

Undergraduate Packaging Programs at CBU

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Abstract – Christian Brothers University (CBU) is one of 15 packaging programs in the United States according to the Institute of Packaging Professionals (www.IoPP.org). CBU started its packaging program with an elective course in spring 2001. Currently, it offers an undergraduate packaging certificate, a B.S. in engineering management with a packaging concentration, and an M.S. in engineering management with a packaging concentration. A new program, a Bachelor of Fine Arts (B.F.A.) in package graphic design, is being developed. Each of these programs develops different skills for the diverse packaging industry. This paper discusses the undergraduate packaging programs offered at CBU.

Keywords: Packaging education, undergraduate curriculum, certificate program, engineering management, graphic design

INTRODUCTION

Packaging at Christian Brothers University started in spring 2001 with an elective course for engineering students in response to industry needs [1]. It grew into a Packaging Engineering Certificate in fall 2002. Between 2004 and 2005, almost \$300,000 was spent on equipment for the Packaging Lab as part of a \$3M grant from the Assisi Foundation of Memphis. In addition, about \$400,000 was spent on related lab equipment in the Polymer Lab, Solid Mechanics Lab, and Manufacturing Lab. CBU introduced two other packaging programs in fall 2007, B.S. and M.S. in engineering management with packaging concentration. The M.S. program is offered in collaboration with Michigan State University [2].

This paper describes the Packaging Engineering Certificate and B.S. in engineering management with a packaging concentration, as well as a new B.F.A. in package graphic design that is under development. The three programs aim to produce different kinds of graduates for the diverse packaging industry.

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PACKAGING ENGINEERING CERTIFICATE

Most engineers are not exposed to packaging in their formal engineering education. The products they design may be expensive – or worse, impossible – to deliver to their destinations. To prevent this problem, some companies involve packaging professionals from the beginning of a new product design process. CBU offers a Packaging Engineering Certificate to its engineering students to give them some exposure to packaging design considerations. It is a valuable addition to their engineering degree and has become popular among chemical and mechanical engineering majors. Given CBU's location in Memphis, a major distribution center, packaging internship opportunities are plentiful.

The certificate program requires the following courses:

- Pre-requisites of college-level chemistry and calculus courses

All engineering students have already had at least one chemistry course and several calculus courses in their program. Those who are not engineering students or not in college need to take these two pre-requisite courses. The courses may be taken at other institutions, including two-year community colleges.

- Two packaging courses:

PKG/CHE/ME 319 Principles of Packaging (3 credits)

Overview of the historical development of packaging, the system of packaging science, along with information about economic importance, social implications and packaging as a profession. Study of the functions of packaging and materials, container types, processes, technology and equipment employed to protect goods during handling, shipping and storage. Introduction of package development process, packaging testing and evaluation methods, standards, and equipment. Brief review of governmental regulations affecting packaging.

PKG/CHE/ME 320 Distribution/Medical Device Packaging (3 credits)

Overview of physical distribution systems, various distribution hazards imposed to products/packages in transit, rules and regulations governing distribution packaging, and common industry guidelines and practices on distribution packaging. Study of the package design process, protective packaging theories and applications, selection and design, other distribution packaging related materials and applications. Introduction to package testing and evaluation methods, standards, and equipment/systems. Introduction to basics of packaging materials, packaging design and development, and sterilization methods used in biomedical industry.

Engineering students may take these two courses as part of their electives during their junior and senior years. A few may need to take one of these two courses as an extra course beyond what is required in their programs.

- An elective course

A materials related course can be counted toward this elective requirement; most engineering students already have such a course in their curriculum. Using CBU (based on the upcoming 2009-2010 Catalog) as an example:

- ChE 245 Materials Science (3 credits) in B.S. Chemical Engineering
- CE 201 Statics (3 credits) + CE 202 Introduction to Strength of Materials (1 credit) in B.S. Civil Engineering
- ME 312 Mechanics of Deformable Solids (3 credits) in B.S. Mechanical Engineering

- CE 201 + CE 202 (as in B.S. Civil Engineering above) or PKG 200 Mechanics of Solids (3 credits) for B.S. Engineering Management (Packaging Concentration) -- It should be noted that students in the B.S. Engineering Management (Packaging Concentration) program automatically get the Packaging Engineering Certificate upon graduation. This program is discussed in detail later in this paper.

The B.S. Electrical Engineering program, which includes a computer engineering option, does not have any materials related course. These students could either take ME 312 (3 credits) as an elective or take CE 202 (1 credit) as an additional course to their B.S. requirements.

- A packaging project

A packaging project of at least 2 credits is required. This project can be taken as a separate course, PKG 490 Packaging Projects (2 credits) or as a part of engineering senior design projects. All engineering students at CBU are required to do a one-year senior design project. If a project has significant packaging related content, it can be counted toward the packaging project requirement upon approval from the Packaging Certificate coordinator.

With these requirements, it is possible for most CBU engineering majors to get the Packaging Engineering Certificate in addition to their B.S. degree without having to take an extra course from their program requirements. Since 2003 CBU has graduated 17 packaging certificate recipients. Many students took one or two packaging courses but did not complete the certificate due to the lack of a packaging project. They can return to finish the certificate requirements after their graduation if they wish. Approximately 40% of the students in the certificate program complete the program requirements. Currently, there are 11 students in this certificate program.

B.S. ENGINEERING MANAGEMENT (PACKAGING CONCENTRATION)

This program was first introduced in the 2007-2008 academic year based on a 2007 internally funded faculty development project by the first author [3]. A good part of the packaging industry would like to see college graduates with a packaging background and business skills, which has become the goal of this program. The program is a collaboration between the Packaging Program and the School of Business at CBU. It should be noted that there is also an Information Technology Concentration for this B.S. Engineering Management program, which is a collaboration between the Electrical Engineering Program and the School of Business. Also, the Department of Civil & Environmental Engineering is working with the School of Business to develop a new Construction Management Concentration for the B.S. Engineering Management.

The program requires the following courses based on the upcoming 2009-2010 Catalog:

- Liberal Studies (33 credits)

This group consists of English, humanities, and social studies courses. Most are part of the general education requirements for all CBU students, regardless of their major. It should be noted that as a Catholic institution, CBU requires two religious studies courses. Also, ENG 371 Business Writing is included in this group so students develop business writing skills beyond the general writing skills found in freshman English composition courses.

- Mathematics & Sciences (15 credits)

This group consists of calculus, chemistry, and physics courses. Unlike CBU's other, ABET accredited engineering programs, this engineering management program requires only one calculus course, a chemistry course with lab, and two physics courses with accompanying labs. The program offers essentially a management degree, so ABET accreditation is not its goal.

- **Business (39 credits)**
This group consists of business courses, including management, marketing, accounting, finance, economics, and business statistics. As mentioned earlier, this is essentially a management program, so 39 out of 122 total graduation credits are devoted to developing business/management skills.

- **Engineering (19 credits)**
This group consists of engineering courses that are useful for packaging professionals. These include CAD, mechanics, manufacturing, materials, computer programming, and engineering economics. They provide essential background that cannot be found in traditional business/management programs.

- **Packaging (16 credits)**
This group consists of the following packaging courses:
 - PKG 101 Introduction to Packaging (1 credit)
 - PKG 201 Packaging Seminars (1 credit)
 - PKG 319 Principles of Packaging (3 credits)
 - PKG 320 Distribution/Medical Device Packaging (3 credits)
 - PKG 490 Packaging Projects (2 credits)
 - PKG 495 Packaging Internship (3 credits)
 - Photoshop class (3 credits) *Note: At the time of this writing, a course number has not yet been assigned.*

The first two courses (PKG 101 and 201) are designed to introduce packaging to students while they take other requirements during their first two years. They will get in-depth packaging knowledge during the junior year in PKG 319 and 320. A course in Photoshop gives them a tool for graphic design, which is not covered in other packaging courses. A packaging project (PKG 490) provides an opportunity for them to apply their acquired knowledge to solving a packaging problem. Finally, an internship gives them working experience in a real-world environment and later job opportunities. As mentioned earlier, graduates of this program will automatically receive the Packaging Engineering Certificate.

Currently, there are three students in this major. Recruiting activities have been intensified to get the word out to high school students and teachers. These activities are discussed in a separate paper presented at this conference [4].

B.F.A. GRAPHIC DESIGN (PACKAGING)

The School of Arts at CBU plans to offer a new graphic design concentration in its Fine Arts program starting in the 2009-2010 academic year. Graphic design is a major component of the packaging industry. Thus, a new program is needed for those who are more artistically inclined and interested in working within this specialty.

A packaging consultant with extensive experience in graphic design for the packaging industry has been brought in to guide the development of a packaging option for this new B.F.A. Graphic Design. It is expected that the program will be finalized by the time this paper is presented.

PACKAGING PROJECTS

A packaging project is required by the Packaging Engineering Certificate and BSEM (Packaging). This is similar to the senior design project requirement in all undergraduate engineering programs at CBU. The project provides students the opportunity to apply their packaging knowledge to a real packaging problem. Projects are sponsored by area packaging companies. Below are two examples of past packaging projects:

Automation of a Packaging Line: A major food company is a subsidiary of a multinational British food company that focuses on agricultural ingredients and oils. This packaging project involved the manufacturing, packaging, and shipping of oil flakes from the company plant in Illinois to its destinations. The project's primary goal was to upgrade the existing packaging line in order to meet the ergonomics

requirements set forth by the National Institute for Occupational Safety and Health (NIOSH). According to NIOSH, back disorders account for 27 percent of all non-fatal occupational injuries and illnesses involving days away from work. Prevention activities should be undertaken based on current knowledge concerning known safe levels of exposure. Before this project was undertaken, the most strenuous operations in the packaging line were vibrating product cases and carrying these cases onto pallets for shipping. Operators were required to lift a fifty-pound case to vibrate the production product. The vibration is a crucial part of the packaging system, as the product needs to settle into the case in order for the lid to close. At the end of the packaging line, operators were required to carry the same fifty-pound case and place it onto a pallet for shipment to the customer. This process was ongoing in continuous eight-hour shifts, with four cases being produced per minute. The objective of this project was to design a new vibratory system that vibrates the case mechanically when filling the case. The vibratory system is controlled by a Programmable Logic Controller (PLC) system during the filling process. In addition, this project researched methods to automate the process of placing the cases on the pallet. The project required a knowledge of PLC programming, AutoCAD, and rewiring of the existing system. It considered realistic constraints, such as health and safety, economics, reliability, manufacturability, and sustainability. The costs of the new vibratory system and a new robotic palletizing system were estimated at \$5,100 and \$110,000, respectively.

Temperature Controlled Packaging Initiative: One product of a medical device manufacturer is refrigerated to maintain its labeled shelf life. The product is sensitive to temperature extremes, which may be experienced during transit to the end customer. The objective of this project was to develop a system that protects the product from these extremes. The project consisted of three distinct phases: research, development, and testing. The research phase included product research, defining and characterizing the distribution environment, and defining specific time-dependent objectives for the project. The development phase consisted of an in-depth literature review of current systems and materials used in temperature controlled packaging, and a decision process to determine several alternatives to consider. The testing phase involved performance testing of several alternatives and subsequent design modifications to improve system performance. The final developed system consisted of a polyurethane insulated container utilizing a water/additive phase change material to maintain the packaging system's internal temperature. Testing results showed the system is capable of maintaining the specified storage temperature for the product. Implementation plans were developed and presented to the project sponsor.

PROGRAM OBJECTIVES & COURSE SELECTIONS

This section describes how courses were put together for two current packaging programs: the Packaging Engineering Certificate and BSEM (Packaging). Please note that the new BFA (Packaging) is under development and not complete at the time of this writing.

Packaging Engineering Certificate: The main objective of this program is to provide packaging background to engineering students, mostly chemical and mechanical engineering majors. To this end, the program requires the following courses:

- ChE/ME/PKG 319 Packaging Principles: This course was developed to give students an overview of the packaging industry and of packaging design, testing, and processes. *Fundamentals of Packaging Technology* [5] from the Institute of Packaging Professionals is used as the course textbook. The book has been widely used by packaging professionals preparing for the Certified Packaging Professional (CPP) examination; it gives a comprehensive coverage of packaging.
- ChE/ME/PKG 320 Distribution and Medical Device Packaging: Distribution is a major part of all packages. This is especially true for Memphis, the home of FedEx World Headquarters. It was decided early on that medical device packaging would be another strength for CBU's packaging program, given the many biomedical firms in Memphis including Smith + Nephew, Medtronic, and Wright Medical.
- Materials Elective: Materials are an integral part of packaging, so knowledge in this area is important to students in the program.
- Packaging Project: As described earlier, a project gives students the opportunity to apply their packaging knowledge to solve a real packaging problem.

BSEM (Packaging): The objectives of this program are (1) to provide students with business skills and (2) to provide students with some packaging background. To reach these objectives the following courses are required:

- Business Skills: Students must have general knowledge of micro- and macro-economics, accounting and finance, management, and statistics and probability. This material is covered by the business portion of the curriculum.
- Packaging Background: These are the same requirements as those of the Packaging Engineering Certificate. However, since this is a four-year degree program, there is room for additional courses, including Introduction to Packaging during the freshman year, Packaging Seminars in the sophomore year, and an internship and graphic design (Photoshop) course in the senior year. These three courses add more packaging knowledge beyond that required by the certificate program. In addition, CAD and manufacturing courses (which may be taken as electives) benefit packaging students greatly.

A program assessment is being planned to evaluate the Packaging Engineering Certificate, which has produced a sufficient number of graduates for an assessment. However, an assessment of the BSEM (Packaging) degree will not be performed until the first batch of graduates enters the workforce in about four years.

CONCLUSION

The three undergraduate programs mentioned in this paper target different groups of people. The Packaging Engineering Certificate focuses on engineering; the B.S. Engineering Management (Packaging Concentration) focuses on management; and the upcoming B.F.A. Graphic Design (Packaging) focuses on visual arts. Graduates of all three programs will be desirable since packaging is a very diverse industry. It would be difficult to include all these skills in a single four-year undergraduate curriculum, so various paths must be provided. As these programs grow, it is possible that CBU will eventually offer a new packaging science program, similar to those being offered at several other packaging programs in the U.S. However, for the time being the packaging program at CBU has chosen to focus on market niches instead of emulating programs from other institutions.

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Siripong Malasri, Ph.D., P.E.

Dr. Malasri is a professor of civil and environmental engineering. He received his Ph.D. from Texas A&M University. His background includes construction management, structural engineering, solid mechanics, material testing, artificial intelligence, and optimization. He was instrumental to the establishment of the packaging engineering program at CBU during his term as engineering dean from 1999-2005. Currently, he serves as packaging activities coordinator. He has been on editorial boards for the *International Journal of Engineering Education* and *Journal of Professional Issues in Engineering Education and Practice*. His recognitions include Outstanding Engineer of the Year (Tennessee Society of Professional Engineers), Award of Excellence (Memphis-Area Joint Engineers Council), Distinguished Lasallian Educator (CBU), and Douglass J. Thomas Chair in Engineering (CBU).

Asit Ray, Ph.D.

Dr. Ray is a professor of chemical engineering at CBU. He earned his Ph.D. from Lehigh University and has over 20 years of teaching/research experience at Auburn and CBU. Dr. Ray spent seven years in the polymer industry, and was four times a NASA/ASEE Summer Faculty Fellow engaging in polymer research at NASA Kennedy Space Center and Langley Research Center. He is actively engaged in laboratory research in polymeric and biomaterials in collaboration with professors from the University of Memphis and Rhodes College and has published over fifteen refereed papers. Dr. Ray co-teaches packaging classes with Mr. Yongquan Zhou. He also serves as the Coordinator of the Packaging Engineering Certificate and Lab at CBU. He was recognized as the 2003 Featured Engineering Faculty by the School of Engineering at CBU.

Yongquan Zhou, CPP

Mr. Zhou is a project engineer in Packaging Design and Development at FedEx Corp. and is an adjunct faculty for the School of Engineering at CBU. He received his B.E. in packaging engineering and M.E. in mechanical engineering from the Wuxi Institute of Light Industry in China, and his M.S. in packaging science from the Rochester Institute of Technology. He is currently working on his Ph.D. at Mississippi State University. Mr. Zhou is a Certified Packaging Professional (CPP) with more than 20 years of experience in the packaging industry, academic classrooms, and research and testing laboratories. Mr. Zhou serves on various IoPP, ASTM, and ISTA technical committees, and was an IoPP AmeriStar Packaging Competition judge from 1997 to 2001. He has published articles in *Packaging Technology and Engineering* and other magazines.

John Ventura, Ph.D., P.E.

Dr. Ventura is an associate professor and Chair of Electrical and Computer Engineering Department at CBU. He is a senior member of IEEE and a professional registered engineer in Mississippi. He received a Bachelor of Science in Electrical Engineering from Christian Brothers College, a Master of Engineering from the University of Florida, and a Ph.D. at the Graduate School of Computer and Information Sciences at Nova Southeastern University in Fort Lauderdale, FL. Dr. Ventura designed and built a manufacturing facility for Mebane Packaging Corporation, a manufacturer of folding cartons, in Greenville, MS. IEEE and CBU recognized John as the 2006 Featured Engineer of the Year, and the Tennessee Society of Engineers recognized him with the chapter-level and state-level 2006 TSPE Distinguished Service Awards.

Paul Shiue, Ph.D.

Dr. Shiue is a professor and chair of the Mechanical Engineering Department at CBU. He received his B.S. from Tatung University in Taiwan and his M.S. and Ph.D. degrees from the University of Memphis. He is an associate member of the American Society of Mechanical Engineers and a professional member of the American Society for Engineering Education. Dr. Shiue is also a member of the editorial advisory board of the *International Journal of Engineering Education* and served as guest editor of a special issue in manufacturing engineering education. He was five times a NASA/ASEE Summer Faculty Fellow at Marshall Space Flight Center. Currently, he is focusing on concurrent engineering and design through manufacturing and product realization processes.

Jose Davila, Ph.D.

Dr. Davila obtained his bachelor's degree in mechanical engineering at Princeton University in 1978. He obtained a master's degree in mechanical engineering at Stanford University in 1980, specializing in thermosciences. During 1980 and 1981 he worked at the University of Puerto Rico's Center for Energy and Environment Research. In 1990 he finished his Ph.D. at the University of Texas at Austin. His dissertation involved wind-tunnel experiments on transition to turbulence in the wake of a flat plate. He taught mechanical engineering courses in Nicaragua as a volunteer with the organization Science for the People in 1990 and 1991. In 1991 he moved to Switzerland and married Nicole Christen. He worked as a research assistant at the Ecole Polytechnique Federale de Lausanne in 1993 and 1994. He taught at the University of Puerto Rico (1994-1999), the Interamerican University of Puerto Rico (1999-2001), the University of Vermont (2001-2005), and Trinity College (Hartford, Connecticut, 2005-2007). Since the fall of 2007, he has been an associate professor of mechanical engineering at Christian Brothers University.