCPC), and, once registered, you can apply for relevant roles in the NHS.

Outside the NHS, postgraduate qualifications can be beneficial (particularly for non-engineering graduates), and may be necessary for some posts.

Competition for jobs in this field is tough so work experience will help you in your applications and interviews. Some employers offer final-year project work, degree sponsorship, internships and industrial placements, which can provide insights into biomedical work.

Research work, voluntary work for charities such as Remap, hospital placements and laboratory experience can also be useful.[3]

Key Skills For Biomedical Engineers

Employers will be looking for:

- experience using computer modelling software
- attention to detail
- problem-solving skills and a solution-focused mindset
- the creative and technical ability to turn designs into products
- interpersonal skills and the ability to empathise with patients
- excellent communication skills
- the ability to work as a part of a multidisciplinary team.

RESULTS AND DISCUSSION

Next: search graduate jobs and internships

View our graduate jobs and internships and don't forget to register with target jobs to get the latest job opportunities, internships, career advice, courses and graduate events based on what's important to you. [4]

Biomedical engineers work with a broad range of professionals ranging from other engineering specialties, to basic laboratory scientists, to physicians and nurses. Strong communications skills are essential as the biomedical engineer often becomes the general interpreter for such widely educated individuals; the biomedical engineer who knows the language of both engineering and medicine.

High school preparation for biomedical engineering would include four years of math (through pre-calculus), one year each of physics, chemistry and biology. Most universities also expect the prospective Biomedical Engineer to have 4 years of English and a mix of social studies and language courses which comprise a strong pre-college curriculum.

What Kind Of Jobs Can I Get After College

Biomedical engineers have a wide range of job opportunities that can include a hospital based practice as a clinical engineer, an industrially based engineer designing medical devices, a technical sales engineer, or a staff engineer in a medical research laboratory. Biomedical Engineers find themselves in a wide variety of specialties which may organize around various diseases, such as cancer, or organ systems such as the cardiovascular system, or technology, such as biomaterials or imaging. A biomedical engineer may have jobs which involve the following skills and applications:

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What Qualifications Do You Need To Be A Biomedical Engineer

Biomedical engineers are expected to hold **at least a bachelor's degree in Biomedical Engineering** from an Accreditation Board of Engineering and Technology, or ABET-accredited program. Biomedical engineers are expected to be knowledgeable in many areas including physics, chemistry, biology, medicine, mathematics, statistics, materials science, and engineering.

It is possible to earn an undergraduate degree in another discipline of engineering, such as electrical engineering, for example, and complete graduate studies in biomedical engineering to transition into the field. After college, biomedical engineers should **expect to continue education** throughout their careers to keep up with the latest improvements in technology.

For research and development and faculty positions, biomedical engineers usually need to earn a **masters or doctoral degree**. In addition, a graduate degree can broaden biomedical engineers educations and help them learn new technology.

Biomedical Engineering: Areas Of Specialization

Biomedical engineering constantly evolves as the frontiers of biological knowledge and technology innovation advance, and the challenges of improving human health shift. Drexel BIOMED is anticipating the future of biomedical engineering by investing in strategic thrust areas with the aim to adress society's most pressing needs.

Spotlight: Neuroengineering and Neural Engineering is unlocking the inner workings of the human brain, working at the interface of engineering and neuroscience to understand, restore, and enhance the properties and capabilities of the human brain. Research areas include modeling of neural systems, neural networks, understanding evolutionary influences in biological control systems, neurocontrol, neurorobotics, and neuroprosthetics as well as brain-computer interfaces.

Moving Discoveries From Lab To Clinic

Biomedical engineers are committed to shepherding their discoveries to the clinical setting, in partnership with entrepreneurs and business, legal, and investment communities. Licensed technologies coming out of biomedical engineer's labs **spur new and growing businesses and create jobs. [6]**

CONCLUSION

In the department of the Technical Service, Biomedical Technology was established in 1989, in accordance with Article 11 of Law 1579, for the management and repair of damage to medical machines. The Biomedical Technology department consists of the following individuals: the Biomedical Technology Supervisor, the Biomedical Technology Fault Manager, and the Biomedical Technology Technicians. The departments/persons involved with Biomedical Technology are: the director of the technical service, the procurement department, the accounting department and the board of directors. Biomedical Technology is responsible for the maintenance, equipment and in general for the proper management of biomedical equipment. To study the reliability of biomedical equipment, various coefficients and indicators have been established internationally. Typical indicators are: the service provision indicator, the indicator of maximum equipment utilization, the indicators of prevention, prediction of malfunctions and the average life of the equipment, the indicator of the average time between two random repairs that will be made on the machine and the cost indicator of the delay for the operation of the machine, measured in hours or days. The reliability of the equipment also depends on how many times an equipment will work properly before it suffers any failure. Statistical distributions such as Gaussian or Weibull are commonly used. A constant parameter of objective assessment of the successful operation of the equipment can be considered the activity of the equipment and all its operating times and average life, its level of inactivity, the impossibility of obtaining active operation and therefore work by the users, the assessment of its global purchase, installation, consumables and maintenance costs. Community Directive 93/42/EEC on medical devices was adopted by Greek legislation with joint ministerial decision DY7/2480/94 and concerns all medical devices except active implantables and in vitro diagnostics. For example, CT scanners, x-ray machines and even syringes and gauze are considered medical devices. According to the directive, products should meet some basic requirements in order to protect the safety and health of patients, users and third parties. The existence of the CE marking on the product indicates that the manufacturer has followed the necessary procedures so that the basic requirements are met and allows the free circulation of these products throughout the European Union. The marking became mandatory from June 14, 1998, and all medical devices must carry it. The biomedical technology department, in order to cope with its obligations, must maintain and process a large amount of data concerning all phases of the operational life of each medical device. Three computerization systems used in various Greek hospitals are: CLE-MANTIS, PRAXIS and MASO-POINT.

CLE-MANTIS was created within the European program BIOTECHNET II and is in the evaluation phase in 11 hospitals throughout Greece.

PRAXIS, developed by the Institute of Biomedical Technology (INBIT) for Datamed.

The MASO-POINT program was carried out by a team of TEI Heraklion exclusively for the needs of the Department of Biomedicine of PAGNI.

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