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**Title of Program:** B. S. Joint-Degree Program in Mechanical Engineering, Western Kentucky University (WKU) and University of Kentucky (UK), Bowling Green, Kentucky[1]

**Suggested CIP Code:** Mechanical Engineering, B14.1901.02

**Program Band Status:** Engineering is within UK's approved band

**Degree:** B. S. Degree Program in Mechanical Engineering

**Brief Description of Program:**

The proposed joint-degree program in Mechanical Engineering represents an effort by the University of Kentucky (UK) and Western Kentucky University (WKU) to offer an undergraduate degree in Mechanical Engineering (ME) at Western Kentucky University to serve south-central Kentucky and portions of western Kentucky. The plan outlined herein is based on a vision of high-quality engineering education, delivered responsively, cost-effectively, creatively, and flexibly to meet contemporary needs in that region of Kentucky. The planned joint-degree program in Mechanical Engineering is one of three proposed joint degree programs in Bowling Green; the others include a joint-degree program between UK and WKU in Civil Engineering and a joint-degree program between the University of Louisville and WKU in Electrical Engineering. The three programs emphasize a project-oriented educational approach, which is embraced by all participating institutions. This "integrated model," whereby students are exposed to engineering course work relatively early in their academic career, is a distinguishing feature of these proposed new engineering programs. UK's participation in expansion of engineering education opportunities through undergraduate joint-degree program development in western Kentucky is consistent with the mission of UK as a comprehensive, public, land-grant university dedicated to preparing students for an increasingly diverse and technological world and to improving the lives of people throughout the Commonwealth. This goal is aided by the delivery of quality undergraduate engineering education to stakeholders in south-central Kentucky and portions of western Kentucky.

The "Strategy for Statewide Engineering Education in Kentucky" was crafted on behalf of the State's public university presidents and adopted by the CPE on July 17, 2000 (see Attachment 1 This document lays out the rationale for the Strategy and provides the background for its creation, which are omitted here for brevity. The reader is referred to Attachment 1 for full disclosure of detail.

To guide the planning and development of the joint bachelor's degrees, the three institutions involved (UK, WKU, and the University of Louisville) have adopted a "Framework of Agreement," offered as Attachment 2, which addresses such issues as program development

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[1] By CPE definition, a "joint" program is "a program that is mutually sponsored by two or more institutions leading to a single credential or degree, which is conferred by both or all participating institutions...All participating institutions share responsibility for all aspects of the program's delivery and quality."

timing, curriculum formulation, faculty composition and status, course responsibility (e.g., agreement that UK is to be responsible for between 16 and 24 credit hours of engineering course work per year in the discipline), administrative structure, provision of academic advising, laboratory and equipment support, provision of library and media resources, and use of distance-learning technologies. Progress continues along all these fronts as program development efforts move forward. For example, in ME, in anticipation of program start-up, UK has been responsible for delivering the following courses: ME 220, EM 313, ME 321, ME 344, two technical electives, and, on an alternating basis with Civil Engineering, EM 221. In the future, the exact courses will likely deviate from this list, in view of student progression within the program, specialties of WKU faculty, and UK faculty availability for distance-delivery of courses from the UK campus or for on-site instruction in Bowling Green. In any event, the joint program as proposed would maintain identical course outcomes and content (with the program in Lexington) for the courses to be delivered initially by UK (EM 221, EM 313, ME 220, ME 321, ME 344) and for EM 302, ME 325, and ME 330.

Faculty in Mechanical Engineering on the Lexington Campus, in concert with counterpart faculty at WKU, have formulated the curriculum for the B.S. degree program in Bowling Green. This curriculum reflects notable differences to the B.S. degree program in Lexington, in response to stakeholders' interests and inputs in the Bowling Green area, especially in regard to the program's emphasis on project-based learning. The Local Advisory Board for the proposed ME program has been formed and met twice in 2002 for purposes of developing by-laws, drafting vision and mission statements, and for formulating program objectives. UK was represented at the initial meetings of the Advisory Board by the Department chair and/or by one or more additional senior faculty members. Another example of the collaboration between the two offering institutions was the addition of a UK/ME nominee for industry representation on the WKU/UK ME Advisory Board (Mr. Don Greer; recently deceased, replacement unnamed), who served also on the Advisory Board for the Lexington ME Department. In addition, Mr. Fred Mudge serves on the executive advisory boards of both the UK College of Engineering and the WKU Department of Engineering.

The program faculty will consist of an equal number of faculty from each institution. At UK, this will include up to four faculty most involved in the instructional mission in the WKU-based program, all of whom are committed to the joint program and its distinct project-oriented approach. UK program faculty will serve on a three-year term basis, renewable as appropriate. It is the responsibility of each campus to recommend program faculty. Any exceptions or modifications to this plan must be approved by the program faculty and recommended to the Steering Committee, through the Department Head and the Dean of the Ogden College. At present, the UK program faculty includes: from UK, Dr. Suzanne Smith, Dr. Scott Stephens, Dr. Pinar Menguc, and Dr. Mark Hanson; from WKU, Prof. Joel Lenoir (Program Coordinator), Dr. Kevin Schmaltz, Prof. Robert Choate, and Dr. Chris Byrne.

The ME curriculum is a combination of WKU courses taught by WKU faculty members and of existing UK courses taught by UK faculty (either on-site or by distance technologies). All official student records will be maintained at WKU; however, electronic access to student records will be provided on a need-to-know basis to all UK advisors, program faculty, and departmental and College student records personnel. In addition, WKU has agreed to provide the UK College of Engineering with a copy of the transcripts for all students enrolled in the joint program on an annual basis (or, alternatively, a list of all students in the program, from which the ME staff can retrieve the records off TOPNET, the student records system at WKU), preferably just prior to the start of each fall term. From the UK perspective, UK degree certification and maintenance of copies of all graduates' transcripts will be handled by the UK College Dean's office, with the UK Registrar authorizing the granting of an earned UK credential from the joint-degree program. The actual diploma certificate will be produced and issued by WKU; however, both institutions will confer the degree, consistent with the CPE definition of a "joint program." For purposes of headcount, both institutions will be granted credit for students enrolled in the joint-degree program.

WKU, UK, and U of L and their joint program faculty agree to actively engage in the process of preparation for ABET accreditation, with a commitment to seek accreditation as early as possible. Since the programs are joint in nature, they will be presented to the accrediting agency jointly and accreditation will be sought independently of existing programs at UK and U of L. It is anticipated that the request for an accreditation visit will be made at the same time for all three programs jointly delivered by the three institutions on the WKU campus.

**Brief Statement of the Need and Demand for the Program:** This is addressed in Attachments 1 and 2; however, it is worthwhile to offer further evidence of program need and demand, as taken from documentation assembled by WKU in the early stages of program development (see Attachment 3).

The CPE has estimated that Kentucky must increase its undergraduate enrollment by 50% from approximately 160,000 to 240,000 by 2020 to bring the per capita enrollment in Kentucky into line with the projected average for the U.S. Engineering undergraduate enrollment in Kentucky, as a percentage of the entire undergraduate student body is approximately 2.25%, while nationally, undergraduate enrollment in engineering represents 3.0% of the whole. Assuming that engineering retains its current percentage of undergraduate enrollment nationally between now and 2020, Kentucky will have to increase its undergraduate engineering enrollment by almost 100%, from 3600 to 7200, to bring itself into line with national norms. Consequently, expansion of engineering programs must be a *part* of the strategy to bring engineering enrollment in Kentucky into line with national norms. The CPE has made it clear that undergraduate engineering education in Kentucky will expand primarily through the creation of joint programs managed by multiple postsecondary institutions, as is being proposed here.

**Proposed Program Options:** Proposed is a B.S. degree program in Mechanical Engineering. While selection of technical electives permits the student to concentrate in one or more technical sub-disciplines, no program options are envisioned.

**Job Opportunities for Program Graduates:** This topic was addressed in Attachment 3. In spite of the recent economic downturn since mid-1999, the job market for mechanical engineering graduates remains firm. Kentucky still ranks near the bottom in engineering graduates per capita, a statistic which stands to be improved with distributed engineering education opportunities. Recent graduates from these two program areas have been less impacted by the mild recession than have graduates from such programs as electrical engineering, chemical engineering, and computer science. Working to the advantage of the placement of graduates is the following Strategy statements: (1) "the strategy will encourage recruiting, mentoring, and placement initiatives for women and minorities; (2) the strategy envisions the creation of a clearinghouse for information about student engineering employment opportunities, including cooperative education, summer internships, and permanent employment with Kentucky businesses and industries; and (3) students at participating institutions will be encouraged to apply for graduate study in engineering..."

**Plans for Program Delivery Through Distance Learning Technologies:**

Kentucky has invested significantly in distance learning infrastructure within the last decade. Initial University plans were to use the system to deliver graduate-level instruction to parts of the state that were distant from the major research institutions. Early College experience via distance was in the delivery of graduate programs in Mining Engineering and toward the Master of Engineering program, both of which are now suspended in distance mode. Mechanical Engineering has been very active in distance education, having delivered over 40 courses by distance since 1991, most via ITV. All of these courses have included undergraduates, with some courses dual-level and others limited to undergraduates.

In the proposed undergraduate program steady-state, UK faculty will be responsible for 16-24 credits per year per program, for a total of 32-48 credits. With consideration that one course, EM 221, is required by both majors, this number falls to 29-45. It is likely that the courses offered by UK faculty will be a blend of on-site and distance-based (primarily ITV or ITV/Web-assisted) courses,[2] complemented by dedicated MS Messenger connections between sites, permitting sharing of application software (e.g., PowerPoint) and video. The College and University have already equipped a sufficient number of ITV rooms, both at UK and at WKU, with required computers, data projectors, and cabling for this purpose. For courses with a significant distance component, on-site, content-proficient faculty (usually WKU faculty, with or without UK joint appointment) or content-proficient UK graduate students or post-doctoral fellows will serve as

[2]In the Paducah programs, for example, there are typically two to four courses per year transmitted via compressed video, originating either in Paducah or in Lexington, and delivered to the alternate site. This course-sharing has aided immeasurably during new-program start-up as on-site faculty members were hired, has assisted communications among faculty colleagues separated by distance, and has permitted strategic faculty hiring decisions to be made by considering faculty in areas of sub-specialization that complement faculty strengths on the alternate campus.

"faculty associates" when needed, again building upon the experience of the College over the past six years. (Note: In Spring and Fall 2003, WKU program faculty served as faculty associates at the receive site for most courses, but in the future, other arrangements must be made, as WKU faculty resources cannot be made available as programs reach steady-state.) It is envisioned that most courses for which UK is responsible will be delivered primarily via ITV (with periodic visits to WKU) in early stages of program development. A recent study of six years' worth of data (1997-2003) of teaching effectiveness in courses offered by distance means, conducted by the Mechanical Engineering Department in October 2003 and involving 581 student enrollments (382 at the originating site and 199 at the receive site), has suggested that ITV delivery of ME course work is *at least* as effective in terms of overall value of the course and quality of teaching (data available upon request).

At present, there are eleven ITV-equipped classrooms in the Bowling Green vicinity, five on the WKU campus, two at the WKU Extended Campus in Glasgow, and one each at the Kentucky Advanced Technical Institute (Bowling Green), the County Support Services Center (Bowling Green), Glasgow High School (Glasgow), and Franklin-Simpson High School (Franklin). All are part of the Kentucky Tele-Linking Network, of which UK is a member institution. The technologies and procedures in place at each distance-learning site will be evaluated as the program progresses. These will be updated as appropriate to provide continuous improvement to the distance-learning program as newer technology develops.

**Names of Primary Contacts at Proposing Institution:** (1) Dr. G. T. Lineberry, Associate Dean for Commonwealth and International Programs, College of Engineering, University of Kentucky, 234 Mining & Minerals Resources Bldg., Lexington, KY 40506-0107; Office: 859/257-2833; Fax: 859/323-1962; Email: gtli@engr.uky.edu. (2) Dr. Keith Rouch, Department Chair, Department of Mechanical Engineering, University of Kentucky, 153 Ralph G. Anderson Bldg., Lexington, KY 40506; Office: 859/257-6336 (x80637); Fax: 859/257-4856; Email: rouch@engr.uky.edu.

**Names of Contacts at Partnering Institution:** (1) Dr. John Reis, Head, Department of Engineering, Western Kentucky University, One Big Red Way, Bowling Green, KY 42101-3576 Office: 270/745-2461; Fax: 270/745-5856; Email: john.reis@wku.edu. (2) Mr. Joel Lenoir, Program Coordinator, Department of Mechanical Engineering, Western Kentucky University, One Big Red Way, 218 Science & Technology Hall, Bowling Green, KY 42101-3576; Office: 270/745-6858; Email: joel.lenoir@wku.edu.

**Preliminary Plans for Collaboration with Other Institutions:** The "Strategy for Statewide Engineering Education in Kentucky" (Attachment 1) establishes the guiding principles for future expansion of engineering education in the Commonwealth, with the "Framework of Agreement" (Attachment 2) outlining the collaborative nature of the joint-degree programs' design. As further examples of collaboration to date, several additional sets of materials are offered: (1) curriculum for the BSME program, as recommended for approval by the WKU/UK ME program faculty (Attachment 4); (2) admission requirements into the proposed joint degree program, (Attachment 5); and (3) an important addendum to the Framework of Agreement, forged in early-2004 between UK and WKU, which handles issues previously insufficiently addressed in the original Framework (Attachment 6).

**Tentative Program Implementation Date:** Upon approval of the program by the CPE and upon assurance of recurring State funding. Refer to Attachment 7 for the draft budget.

Attachment 1. Strategy for Statewide Engineering Education in Kentucky.

# STRATEGY FOR STATEWIDE ENGINEERING EDUCATION IN KENTUCKY

*ACTION*
Agenda Item D-1
July 17, 2000

## Recommendation:

That the Council approve the attached Strategy for Statewide Engineering Education in Kentucky.

That the Council instruct staff to expedite reviews of all proposed programs that fall within this strategy.

That the Council commend the presidents, chief academic officers, and members of institutional faculties and staffs for working together to develop this strategy quickly.

## Rationale:

This statewide strategy takes advantage of the substantial resources invested in engineering, science, and technology while creating programs that are multi-institutional, and available throughout the state, and that meet the needs of traditional and nontraditional students as well as practitioners.

This strategy reflects the intent of *The Postsecondary Education Improvement Act of 1997* and the Council s *Action Agenda*: to grow responsibly, to focus on the highest possible quality, to use resources effectively, to use technology wisely, to target underserved areas, and to help employers be successful.

The need for expanded engineering education is immediate and requires that programs of high quality be developed, approved, and implemented as quickly as possible.

## Background:

At its March 2000 meeting, the Council requested that the University of Kentucky, the University of Louisville, Western Kentucky University, and Council staff, in consultation with the other comprehensive universities and the Kentucky Community and Technical College System, design a proposal to expand engineering education in Kentucky.

Since the March meeting, the presidents of Kentucky s universities, the president of the KCTCS, and the chief executive officer of the Kentucky Commonwealth Virtual University have met several times with Gordon Davies and Sue Hodges Moore and held a joint meeting with chief academic officers and faculty representatives. The chief academic officers and faculty representatives also met to discuss the strategy.

The strategy has been signed by the presidents, with the exception of Dr. Charles Wethington, University of Kentucky, who is consulting with the UK engineering faculty.

# Strategy for Statewide Engineering Education in Kentucky
## July 17, 2000

Kentucky needs a statewide strategy to educate more engineers and to integrate engineering education more closely into the technology-driven New Economy. The Council on Postsecondary Education, at its March 20, 2000, meeting, approved the recommendation that the public universities and colleges work together with the Council staff to design a statewide strategy to expand engineering education. The statewide strategy is intended to meet two primary needs:

1. the need to increase the number of baccalaureate engineers in Kentucky, and
2. the need to address regional issues of access and productivity in engineering education.

Kentucky s progress in meeting these needs will be assessed periodically by the Council and all participating institutions.

The strategy for engineering education in Kentucky will eventually integrate secondary, baccalaureate, and post-baccalaureate programs. It will involve secondary schools, the Kentucky Community and Technical College System, the comprehensive universities, the research universities, the independent colleges and universities, and the Kentucky Commonwealth Virtual University.

Access to undergraduate engineering education will expand primarily through the creation of joint programs managed by multiple postsecondary institutions. The programs will be tailored to meet demonstrated regional or statewide needs. They will be separately accredited and degrees will be conferred jointly. All participating institutions will be involved in program development, delivery, and administration. Students will be able to complete all degree requirements at their home campus through resident instruction, courses delivered through the Kentucky ~~Commonwealth~~ Virtual University, or courses delivered by participating institutions through other distance delivery methods.

The Council would like to consider the first joint program proposals as early as November 2000. The Council will accelerate the approval process for joint programs that satisfy the criteria outlined in this strategy document s final form.

The joint programs should build on the strengths of existing engineering programs at the University of Kentucky and the University of Louisville while accommodating employer needs identified by the comprehensive institutions. The University of Kentucky and the University of Louisville will agree which institution will have the responsibility for statewide development of joint programs by discipline with interested comprehensive institutions. All joint programs will become separately accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET) as soon as possible.

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During the start-up phase of each joint program, the deans of engineering at the University of Kentucky and the University of Louisville will, on behalf of all participating institutions, recommend that the Kentucky State Board for Licensure for Professional Engineers and Land Surveyors grant approval to the joint program so that students may sit for the appropriate Engineering Fundamentals Examination administered by the board twice yearly in Lexington and Louisville.

The specific structure of each joint program may differ from one another, depending on the needs of area employers and the strengths of the institutions involved in each program. Prior to submitting a proposal for the Council s consideration, the appropriate faculty of each participating institution will agree on the appointment, tenure, and promotion policies for program faculty, the allocation of equipment and facilities, provision of student services, assessment criteria, and the general management of the joint program. Decisions regarding the salary, rank, and tenure of individual faculty members will be the responsibility of the employing institution. Adjunct or joint appointments to the faculty of the other participating institution(s) may be offered.

The Council staff will recommend to the Council appropriate funding for the equipment and facilities needs of the strategy as the Council develops its operating and capital budget recommendations for the next biennium. Funding could also be sought in the 2002 Legislative Session as part of the New Economy initiatives authorized in House Bill 572 of the 2000 session.

Working with the institutions, the Council will develop procedures for counting enrollments and graduates, disbursing funds, and establishing tuition rates.

The strategy is open to selected, non-duplicative, stand-alone engineering programs at comprehensive universities as well as to other types of multi-institutional arrangements. The strategy also envisions the continued strengthening and expansion of the existing engineering programs at the University of Kentucky and the University of Louisville and the development of new undergraduate and graduate engineering programs that support the strategic plans of both institutions and the New Economy initiatives.

The Kentucky Community and Technical College System and Lexington Community College will develop pre-engineering curricula (in conjunction with the University of Kentucky and the University of Louisville) that will enable community and technical college graduates to meet all third-year engineering entrance requirements of Kentucky s public baccalaureate institutions. In addition, the Kentucky Community and Technical College System and Lexington Community College may develop additional Engineering Technology programs at the associate degree level. The universities may also work with the Kentucky Community and Technical College System and Lexington Community College to offer such programs and to align associate and baccalaureate engineering technology programs. These programs will become accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) as soon as possible.

The strategy will encourage recruiting, mentoring, and placement initiatives for women and minorities.

The strategy envisions the creation of a clearinghouse for information about student engineering employment opportunities, including cooperative education, summer internships, and permanent employment with Kentucky businesses and industries.

Students at participating institutions will be encouraged to apply for graduate study in engineering at the University of Kentucky and the University of Louisville. Engineering articulation agreements, early admissions policies, and other strategies will be used to make the transition to graduate study as smooth as possible. The strategy is also open to the use of comprehensive institutions as remote sites for the delivery of master s programs of the University of Kentucky and the University of Louisville through resident instruction, courses delivered through the Kentucky Commonwealth Virtual University, or courses delivered through other distance delivery methods.

The Council will play its usual coordinating role in the development and implementation of the strategy, including adjudicating disputes, facilitating statewide discussions, measuring effectiveness, and determining statewide funding and construction needs.

Signed July 5, 2000

Kern Alexander, MuSU

Ronald G. Eaglin, MoSU

Robert Kustra, EKU

Michael B. McCall, KCTCS

Gary A. Ransdell, WKU

George W. Reid, KSU

Mary Beth Susman, KCVU

John W. Shumaker, UofL

James C. Votruba, NKU

Charles T. Wethington, UK

Gordon K. Davies, CPE

Attachment 2. Framework of Agreement.

Office of the Provost and Vice President
for Academic Affairs
270-745-2296
FAX: 270-745-5442

WESTERN KENTUCKY UNIVERSITY

Western Kentucky University
1 Big Red Way
Bowling Green, KY 42101-3576

January 17, 2001



*MEMORANDUM*

TO: Dr. Charles Wethington, President
Dr. John Shumaker, President
Dr. Elisabeth Zinser, Chancellor
Dr. Carol Garrison, Provost
Dr. Thomas Lester, Dean
Dr. Thomas Hanley, Dean

FROM: Barbara G. Burch
Provost and Vice President for Academic Affairs

RE: Framework of Agreement

Attached for your files is a copy of the signed Framework of Agreement for the WKU-UK/UofL Joint Bachelor's Degrees in Civil, Electrical and Mechanical Engineering.

BGB:lph

Attachment

xc: President Gary Ransdell
Dr. Martin Houston
Dr. Daniel Rabuzzi

# FRAMEWORK OF AGREEMENT

## WKU-UK/UofL JOINT BACHELOR'S DEGREES IN CIVIL, ELECTRICAL, AND MECHANICAL ENGINEERING

Western Kentucky University, the University of Kentucky and the University of Louisville, wish to enter agreements to jointly offer Bachelor of Science degree programs in civil engineering, electrical engineering, and mechanical engineering. The joint degree programs will be developed based on the following understanding:

1. The joint degree programs will be developed and offered consistent with the "Strategy for Statewide Engineering Education in Kentucky" recommended by the presidents of the public post-secondary institutions in the state and adopted by the Kentucky Council on Postsecondary Education in July 2000.

2. The joint degree programs will follow the principles contained in the policy on Joint Programs approved by the Kentucky Council on Postsecondary Education.

3. The joint degree programs will be offered on the campus of Western Kentucky University, primarily to serve students in south central and portions of western Kentucky.

4. The three universities agree to pursue the development of the joint degree program as expeditiously as possible so that the curricula can be implemented by fall, 2001.

5. The University of Kentucky will work with Western Kentucky University to jointly offer bachelor's degree programs in civil engineering and in mechanical engineering. The University of Louisville will work with Western Kentucky University to jointly offer a bachelor's degree in electrical engineering.

6. The three universities agree to present the basic outlines and principles of the joint degree programs to the February 2001 meeting of the Kentucky Council on Postsecondary Education.

7. The three universities will agree on the curricula. The curricula will be consistent with EAC/ABET criteria. General education requirements will be coordinated through the statewide General Education Transfer Framework agreement and through negotiation of any outstanding additional issues.

8. The three universities will be jointly responsible for course offerings and will fulfill instructional responsibilities consistent with SACS accreditation standards. The University of Kentucky and the University of Louisville will be expected to be responsible for 16-24 hours of engineering course work per year in the discipline. This course work may be offered through both electronic and on-campus formats and may in part be offered by faculty who hold joint faculty appointments between Western Kentucky University and the University of Kentucky or between Western Kentucky University and the University of Louisville, as appropriate. Western Kentucky University will be expected to provide the balance of the course work leading to the degrees. The three universities will agree on appropriate delivery formats.

9. Western Kentucky University agrees to dedicate at least four full-time faculty positions to support instruction in each joint degree program. The University of Kentucky, University of Louisville, and Western Kentucky University will seek supplemental funds through the Council on Postsecondary Education to meet their instructional responsibilities to the joint degree programs. The credentials of all faculty assigned by any of the participating universities to the programs will be consistent with applicable SACS and EAC/ABET criteria.

10. Faculty in the program will be employed and hold their primary faculty status with the "home" institution. The University of Kentucky and Western Kentucky University shall be collaboratively involved in the process of staffing the programs in civil and mechanical engineering. The University of Louisville and Western Kentucky University shall be collaboratively involved in the process of staffing the program in electrical engineering. All newly hired tenured/tenure-track program faculties will normally possess an appropriate doctorate in the discipline or closely related discipline. All program faculty will be subject to the tenure and promotion guidelines of their "home" institution. All program faculties will be eligible for licensure as professional engineers in Kentucky. The University of Kentucky and the University of Louisville may grant appropriate faculty status to Western Kentucky University faculty members assigned to the joint programs. Western Kentucky University may grant appropriate faculty status to faculty members assigned to the joint degree programs by the University of Kentucky and the University of Louisville.

1 The joint programs will be hosted by the Department of Engineering in the Ogden College of Science, Technology, and Health at Western Kentucky University. Administration of the Department will be the responsibility of the Head, Department of Engineering. The Dean of the Ogden College, following existing policies and procedures of Western Kentucky University, will select the department head. It is expected that the Dean of Ogden College will consult with the deans of engineering at the University of Kentucky and the University of Louisville in the appointment and reappointment of the Head of the Department

of Engineering. The Head of the Department will report to the Dean of Ogden College in consultation with deans of engineering at the University of Kentucky and the University of Louisville.

12. Program coordinators for each of the joint engineering programs will be appointed from the resident program faculty by the dean of Ogden College at Western Kentucky University in consultation with the deans of engineering at the University of Kentucky or the University of Louisville, as appropriate. A liaison for each of the joint programs will be appointed by the respective deans of engineering at the University of Kentucky or the University of Louisville in consultation with the Dean of Ogden College.

13. A Joint Engineering Program Steering Committee will be created to oversee the implementation of program policies and formulation of changes and/or new policies. The committee takes policy changes through the respective universities' established processes. Membership consists of the Provost of the University of Louisville, the Chancellor of the Lexington Campus of the University of Kentucky, and the Provost and Vice President for Academic Affairs of Western Kentucky University, the Dean of the Speed Scientific School, the Dean of Engineering at the University of Kentucky, and the Dean of the Ogden College of Science, Technology, and Health at Western Kentucky University, or their designated representatives.

14. Insofar as possible, the participating universities agree that course work leading to each of the degrees will be articulated with the partnering institution. However, it is recognized that the joint degree programs offered at WKU will embrace an applied, project-oriented educational approach. Since the curricula of the joint programs will incorporate some innovative elements, the universities agree that the curriculum for each program will be comparable, but not identical with the companion programs at the University of Kentucky and the University of Louisville.

15. The universities agree that an Admissions Committee, whose members will ensure that students entering the programs meet common admissions standards and that criteria for recommending admission are applied uniformly, will govern admission into the joint programs. Membership will consist of the Associate Deans of Engineering for undergraduate studies (or equivalent) at the University of Kentucky and at the University of Louisville, and two members of the program faculty at Western Kentucky University selected by the Department Head of Engineering.

16. Students currently enrolled at Western Kentucky University may be admitted into the joint engineering programs beginning in fall 2001. Such students will be required to satisfy the applicable admission standards.

17 Western Kentucky University will provide basic administrative support for the joint degree programs, including admission services, registration, and student financial aid.

18. Academic advising will be provided by the full-time resident faculty at Western Kentucky University and by any full-time faculty members assigned to the program by the University of Kentucky and the University of Louisville.

19. Laboratory and equipment support for the joint degree programs will be provided by Western Kentucky University, supplemented by appropriate additional resources provided by the state. Western Kentucky University, the University of Louisville, and the University of Kentucky agree to prepare a joint proposal through the Council on Postsecondary Education for special state funding for laboratory and equipment support.

20. Western Kentucky University agrees to provide appropriate library and media resources to support the joint degree programs supplemented by resources that can be made available by the University of Kentucky, the University of Louisville, and the Kentucky Virtual Library.

21. The three universities agree to study ways in which distance learning technologies and the Kentucky Virtual University can be used to effectively and efficiently deliver instructional content for the joint degree programs.

Elizabeth A. Zinser
Chancellor, Lexington Campus

University of Kentucky

Barbara G. Burch
Provost and Vice President for Academic Affairs
Western Kentucky University

Carol Z. Garrison
University Provost
University of Louisville

Thomas R. Hanley, Dean
Speed Scientific School
University of Louisville

Thomas. W. Lester, Dean
College of Engineering

University of Kentucky

Martin R. Houston, Dean
Ogden College of Science, Technology, and Health
Western Kentucky University

1/12/01
Date

Attachment 3. WKU statement of program need.

## 1.02 Internal/External Influences

Engineering education in Kentucky has been delivered under a system that allowed only the University of Kentucky, among the publicly- supported institutions, to offer engineering programs at the baccalaureate and advanced levels. This stricture was modified when the University of Louisville became part of the publicly-supported higher education system, but, for the regional institutions of the state, the prohibition has remained intact. As a consequence, accredited baccalaureate engineering programs have been available only in Lexington and the number and origin of engineering students have been affected. To the extent that availability of engineering programs affects regional economic development, the decision to limit accessibility in Kentucky has most certainly affected the manner in which the state has developed.

Substantial evidence exists which describes the productivity of the current engineering education system in Kentucky. A study, "Engineering Education Needs and Instructional Delivery Models for Far Western Kentucky" presented by MGT of America Inc to the Council on Higher Education in 1995, contains a variety of data descriptive of the engineering education system.

- The total number of engineering schools and the number of schools per million population in the ages 15-44 in Kentucky is substantially less than in the contiguous states, the SREB states, and the national average for all states.
- The undergraduate engineering enrollment and the enrollment per million population in the ages 15-44 in Kentucky is substantially less than in the contiguous states, the SREB states, and the national average for all states.
- The baccalaureate engineering degrees granted and the baccalaureate degrees granted per million population in the ages 15-44 are substantially less than in the contiguous states, the SREB states, and the national average for all states.
- The average enrollment per institution in Kentucky is higher than in the contiguous states, the SREB states, and the national average but the number of degrees/ institution is smaller.
- The percentage of engineering enrollment to total enrollment for first-time enrollment students in Kentucky is substantially lower than the national average.
- The interest and potential of high school seniors in Kentucky in engineering education are essentially the same as in the contiguous states, the SREB states, and the national average.
- There are regions of the state significantly under-represented in engineering education.

In addition, the proportion of workers in Kentucky who are engineers is significantly lower than the national average.

More recent data show little change from the earlier results. The 1998 *Directory of Undergraduate Engineering Statistics* contains data which suggest that Kentucky continues to enroll students on a per capita basis at about one-half of the contiguous states average and less than any of its contiguous states. Kentucky also continues to produce baccalaureate engineering degrees, on a per capita basis, at about one-half of the contiguous states' average and, again, less than any of its contiguous states. Similar results are seen for the individual engineering disciplines.

Competition among states for economic development will continue to be intense for the coming decades. One factor for success in that competition will be the level of technical preparation of the work-force, including engineers, within each state. By almost any measure of productivity in engineering education at the baccalaureate level, Kentucky does not compare favorably with the states with which it must compete. The total number of engineering students, proportion of engineering students to all students, per capita engineering students, number of engineering graduates, and per capita engineering graduates are all below the levels observed nationally and regionally. Examination of the distribution of engineering students by county of origin or region of origin within the state demonstrates the effect of limiting the availability of engineering education.

Kentucky, if it wishes to better position itself for economic development in the coming decades, needs to establish a system with greater distribution of baccalaureate engineering programs. The need is for *basic, baccalaureate, practice-oriented* programs of good quality capable of producing graduates within a region who will help attract industrial and other economic development to that region. Kentucky does not need to duplicate the programs at the University of Kentucky or the University of Louisville. The advanced programs at those institutions serve the state well and should be enhanced but should also be complemented by basic programs distributed throughout the state. Such a system would address the deficiencies of the current arrangement and can be implemented within the context of existing resources.

Since the need is for baccalaureate programs, the regional institutions must, of necessity, become the focus for a modified system. The regional institutions have the prerequisite supporting programs and facilities to offer a wide range of baccalaureate curricula including, where appropriate, engineering programs. Kentucky has made a substantial investment in its regional institutions and should capitalize on that investment to meet its long-term needs.

WKU has significant experience with engineering- related programs. As a consequence of having offered accredited, baccalaureate engineering technology programs since 1973, the University has made a significant investment in facilities, equipment, library resources, and faculty of the kind and quality necessary to support basic engineering programs. In addition, WKU has gained credibility with area industries for the quality of technical preparation of the graduates of the engineering technology programs. Many of the nearly 1,000 graduates of those programs have made substantial contributions to industries throughout the state.

To demonstrate the specific regional need, WKU, in cooperation with UK has performed an engineering education needs assessment in Western's primary region of impact.

**Needs Assessment**

The 1997 Kentucky Directory of Manufacturers was used to identify 203 companies with more than five employees and more than $500,000 in annual sales in the 27 county region surrounding Western Kentucky University. Added to this group were 13 additional non-manufacturing companies that had hired WKU engineering technology graduates during the past five years. The resulting 216 companies comprised the list to be contacted by telephone to determine current and future hiring practices for engineers and other pertinent information. The set of companies selected was not intended to be exhaustive of those with a possible interest in engineering education issues but sufficiently broad to provide a reliable source of information about the issues of interest.

The survey produced responses from 165 or 77.4% of the firms in the survey population. Of that group, 82 companies reported employing a total of 907 engineers or engineering technologists. Mechanical and electrical engineers/engineering technologists were the most frequently reported with 36% of the total number from those two disciplines. Additionally, it is likely that a significant portion of the industrial, manufacturing, and electro-mechanical engineers reported are trained in the mechanical and electrical engineering/engineering technology disciplines.

The survey produced evidence of a strong current and future need for engineers in the survey region. Almost 80% of the companies who employ engineers or engineering technologists indicated that they anticipated new hires within the next two years and almost 60% anticipated hiring replacements during the same period. The total demand was reported to be 227 anticipated hires during the period. For longer periods, a smaller percentage were willing to project hiring activity, but a significant demand was reported over a period of at least a decade. (It is important to note that valid responses would include zero, so the missing respondents chose not to respond which may or may not indicate no interest in hiring new or replacement engineers.)

The needs assessment indicated a strong regional interest in engineering education and a strong demand for engineering graduates. Respondents to the survey mentioned the lack of an engineering degree programs at Western Kentucky University as a significant issue. Respondents to a Chamber of Commerce business climate survey in Bowling Green cited difficulty attracting sufficient numbers of engineers more than any other issue. As one respondent succinctly stated - "need engineers badly."

Data which describe the productivity of the current system of engineering education provide a compelling case for change. The current system exhibits low productivity for enrollment and for production of graduates compared to other states and regions. Indeed, Kentucky currently is among the least productive states in the nation for per capita production of baccalaureate engineering degrees. Moreover, the current system results in an uneven distribution of engineering students geographically across Kentucky. To the extent that engineering education is a factor in economic development of the state and its regions, these and other data suggest that fundamental change is needed. Additionally, the strength of interest and need identified in the needs assessment suggest that the South-central Kentucky region is one in which a response is imperative.

### 1.03 Relationship to University Organization Structure

The existing programs in engineering technology at WKU are contained in the Department of Engineering Technology:

**Department of Engineering Technology**

| | | | | |
|---|---|---|---|---|
| Civil Engineering Technology (CET)* | Electrical Engineering Technology (EET)* | Electro-Mechanical Engineering Technology (EMET)* | Mechanical Engineering Technology (MET)* | Environmental Science/ Industrial Hygiene** |

*accredited by TAC of ABET
** accredited by RAC of ABET

Under the proposed modification, the engineering technology programs will be replaced and the department will be renamed the Department of Engineering. The Department of Engineering will contain the programs:

**Department of Engineering**

| | | | |
|---|---|---|---|
| Civil Engineering | Electrical Engineering | Mechanical Engineering | Environmental Science/Industrial Hygiene |

The Department of Engineering will be administratively contained within the Ogden College of Science, Technology, and Health with its department head directly responsible to the dean. Ogden College is one of five undergraduate colleges reporting to the Provost and Vice-President for Academic Affairs. The organizational chart which follows depicts the relationship of the Department of Engineering to the other units.

**Attachment 4. WKU/UK Joint Program Mechanical Engineering Curriculum, Bachelor of Science**

| | | | | | |
|---|---|---|---|---|---|
| | | 3 | CS 245 | Intro to Comp Prog Lang | 1.5 |
| | | 4.5 | | | |
| | | | SCOM 161 | Business Speaking | |
| | Materials/Methods Mfg. | | PHYS 250/251 | Physics I & Lab | 4 |
| CHEM 120/121E | Chemistry for Engineers | | HIST 119/120 | Western Civilization | 3 |
| | | | Category F | | 2 |
| | | **18.5** | | | **18** |

| | **Third Semester** | | | **Fourth Semester** | |
|---|---|---|---|---|---|
| | | 4 | ME 200 | | 2 |
| *EM 221* | *Statics* | | MATH 331 | Differential Equations | |
| EE 250 | EE Fundamentals | 4 | *EM 313* | | |
| PHYS 260/261 | [illegible] | 4 | EM 302 | Mechanics of Deformable Solids | |
| AMS 205 | CADD for Manufacturing | | | Mechanics of Deformable Solids Lab | |
| | | | EE 285 | Intro to Ind. Automation | 2 |
| | | | Category B | | |
| | | | | | **17** |

| | **Fifth Semester** | | | | |
|---|---|---|---|---|---|
| STAT 301 | Applied Statistics | 3 | ME 300 | Junior Design | 2 |
| MATH 350 | | 3 | ~~ME 310~~ | Eng. Instru. And Exper | [illegible] |
| | | | ME 320 | | |
| *ME 220* | *Eng. Thermodynamics I* | | *ME 321* | *Eng. Thermodynamics II* | *3* |
| *ME 344* | *Mechanical Design* | | ME ... | *ME Tech. Elective I* | *3* |
| Category B | Elective | | [illegible] | Fluid Mechanics | 3 |
| ENG 200 | Intro. To Literature | | | | 3 |
| | | | | | **17** |

| | **Seventh Semester** | | | **Eighth Semester** | |
|---|---|---|---|---|---|
| ME 325 | Heat Transfer | 3 | ME 430 | | 3 |
| | ME Vib/Controls & Lab | [illegible] | [illegible] | | 3 |
| | | | [illegible] | | |
| ME 400 | Mechanical Eng Design | 2 | ME ... | | |
| | Senior ME Lab I | 3 | Category C | Elective | |
| | ME Tech. Elective II | | | Elective | |
| | Junior English | 3 | | | |
| | | **18** | | | |

TABLE 4-2. SUMMARY OF COURSES IN THE JOINT UK/WKU PROGRAM IN MECHANICAL ENGINEERING, and TENTATIVE ASSIGNMENT OF RESPONSIBILITY FOR DELIVERY

| UK Course | Title | UK delivery | WKU delivery | Combined |
|---|---|---|---|---|
| EM 221 | Statics | 3 | | |
| EM 302 | Solids | | 3 | |
| | Dynamics | 3 | | |
| | Thermo I | 3 | | |
| | Thermo II | 3 | | |
| | | | 3 | |
| | | | 3 | |
| | | 3 | | |
| Tech Elective | (UK) | 3 or 6 | 3 or 6 | |
| SUMMARY | | | | |
| Platform (hr) [identified below] | | | 11.5 | 11.5 |
| Mechanics (hr) | | 6 | 4 | 10 |
| Engineering Core (hr) | | 12 or 15 | 25 or 28 | |
| Lab (hr) | | | 9 | 9 |
| (hr) | | | 34 | 34 |
| General Studies (hr) | | | 35 | 35 |
| Total (hr) | | 18 or 21 | 118.5 or 121.5 | |

Platform courses:

| Platform Course | Name | Credits |
|---|---|---|
| UC101/ME101 | Freshman Seminar | 3 |
| CS 245 | Intro to Computer Prog. Lang | 1.5 |
| ME 240/241 | Materials/Methods Manuf | 4 |
| AMS 205 | CADD for Manufacturing | 3 |
| Total | | 11.5 |

TABLE 4-3. SUMMARY OF PREREQUISITES IN JOINT PROGRAM IN MECHANICAL ENGINEERING (Refer to Admission Standards for notes)

| UK/WKU JOINT PROGRAM-- | Course Title | Prerequisites | Co-requisites | WKU Syllabus if different |
|---|---|---|---|---|
| UC/ME 101 | Freshman Seminar | None | UC101/ME101 | |
| ME 240/241 | Matl & Meth of Mfg | High School Chemistry or Physics | ME 101, ME 240/241, MATH 116 | |
| ME 200 | Sophomore Design | EM 221 | AMS 205, EE 285 | |
| ME 300 | Junior Design | ME 200, ME 344 | ME 320 | |
| ME 400 | Mechanical Engr Design | ME 300 | | |
| *EM 221* | Statics | | MATH 327 | UK course & syllabus |
| *EM 313* | Dynamics | EM 221 | MATH 331 | UK course & syllabus |
| *EM 302* | Solids | EM 221 ~~(or CE 244?)~~ | ME 331, MATH 331 | Also WKU lists MATH 227, not MATH 331, includes CE 244, course description does not match UK, to be based on UK syllabus |
| *ME 331* | Solids Lab | | EM 302 | Has MATH 227, not MATH 327, also CE 244 |
| *ME 220* | Thermo I | PHYS 250 | MATH 331 | |
| *ME 321* | Thermo 2 | ME 220, MATH 331 | None | |
| *ME 344* | Mechanical Design | EM 302, ME 240 | | |
| *ME 330* | Fluids | ME 220, CS 245, MATH 331 | None | WKU also lists EM221, does not have ME 220 or CS 245, course description does not match UK, to be based on UK syllabus |
| *ME 325* | *Heat Transfer* | ME 330, MATH 331, CS 245 | None | Has MA350, does not have CS 245, course description. does not match UK, to be based on UK syllabus |
| ME 320 | Engr. Instrum &Exper. | STAT 301, EM 302, EE 285 | | Needs number change |
| ME 410/411 | ME Vib & Controls& Lab | ME 320, MATH 350 | ME 410/411 | |
| ME 420 | Senior ME Lab I | ME 320 | ME 325 | |
| ME 430 | Senior ME Lab II | ME 420 | | |
| ME 490 | Capstone Design | ME 400, ME 325 | | Need number change from 412 to 490 |
| EE 250 | Electrical Engr Fundamentals | MATH 126 | MATH 227 | |
| EE 285 | Intro to Industrial Automation | CS 245, EE 250 | | |
| AMS 205 | CADD for Mfg | None | | |
| CS 245 | Intro to C Programming | None | | Syllabus from WKU website lists CS230 as pre-req?? |
| MATH 126 | Calculus I | * | * | |
| MATH 227 | Calculus & Anal Geometry II | * | * | |
| MATH 327 | Multivariable Calculus | * | * | |
| MATH 331 | Differential Equations | * | * | |
| MATH 350 | Adv. Engr. Math | * | * | |
| STAT 301 | Intro. Prob & Statistics | * | * | |
| CHEM 120/121E | College Chem I/Eng & Lab | * | * | |
| PHYS 250/251 | Univ. Physics I & Lab | * | * | |

| | | | | |
|---|---|---|---|---|
| PHYS 260/261 | Univ. Physics II & Lab | * | * | |

* WKU TO PROVIDE PREREQUISITE INFORMATION FOR WKU COURSES

## MODIFICATIONS TO SYLLABI FOR WKU COURSES

During the initial review process within UK, a number of modifications to these syllabi were requested as a condition of approval of the program. Some of these are summarized in Table 4-3.

The following are UK courses, with UK course numbers, and consistency is needed to avoid confusion of students in the state. (Note that syllabi for the following UK courses --- EM 221, EM 313, ME 220, ME 321, and ME 344 – are not included since they have prior approval as part of the UK program).

EM 302: Course description and title do not match UK, and prerequisites do not agree with those approved by Joint Program Faculty and UK faculty. Per table, prerequisite is to be EM 221, with co-requisite of MATH 331 and ME 331. Also CE 244 is listed, and should be removed.

Prerequisites for UK courses EM 221, EM 313, and ME 344 were agreed to by Joint Program Faculty, as noted in the table 4-3. (This represents a compromise from the original UK pre-requisites for these courses).

ME 330: Course description does not match that at UK, and prerequisites do not agree with those approved by Joint Program Faculty and UK faculty. Course requires prerequisites of ME 220, CS 245, and MATH 331 to be consistent with prerequisites agreed to by Joint Program Faculty.

ME 325: Course description does not match that at UK, and prerequisites do not agree with those approved by Joint Program Faculty and UK faculty. Course requires prerequisites of ME 330, CS 245, and MATH 331 to be consistent with prerequisites agreed to by Joint Program Faculty.

WKU Courses:

ME 331 need only have EM 302 as a co-requisite

ME 320 (Engineering Instrumentation and Experimentation) is listed as ME 310 in WKU syllabus, and needs to be changed to avoid confusion of students (ME 320 was the original number assigned by WKU).

ME 490 (Capstone Design) is listed as ME 412 in WKU syllabus, and needs to be changed to avoid confusion of students (ME 490 was the original number assigned by WKU).

CS 245: Syllabus was not provided by WKU, but the one currently on the website includes CS 230 as a prerequisite. This needs clarification.

Syllabi for EE 250, AMS 205, and CS 245 were not provided by WKU, but extracted from WKU website, and revised format is needed.

Syllabi for MATH 126, 227, 327, and 331are for courses with UK equivalence, and syllabi are not needed

Syllabi for other courses for which equivalencies are not current need to be provided ( except for General Studies courses, which are part of block transfer). These include STAT 301 and MATH 350.

Syllabi for ME 200, 300, 400 are felt to be too general. It is also felt that there is insufficient evidence of ethics and safety being adequately addressed in the curriculum. (These concerns were identified in the initial review two years ago, and were to be addressed by WKU).

# ME 101: The Mechanical Engineering Freshman Experience

Course Title and Designation:
Mechanical Engineering Freshman Experience, ME 101 credit, lecture

2. Prerequisites and Corequisites:
None. This course serves as an entry course for all students expressing an interest in studying Mechanical Engineering.

3. Catalog Description:
*An introduction to the art and science of Mechanical Engineering, with a focus on developing the innate design skills of the student. Students will use the fundamental fabrication methods to create an engineering prototype. Techniques for effective technical communication will be introduced through application.*

4. Text and Supporting Resources:
No text required. Students will use the resources of the prototype fabrication facility already in place.

5. Goals:
To introduce students to the concepts of design through practice on a design project. To expand the students' understanding of the relationships between materials, form and function, and production processes. To assist in the development of technical communication skills – written, oral, and graphical.

6. Course Outcomes:
**By the end of this course, the student should be able to:**

- **Sketch basic mechanical components, including projections and cross sections.**
- **Select appropriate drill sizes for tapping, countersinking, and reaming.**
- **Dimension a part showing an understanding for the fabrication processes involved.**
- **Create a conceptual design for a simple project.**
- **Verify a design using a design validation spreadsheet.**
- **Create a budget and bill of materials for a simple project.**
- **Perform the basic shop functions safely: drilling, turning, milling, sawing, tapping, reaming, countersinking.**
- Construct a physical prototype of a simple design.

7 Topics:
Basics of hand sketching
Dimensioning
Fundamentals of fabrication
Creation of budgets and bill of materials
Use of spreadsheets in evaluating designs
Documentation of designs for review by others

8 Experiences Contributing to Program Outcomes:
*Students work to design, build, test, document, and demonstrate a model of a small steam engine. They are required to produce:*

A bound report with a cover page containing all documentation as listed below.

2. An assembly drawing of engine showing all necessary views.
3. Individual prints of each part showing all necessary views and dimensions.
4. An EXCEL budget sheet showing the identity of each part used and the cost of each, with the total engine cost shown.
5. A printout showing analysis of the engine using the provided Excel spreadsheet.
6. A public demonstration of engine.

UC 101 Freshman Experience

Course Title and Designation:
Freshman Experience, UC 101, 2 Credits, Lecture

2. Prerequisites and Co requisites:
Prerequisites: None.
Co requisite: ME 101. Will become the hands-on design component of the revised UC101 course. Currently is not directly tied to the UC101 material.

3. Catalog Description:
*This course is designed as part of a 3 hour Freshman Experience in Mechanical Engineering and should be taken with ME 101. We will deal with topics such as university life, engineering careers, time management, professional skills and computer tools, advising and academic policies, and keys to academic success as a mechanical engineering student.*

4. Text and Supporting Resources:
Engineering Your Future, by Oakes, Leone and Gunn, Third Edition. No other resources required for course.

5. Goals:
The overall goal is to provide incoming students with an improved understanding of both engineering in general and the Mechanical Engineering discipline, to show students the opportunities available for engineering students at WKU, and to provide some basic technical skills.

6. Course Outcomes:
   - Explain the differences between Civil, Electrical and Mechanical Engineering.
   - Describe engineering organizations at WKU and elsewhere.
   - Make use of the information/research facilities available at WKU.
   - Use effective Goal Setting, Time Management, and Note/Test Taking Skills.
   - Use software to generate documents, perform calculations, and complete professional tasks.
   - Evaluate professional ethical responsibilities and dilemmas.
   - Write an effective journal account of your observations.
   - Work in a team setting to devise and create functioning engineering designs.

7. Topics:
   Introduction to Engineering disciplines, visit to local industry?
   - Introduction to University Support: Libraries, Kentucky Museum, Career Center
   - Academic Success Topics: Time Management, Test/Note Taking, Goal Setting
   - Engineering Design: design process, team projects
   - Professional Tools: MS Word, Excel, PowerPoint
   - Engineering Ethics

7 Experiences Contributing to Program Outcomes:
Course supports Professional Component requirements.

**ME 200 Sophomore Design**

Course Title and Designation:
Sophomore Design, ME 200, 2 Credit Hours, Seminar

2. Prerequisites and Co requisites:
Prerequisites: EM 221
Co requisite: AMS 205, EE 285

3 Catalog Description:
Enhances design abilities through individual and team design projects, and develops structured problem-solving techniques and written, oral and graphical communication skills.

4. Text and Supporting Resources
Machinery's Handbook
Calipers
Steel Rule

5 Goals:
To enhance the design abilities of the students through individual and team design projects. To continue developing structured problem-solving techniques through practice. To continue developing the written, oral and graphical communication skills of the students.

6. Course Outcomes:
The students will be able to:

Use commercial word processing, calculation, presentation and graphics software to perform and convey engineering design work.
Give an effective oral business presentation.
Demonstrate effective writing of engineering documentation. Examples include: memos scheduling meetings and presentations, describing team norms, and discussing ethical behavior; final reports with appropriate technical detail and graphical documentation.
Create and implement project plans.
Evaluate the performance of team members and demonstrate that they are effective team members.
Explain the principles and issues of ethical behavior in engineering and professional fields.

Topics:
- Engineering Tools: MathCAD, Engineering Drawings
- Professional Skills: Presentations, Reports and Memos
- Project Management: Project Planning, Design and Technical Reviews
- Teamwork, Norms & Expectations, Peer Evaluations
- Engineering Professionalism and Ethics

8. Experiences Contributing to Program Outcomes:
Course satisfies progressive design experience requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

# ME 240, Materials and Methods of Manufacturing

Course Title and Designation:
Materials and Methods of Manufacturing, ME 240. Lecture, L course, 3 credit hours.

2. Prerequisites and Corequisites:
Prerequisite: High school chemistry or physics. Corequisites: ME 101, ME 241, Math 116. Course builds upon fundamental scientific principles. Use of algebra and ability to work with abstract concepts.

3. Catalog Description:
Materials: Atomic structure and bonding, crystal structure and geometry, solidification, imperfections, diffusion, mechanical properties, strengthening mechanisms, processing, phase diagrams, engineering alloys, and introduction to polymeric, ceramic and composite materials. Methods of Manufacturing: measurement, design process, material selection, manufacturing properties of materials, material removal processes, and joining processes. (Fall)

4. Text and Supporting Resources:
*Materials and Processes in Manufacturing*, eight edition, Paul Degarmo, J.T. Black and Ronald A. Kosher, Prentice Hall, 1997. Additional material handed out as needed.

5. Goals:
To introduce engineering students to the science of engineering materials. To provide a fundamental basis for understanding how and why materials behave as they do. To give insight into the relationships between materials processing and properties. Expose students to methods of manufacturing using common engineering materials. Supports program outcomes 1, 2, 3.

6. Course Outcomes:
Upon completion of this course students should be able to:
- Identify relationships between atomic bond types and material properties
- Identify relationships between crystal structure and material properties
- Identify relationships between phase structure and material properties
- Characterize the solid phases present in an alloy
- Determine mechanical properties from test data
- Determine the influence of heat treatment on alloy properties
- Characterize the influence of temperature and time related to heat treatments
- Identify the physical characteristics unique to metals, polymers and ceramics
- Select a shaping method for a product
- Identify relationships between shaping processes and material properties
- Be familiar with common manufacturing processes

Topics:
The course will cover, at the appropriate depth for freshman, the following topics
Atomic structure and bonding
Crystal structures
Dislocations and plastic deformation
Strengthening mechanisms and processes

Physical and mechanical properties
Diffusion in solids
Phase changes and phase diagrams

- Metals, polymers and ceramics
- Heat treatment of steel
- Ferrous and non-ferrous alloys

Casting processes in manufacturing
Forming processes in manufacturing
Manufacturing through material removal
Manufacturing through material joining

8. Experiences Contributing to Program Outcomes:
Course provides foundational knowledge upon which mechanical design skills can be built. There are no experiences in the course that would be proper for direct assessment of the program outcomes. The course experiences do support student development in the professional component of ABET.

# ME 241, Materials and Methods of Manufacturing Lab

Course Title and Designation:
Materials and Methods of Manufacturing Lab, ME 241 Laboratory, B course, credit hour.

Prerequisites and Corequisites:
Prerequisite: High school chemistry or physics. Corequisites: ME 101, ME 240, Math 116. Course utilizes fundamental scientific principles for experimentation. Use of algebra and ability to work with abstract concepts.

3 Catalog Description:
Laboratory supporting ME240. Experiments to develop understanding of materials science, engineering material properties and relationships between processing and properties. Exposure to manufacturing methods through experimentation and observation, including field trips to regional sites. (Fall)

4. Text and Supporting Resources:
*Materials and Processes in Manufacturing*, eight edition, Paul Degarmo, J.T. Black and Ronald A. Kosher, Prentice Hall, 1997. Additional background material handed out as needed. Software required: Word and Excel (or equivalent).

5. Goals:
To introduce engineering students to the analysis tools needed to characterize some important material properties. To give experimental experiences that demonstrate the relationships between materials processing and properties. To give exposure to manufacturing methods through site visits and experiment. Introduce how to plan, conduct, analyze and report experimental work. Both short and extended Lab reports will be required of students. Supports program outcomes 2, 4.

6. Course Outcomes:
Upon completion of this course students should be able to:

- By inspection distinguish between metallic, polymeric, and ceramic materials
- Characterize spatial relationships within crystal structures
- Describe mechanism for cold work and recrystallization of alloys
- Collect and analyze experimental test data
- Report experimental results through tables and graphs
- Write an engineering lab report
- Determine mechanical properties from tensile test results
- Measure hardness of a material
- Characterize phase and grain structures in a material
- Specify a manufacturing process for producing a shape
- Describe relationships between shaping processes and material properties
- Identify common manufacturing processes

7 Topics:
The Lab activities will cover the following topics
Crystal structures
Grain and phase structures
Cold work and recrystallization

- Tensile testing
- Metallagraphic evaluation
- Rockwell hardness testing
- Cold rolling of metals and property analysis
- Site visits to regional industries giving exposure to activities such as
    - Casting processes
    - Forming processes
    - Machining processes
    - Manufacturing management
    - Material-manufacturing process relationships

8. Experiences Contributing to Program Outcomes:
   Course provides foundational knowledge in experimental work, property assessment and report preparation. There are no reliable experiences in the course that would be proper for direct assessment of the program outcomes. There may be instances where projects with regional constituents provide evidence of activities consistent with our program mission. The course experiences do support student development in the professional component of ABET.

# EE 250 Fundamentals of Electrical Engineering

**Credits:**

Four credit hours (Three hours lecture, two hours lab)

**Course Description:**

*An introductory course in electrical engineering. Topics include circuit analysis, analog electronics, and energy conversion devices such as magnetic circuits and rotating machinery. Not acceptable as credit for EE majors. Laboratory included.*

**Prerequisites:** Math 126

**Corequisites:** Math 227

**Text and special references:**

Electrical Engineering, Principles and Applications, Allen Hambley.

**Goals/Objectives:**

The objective of this course is to provide a foundation for non-EE majors in electrical engineering topics.

**Content outline:**

1. Introduction to circuits
2. Resistive circuits
3. Inductance and capacitance
4. Transients
5. Diodes
6. Field effect transistors
7. Bipolar junction transistors
8. Operational amplifiers
9. Magnetic circuits and transformers
10. DC machines
11. AC machines

**Laboratory projects:** Students will complete twelve laboratory projects.

**Student Requirements:**

Students are required to attend class, complete homework and examinations, and complete laboratory assignments. The students' grades will be based upon the performance of the above criteria.

## EE 285 Introduction to Industrial Automation

Credits Two credit hours (four contact hours per week)

Course Description:Introduction to microcontrollers including block diagrams and memory maps,programming software and hardware, programming projects that apply microcontroller techniques to various mechanical systems

Prerequisites: CS 245, EE 180, and EE 210 for EE majors; CS 245 and EE 250 for ME majors :-"

Corequisites: None

Text and special references:
Instructor provided material.

Goals/Objectives:
The objective of this course is to introduce students to various types of microcontrollers, to learn programming skills to program a microcontroller to control various mechanical systems, and to develop project skills through a variety of practical projects.

Content outline:

Digital Section:
1. Ability to use Karnaugh maps to minimize the design of a logic circuit
2. Design combinational logic circuit
3. Design synchronous and asynchronous sequential circuits.

PLC Section:
1. Create a structured PLC program to solve an automation problem
2. Document a PLC Program for archival purposes
3. Document project results in an appropriate manner
4. - Wire sinking and sourcing sensors and power supplies to a PLC
5. Build a proof-of-concept model for a sensor validation experiment

Microprocessor Section:.
1. Demonstrate a working knowledge of the ATMELAVR Flash microcomputers
2. Demonstrate a working knowledge of the necessary steps and methods used to interface a microcomputer to devices such as LDC displays, motors, sensors, etc.
3. Demonstrate the use of interrupts and other programming techniques related to .- microprocessors

Laboratory projects: Students will be engaged in multiple projects throughout the semester

## ME 300 Junior Design

. Course Title and Designation:
Junior Design, ME 300, 2 Credit Hours, Seminar

2. Prerequisites and Co requisites:
Prerequisites: ME 200, ME 344
Corequisites: ME310

3. Catalog Description:
Introduces the concept of design methodologies (Design for Assembly, Design for Manufacturing, etc.) and applies these techniques to design projects. Written, oral, and graphical communication skills of the students will continue to be developed, including skills in working with vendors for production of components to engineering specifications.

4. Text and Supporting Resources:

5. Goals:
This course will introduce the concept of design methodologies (Design for Assembly, Design for Manufacturing, etc.) and to apply these techniques to design projects. Competitive benchmarking will be introduced as a design specification and evaluation tool. Written, oral, and graphical communication skills of the students will continue to be developed. Skills will be developed in working with vendors for production of components to engineering specifications.

6. Course Outcomes:

The students will be able to:

- Use commercial word processing, calculation, presentation and graphics software to perform and convey engineering design work.
- Give an effective oral business presentation.
- Demonstrate effective writing of engineering documentation. Examples include: memos scheduling meetings and presentations, describing team norms, and discussing ethical behavior; final reports with appropriate technical detail and graphical documentation.
- Create and use timelines and responsibility charts for project planning.
- Use creative problem solving techniques for solving business and technical problems
- Complete effective performance evaluations of team members and demonstrate that they are effective team members.
- Describe and implement different design methodologies.
- Explain the principles and issues of ethical behavior in engineering and professional fields.

7. Topics:
- Engineering Tools: MathCAD, MATLAB, Engineering Drawings
- Design Methodologies
- Professional Skills: Presentations, Proposals, Reports and Memos
- Project Management: Project Planning, Design and Technical Reviews, Timelines, Responsibility Charts
- Teamwork, Norms & Expectations, Peer Evaluations
- Engineering Professionalism and Ethics

8. Experiences Contributing to Program Outcomes:
   Course satisfies progressive design experience requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

# EM 302, Mechanics of Deformable Solids

1. Course Title and Designation:
   Mechanics of Deformable Solids, EM 302, 3 crs, Lecture, L.

2. Prerequisites and Corequisites:
   Prerequisites: Math 227, EM 221 or CE 244. Builds upon laws of mechanics learned in EM 221 and uses differential and integral calculus.
   Corequisite: ME 331(concurrent). Laboratory taken at same time as lecture to allow for experimental verification of topics learned. In special cases may be taken as prerequisite.

3. Catalog Description:
   Study of fundamental principles and physical laws governing the response of mechanical components to external forces. Concepts of stress, equivalent systems, rigid body equilibrium, stress-strain and deformation, torsion, internal forces and bending moments, shear and bending moment diagrams, flexural loading, Mohr's circle and pressure vessels are presented.

4. Text and Supporting Resources:
   *Mechanics of Materials*, third edition, Ferdinand P. Beer, E. Russell Johnston, Jr. and John T. DeWolf, Mcgraw-Hill, Inc., 2002. No other resources required for course.

5. Goals:
   To equip students with the required fundamental principles and skills necessary to determine the stresses and deformations of typical mechanical components subjected to external forces. Prepare students for designing systems within strength limitations.

6. Course Outcomes:
   **Students will be able to determine; normal and shear stresses in mechanical components under known loads, deflections under axial and transverse load conditions. Students will be able to model the variation of stresses in structural members and determine the locations and magnitudes of maximum stresses and deflections.**

7. Topics:
   - Static systems, forces and stresses
     Stress-strain behavior of solids
   - St. Venant's principle, stress concentrations
   - Torsion in axi-symmetric members, statically indeterminate shafts
   - Bending of uniform cross-section beams
   - Unsymmetric bending
     Shear and bending moment diagrams
   - Shear stresses in beams
   - Thin wall pressure vessels
   - Transformations of stress and strain
   - Mohr's circle for plane stress
   - Beam deflections
     Statically indeterminate beams
   - Columns, stability and buckling

8. Experiences Contributing to Program Outcomes:
Course satisfies general engineering science requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

**ME 310: Engineering Instrumentation and Experimentation**

9. Course Title and Designation:
   Engineering Instrumentation and Experimentation, ME 310, 2 hrs. lecture, 1 hr. laboratory.

10. Prerequisites and Corequisites:
    Prerequisites: STAT 301, EM 302, EE 285. Builds upon basic sensor integration from EE 285. Course utilizes statistical analysis of experimental data. Basic stress analysis techniques are used in the analysis of strain gages and bridge networks.

11. Catalog Description:
    The use of sensors and instruments to measure the behavior of mechanical systems is explored in lectures and laboratory exercises. Application of sensors, calibration of systems, and methods of data collection and analysis are covered, with an emphasis on uncertainty analysis.

12. Text and Supporting Resources:
    *Mechanical Measurements*, 5$^{th}$ edition, Beckwith, Marangoni, and Lienhard. The course will use existing resources in the Multi-Disciplinary Laboratory. Software such as Excel and MATLab will be used for data analysis.

13. Goals:
    Students will be actively involved in planning and conducting experiments using industrial quality engineering instrumentation. Students will work in teams to perform the experiments and analyze the data. Students will become familiar with various sensors and will learn the basics of sensor specification. Students will learn the fundamentals of experiment planning, calibration, and data analysis. Students will learn to keep an engineering notebook. Students will gain experience in writing engineering memos to summarize experiments.

14. Course Outcomes:
    By the end of the semester, students will be able to:

- Formulate mathematical models of simple physical systems.
- Develop a complete uncertainty estimation for a mathematical model of a measurement system.
- Compute the resolution and sensitivity of measurement system.
- Perform a calibration of a standard and use that standard to calibrate a tool.
- Select sensors and interfaces for a range of applications including thermal, strain, pressure, and load.
- Plan and conduct an experiment to measure and/or verify a physical quantity.
- Document experimental results in an appropriate manner.

15. Topics:

- *Calibration fundamentals*
- *Mathematical modeling*
- *Uncertainty analysis*
- *Sensitivity analysis*
- *Digital data collection*
- *Dynamic system response*
- *Selection of sensors*
- *Application of sensors: thermal, strain, pressure, force*

16. Experiences Contributing to Program Outcomes:
Students will be required to complete a range of laboratory experiences in a team environment and to professionally document their work. They will also use mathematics and the physical sciences to characterize mechanical systems. Specific mathematical topics include differential calculus, differential equations, linear algebra, and statistics.

**ME 325 Elements of Heat Transfer**

8. Course Title and Designation:
   Elements of Heat Transfer, ME 325, 3 Credits, Lecture

9. Prerequisites and Co requisites:
   Prerequisites: MATH 350, ME 330

10. Catalog Description:
   Discussion of the basic physical laws of heat transfer including steady-state and transient heat flow, one, two, and three-dimensional heat conduction in solids, free or forced convection in fluids, radiation, and phase change. Analysis of heat exchangers.

11. Text and Supporting Resources:
   Cengel, Heat Transfer, A Practical Approach, 2nd edition No other resources required for course.

12. Goals:
   The overall goal is to teach the students to recognize appropriate modes of heat transfer and apply these engineering principles to physical phenomena in the design of components, and integrate these concepts into a valid engineering design. This course also develops and stimulates independent and team problem solving skills as applied to complex engineering problems and problem verification, and effective communication of engineering designs. At the end of the course students will have a working knowledge of the topics covered in Heat Transfer and will be able to apply these ideas in a mechanical engineer's job.

13. Course Outcomes:

Students will have the ability:

- to recognize appropriate modes of heat transfer.
- to apply heat conduction equation to analyze steady conduction problems.
- to apply appropriate methods to solve convection (forced or free) problems.
- to analyze radiation heat transfer problems.
- to analyze and determine sizes for heat exchangers.

8. Topics:

- Steady-State Conduction
- One dimension
- Resistance Networks: plane walls, cylinders and spheres
- Fins; Multi-dimensional conduction
- Insulation and R values
- Transient Conduction
- Lumped heat capacity system
- Heisler charts; Multi-dimensional systems
- Forced-Convection Heat Transfer
- Boundary layers, laminar and turbulent flow
- Flow over flat plates; cylinders and spheres
- Empirical relations for pipe and tube flow
- Natural-Convection Systems (Free Convection)
- Radiation Heat Transfer
- Physical mechanisms; Blackbody radiation

Radiation view factors; Network analysis for black and gray surfaces
Heat Exchangers
Types of heat exchangers
LMTD and Effectiveness-NTU Methods

8. Experiences Contributing to Program Outcomes:
Course satisfies general engineering science requirements and prepares students for design of thermal-fluid systems. Course develops the use of math, physical science and problem solving skills to characterize relationships within thermal-fluid systems.

**ME 330 Fluid Mechanics**

Course Title and Designation:
Fluid Mechanics, ME 330, 3 Credits, Lecture

2. Prerequisites and Co requisites:
Prerequisites: MATH 331, EM221. Strong ability to integrate/differentiate expected; familiarity with differential equations expected for Navier-Stokes equation. EM221 necessary for coverage of Fluid Statics.
Co requisite: none

3. Catalog Description:
An introduction to the physical laws governing the mechanical behavior of liquids and gasses, with applications of conservation of mass, energy and momentum equations. Fluid statics, internal and external fluid flow. Flow measurement. Scale modeling and similitude. Hydraulic machinery analysis and pipe networks.

4. Text and Supporting Resources:
White, Fluid Mechanics, 5th edition. No other resources required for course? Software in future?

5. Goals:
The overall goal is to teach the students how to recognize categories of fluid mechanics problems and correctly use engineering principles to approach and solve problems. The course is also intended to develop and stimulate independent problem solving skills applied to complex engineering problems, investigation of fluid mechanics principles, and effective communication of engineering data.

6. Course Outcomes:
Students will be able to:

- Analyze forces and pressures for static fluid problems.
- Recognize and apply appropriate conservation equations to analyze steady flow fluid problems.
- Analyze transient fluid behavior using energy and momentum equations to determine forces and velocities.
- Perform similitude and dimensional analysis.
- Determine internal (pipe flow) and external (boundary layer) flow solutions.
- Understand pressure and flow measurement devices.
- Analyze and determine sizes for hydraulic machinery (such as pumps, turbines).
- Apply conservation equations to compressible flow.

9. Topics:

- Fluid Properties and Fluid Flow Properties
  Hydrostatics and Forces, Forces on Curved Surfaces
- Buoyancy, Motion
- Pressure, Flow Measurement
- Basic Physical Laws, Reynolds Transport Theorem
- Conservation of Mass, Momentum, Angular Momentum and Energy
- Bernoulli's Equation
- Dimensional Analysis and Pi Theorem; Similitude and Modeling
  Internal Flow, Flow Regimes
- Pipe Flow and Pipe Losses, Multiple Pipes

External Flow, Boundary Layers; Flat Plates
Pressure Gradients; Lift and Drag
Turbomachinery
Pump Performance; Operating Characteristics
Turbines, Types, Performance, Operation
Compressible Flow
Speed of Sound, Isentropic Flow, Internal Flow

- Shock Waves, Diverging/Converging Nozzles

9. Experiences Contributing to Program Outcomes:
Course satisfies general engineering science requirements and prepares students for design of thermal-fluid systems. Course develops the use of math, physical science and problem solving skills to characterize relationships within thermal-fluid systems.

ME 331, Strength of Materials Lab

Course Title and Designation:
Strength of Materials Lab, ME 331, 1 credit, Laboratory, B.

2. Prerequisites and Corequisites:
Prerequisites: Math 227, EM 221 or CE 244. Builds upon laws of mechanics learned in EM 221 and uses differential and integral calculus.
Corequisite: EM 302 (concurrent). Laboratory is taken at same time as lecture to allow for experimental verification of topics learned. In special cases may be taken as prerequisite.

3. Catalog Description:
Implementation of fundamental principles and physical laws governing the response of mechanical components to external forces. A variety of experiments and projects are used to aid understanding of topics presented in EM 302. Students will learn how to plan, conduct and report on experiments to measure the performance characteristics of materials and mechanical systems. Skills in report preparation will be developed (spring).

4. Text and Supporting Resources:
Mechanics of Materials, third edition, Ferdinand P. Beer, E. Russell Johnston, Jr. and John T. DeWolf, Mcgraw-Hill, Inc., 2002. Software: Word, Excel and Powerpoint(?) (or equivalent).

5. Goals:
**To equip students with understanding of the fundamental principles and techniques for testing and measuring the response of mechanical components to external forces. To provide knowledge regarding strengthening mechanisms in engineering materials. Develop an understanding of how property data is generated and reported. Create a bridge between theoretical knowledge (developed in ME 240/241, EM 221) and application.**

6. Course Outcomes:
**Upon completion of this course students should be able to:**

- **Plan, conduct, analyze and evaluate experiments**
- **Determine mechanical properties from tensile testing**
- **Perform hardness, torsion and impact tests**
- **Measure influence of work hardening and/or heat treatment of alloys**
- **Measure material response by strain gauge technology**
- **Measure beam stresses for axial and eccentric loading**
- **Measure structural deflections**
- **Compare analytical and theoretical results**
- **Produce reports**
- **Communicate test results through presentation (graphical or oral)**

Topics:
**The course will cover the following topics:**

- Data recording methods
- Testing of material properties using standard tools; tension, torsion, hardness, impact, flexure, and compression.
- Standard measures of strength

- Influence of heat treatment on microstructures and properties
- Stresses and deflections in beams –location and magnitude of maximums
- Data reporting methods

8. Experiences Contributing to Program Outcomes:
Course will contain experimental work that supports outcomes 1, 2and 3. Course will cover communication of experimental results in support of outcome 5.

**ME 400 Mechanical Engineering Design**

Course Title and Designation:
Mechanical Engineering Design, ME 400, 2 Credit Hours, Seminar

2. Prerequisites and Co requisites:
   Prerequisites: ME300
   Co requisite: none

3. Catalog Description:
   A formal introduction to product development methodologies and project management techniques, building upon experiences in previous design courses. Students will perform team design projects as well as complete the design specifications for their senior capstone project.

4. Text and Supporting Resources: David Ullman, The Mechanical Design Process, 2nd edition, McGraw-Hill, 1997. Wilson, Kennedy and Trammel, Superior Product Development, Blackwell Publishers, 1996

5. Goals:
   Formalize the students' design experiences within the context of established product development methodologies, reinforced by two team design projects. Generate the design specifications for the students' senior capstone design project. Continue developing the written, oral and graphical communication skills of the students.

6. Course Outcomes:
   - Be capable of giving an effective oral business presentation.
   - Be capable of writing a clear, concise project proposal that flows from general to specific.
   - Be capable of explaining the principles and issues of ethical behavior in engineering and professional fields.
   - Be capable of using creative problem solving techniques for solving business and technical problems.
   - Be able to create and use timelines and responsibility charts for project planning.
   - Be able to complete effective performance evaluations of team members.
   - Demonstrate that they are effective team members.

7. Topics:
   - Product development methodologies
   - Team project #1: Design specifications and customer needs.
   - Team project #2: Design, Build and Test.
     Design specifications for capstone design project.
   - ...
   - Legal Forms, Project Acceptance Letters
   - Team Building; Creative Problem Solving
   - Ethics
   - Project Planning
   - Scope Presentations
     Engineering Drawings
   - Peer Evaluations

- Design Review Guidelines
- 

8. Experiences Contributing to Program Outcomes:
Course satisfies progressive design experience requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

## ME 410: Mechanical Vibrations and Controls

Course Title and Designation:
Mechanical Vibrations and Controls, ME 410, 3 hrs lecture.

2 Prerequisites and Corequisites:
Prerequisites: ME 310, MATH 350. Corequisite: ME 411. Course builds upon fundamentals of dynamic system modeling and makes use of Laplace transforms to solve problems.

3 Catalog Description:
An introduction to system modeling and prediction. Basic vibration analysis and measurement is presented, including free and forced responses. Fundamental system control theory is incorporated into the study of dynamic behavior, including stability analysis, controller design, and disturbance inputs.

4 Text and Supporting Resources:
To be determined. Course will use existing resources in the Dynamic Systems Laboratory.

5. Goals:
Students will become familiar with the mathematical modeling of systems and the use of Laplace transforms in the modeling process. Students will gain a basic understanding of vibration analysis and measurement, including free and forced responses. Vibration isolation and transmissibility will be incorporated in the context of a design project. Through an extension of the dynamic modeling of physical systems, students will study and understand feedback control systems with an emphasis on stability analysis.

6. Course Outcomes:
By the end of the course, students will be able to:

- Construct a mathematical model of a dynamic mechanical system
- Use Laplace transforms to solve systems of differential equations
- Analyze vibratory response of free and forced systems
- Determine the transfer function for a control system
- Determine the stability of a control system
- Design a controller for a basic control system

7 Topics:

- Mathematical modeling of physical systems
- Laplace applications
- Free and forced vibrations
- Vibration isolation and transmissibility, including balancing
- Closed loop feedback control
- Stability analysis of control systems
- Disturbance inputs and response
- Frequency response of control systems

8 Experiences Contributing to Program Outcomes:
Students will extensively use mathematics and prior engineering knowledge to model the behavior of mechanical systems. Students will complete a major modeling and analysis project during the course.

# ME 411: Mechanical Vibrations and Controls LAB

Course Title and Designation:
Mechanical Vibrations and Controls Laboratory, hr. laboratory.

2 Prerequisites and Corequisites:
Corequisite: ME 410. This is a supporting laboratory for the lecture course.

3 Catalog Description:
An applied laboratory in system modeling and prediction. Experiments in basic vibration analysis and measurement are presented, including free and forced responses. Experiments in fundamental system control theory are incorporated into the study of dynamic system response.

4. Text and Supporting Resources:
To be determined. Course will use existing resources in the Dynamic Systems Laboratory.

5. Goals:
Students will become familiar with the measurement of dynamic system response. Students will learn the fundamentals of system identification with applications in vibrations and controls. Industrial techniques in isolation, absorption, and balancing will be evaluated. Students will learn the basics of machine fault analysis based on vibration signatures.

6. Course Outcomes:
By the end of the course, students will be able to:
- Construct and experimentally verify a mathematical model of a dynamic mechanical system
- Measure the vibratory response of free and forced systems
- Implement and measure the effectiveness of a control algorithm in an electromechanical system
- Measure the stability of a control system

7. Topics:
Experiments include:
- System parameter identification
- Response of second order systems: free, step input, and harmonic forcing
- Base motion excitation
- Machinery isolation tests
- Vibration absorber tests
- Machinery fault signature analysis
- Controller design for step response: second and third order systems
  Controller design for harmonic response: second and third order systems
  Analysis of disturbance input response and controller design
- Balancing of multi-plane systems

8 Experiences Contributing to Program Outcomes:
Students will be required to complete a range of laboratory experiences in a team environment and to professionally document their work. They will also use mathematics and the physical sciences to characterize mechanical systems. Specific mathematical topics include differential equations, linear algebra, and Laplace transforms.

ME 412 Mechanical Engineering Senior Project

1. Course Title and Designation:
   Mechanical Engineering Senior Project, ME 412, 3 Credit Hours, Seminar

2. Prerequisites and Co requisites:
   Prerequisites: ME400, ME325
   Co requisite: none

3. Catalog Description:
   Students work in design teams to develop robust solutions to complex system design problems. Focus will be on design-build-test of the proposed solution. Students expected to demonstrate all aspects of professional engineering practice.

4. Text and Supporting Resources: none.

5. Goals:
   Successfully execute the design of a complex engineering system, including the development and testing of the technology involved. Document the work performed in a professional manner at all times. Explain and defend the design at multiple design reviews and at a final design presentation.

6. Course Outcomes:
   - Demonstrate appropriate ethical behavior in engineering and professional fields.
   - Give effective oral business presentations.
   - Document projects through clear, concise project proposals and final reports.
   - Communicate effectively using short business memos.
   - Execute a project using management tools (timelines, responsibility charts, etc.)
   - Complete effective performance evaluations of team members.
   - Demonstrate that they are effective team members.

7. Topics:
   - Design proposals
   - Creation of engineering notebook
   - Design review
   - Technology of process and product
     Final design specifications: report and presentation.
   - Assembly and test
   - Verification of operating space
   - ...
   - Peer Evaluations
   - Design, Testing Reviews
   - Project management – project control
   - Project completion and responsibilities
   - Project acceptance criteria

8. Experiences Contributing to Program Outcomes:
   Course satisfies progressive design experience requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

**ME 420 Senior Mechanical Engineering Lab**

Course Title and Designation:
Senior Mechanical Engineering Laboratory I, ME 420, Credit Hour, Lecture, 2 Credit Hours, Lab

Prerequisites and Co requisites:
Prerequisites: ME310
Co requisite: ME325

3. Catalog Description:
Introduces thermal-fluid measurements and instrumentation, and reinforce preparation of engineering reports, uncertainty analysis, experimental design. Experiments include fluid measurements, pipe flow and turbomachinery characteristics, heat transfer measurements, and various thermodynamic cycles.

4. Text and Supporting Resources: Holman, Experimental Methods for Engineers, 7th edition, McGraw-Hill, 2001.

5. Goals:
Equip students to plan, conduct, and evaluate the results of measurement and testing of thermal-fluid systems as well as develop the capability to produce professional engineering reports. The basic theory and objective of each experiment, including the theory and application of thermal-fluid measurements and instrumentation, is presented in lecture. Students will apply and compare fundamental knowledge of heat transfer, thermodynamics and fluid mechanics to experimental results. In addition, students will learn and apply teamwork skills.

6. Course Outcomes:
   - Evaluate and apply methods of experimental measurement for thermal-fluid phenomena.
   - Document experimental results through clear, concise lab reports.
   - Provide an accurate evaluation of the uncertainty of experimental results.
   - Perform effectively as team members.
   -

7. Topics:
   - Engineering report writing
   - Thermal-fluid measurements and instrumentation
   - Experimental methods and uncertainty
   - Viscous Flow
   - Pump characteristics
   - Wind Tunnel (laminar and turbulent flow)
   - Heat Exchangers (double pipe, cross flow)
   - Refrigeration and Heat Pump cycles

8. Experiences Contributing to Program Outcomes:
Course satisfies progressive design experience requirements and prepares students for design of mechanical systems. Use of math, physical science and problem solving skills to characterize relationships within mechanical systems.

**ME 430: Senior ME Lab II**

Course Title and Designation:
Senior Mechanical Engineering Laboratory II, Lecture hour, Laboratory 2 hours

2. Prerequisites and Corequisites
*Prerequisites: ME 420. The course builds upon the previous senior laboratory.*

3. Catalog Description:
This capstone laboratory course is focused on developing proficiency in engineering studies of mechanical systems. Three comprehensive studies will be conducted where design, planning, execution and documentation are emphasized, with particular focus on the prediction and measurement of system performance. Students are guided in the preparation of extended engineering reports.

4. Text and Supporting Resources:
*Mechanical Measurements*, 5th edition, Beckwith, Marangoni, and Lienhard. The course will use existing resources in the Multi-Disciplinary Laboratory. Software such as Excel and MATLab will be used for data analysis.

5. Goals:
Equip students to design, plan, conduct, evaluate, and document major experiments in a team environment. Develop the capability to produce professional engineering reports, and convey these in a professional manner. Further develop the ability to utilize mathematics and the physical sciences to characterize physical systems.

6. Course Outcomes:
By the end of the course, students will be able to:
- Design, plan, and conduct experiments to predict system performance.
- Evaluate and apply various methods of experimental measurement for physical phenomena.
- Document experimental results through comprehensive reports.
- Provide an appropriate evaluation of the uncertainty of experimental results.
- Perform effectively as team members.
- Prepare an oral/graphical/written presentation suitable for delivery at a professional function.

7. Topics:
*Experimental planning and management*
*Mathematical modeling of physical systems*
*Selection of measurement systems and sensors*
*Effective reports for documenting experimental work*

8. Experiences Contributing to Program Outcomes:
Students will be required to complete three major experimental experiences in a team environment and to professionally document their work. They will also use mathematics and the physical sciences to model the behavior of physical systems. Specific mathematical topics include differential equations, linear algebra, Laplace transforms, and statistics.

Attachment 5. WKU-UK Mechanical Engineering Admission Standards.

## WKU-UK Joint Bachelor of Science Program in Mechanical Engineering

**Admission Standards**

### Admission to Western Kentucky University

1. Students are admitted to Western under the institutional standard, which currently requires completion of the pre-college curriculum, a minimum high school GPA of 2.5, and a minimum composite ACT of 20.

2. Students are not immediately admitted directly into any major of the University. If a student expresses an interest in a specific major, then that student will be assigned an advisor from that area and will be put in an appropriate section of the University introductory course, UC 101, but the student is identified as a pre-major until certain specified courses are completed.

### Filing a Degree Program

1. A student transitions from pre-major upon completion of a specified portion of the curriculum. Required are a minimum of 24 hours, including UC 101, ENG 100, HIS 119 or 120, COMM (Speech Communications) 145 or 161, and a mathematics course. Additional requirements are specified for each major for a minimum total requirement of 24 hours. A department may also specify a required grade point average. The ME programmatic requirements are given below.

2. Students are expected to meet the pre-major requirements within the first 48 hours of degree credit and are expected to file a degree program (this is primarily a curricular "roadmap" or plan for the student), in a specified major after 60 hours (junior status).

3. Students will be eligible to file a degree program when they complete the Tier I courses defined below with a grade of "C" or better in each and a cumulative GPA of 2.5 in all Tier I core courses, and meet the other requirements as noted

### Engineering Standing in the Joint WKU/UK ME Program

Formal admission to "engineering standing" would occur after students also complete the second-tier core courses MATH 327 and 331, and PHYS 260/261, each with grades of "C" or better and while maintaining a cumulative GPA of 2.5 in all Tier I and Tier II core courses.

### Repeat Options and Request for Waivers

Use of official repeat options can be used to improve grades in the core courses, with a limit of repeats as allowed by WKU. Student requests for a waiver of any of these requirements will be considered only after all repeat options are utilized, and then will be considered upon petition to the Joint Program Faculty. Approval will require a majority vote of the Joint Program Faculty.

NOTE: Any student eligible to file for a degree program prior to May 2004 may petition for waivers of specific core requirements. Approval would be granted by vote of the joint program

ATTACHMENT 6

# ADDENDUM TO THE FRAMEWORK

## JOINT ENGINEERING PROGRAM
## UNIVERSITY OF KENTUCKY
## WESTERN KENTUCKY UNIVERSITY

The agreements described herein apply to the joint programs in civil and mechanical engineering offered by the University of Kentucky (UK) and Western Kentucky University (WKU).

2. UK Engineering faculty will teach a minimum of 16 hours of any level engineering course work to each student who graduates from the program.

3. WKU faculty may be jointly appointed as graduate faculty at UK, and UK faculty may be jointly appointed as graduate faculty at WKU. WKU faculty who are jointly appointed as graduate faculty at UK may teach courses in UK's University Scholars program to meet teaching loads.

4. WKU students who are admitted to the University Scholars program will receive graduate credit for these courses.

5. The Accreditation Board for Engineering and Technology (ABET) and the Council on Postsecondary Education (CPE) will organize a mock accreditation visit to be held in May 2004.

6. The authority to make decisions on the joint program curriculum, including course curriculum and educational content, will reside with the joint program faculty. Curriculum changes for courses that do not reside in the Department of Engineering at WKU or the Departments of Mechanical and Civil Engineering at UK may need to be routed through normal college and university level committees.

7. Joint program faculty, which will be equally represented by UK and WKU, will resolve conflicts by use of the "possession arrow" method which comes into play when votes among the joint program faculty are deadlocked. In accordance with a coin toss held December 8, 2003, the possession arrow will start with UK.

8. Any decision resolved by the "possession arrow" method will not be implemented for 30 days. The Joint Program Steering Committee may review such decisions during the 30-day period.

9 Amendments or modifications of this memorandum of agreement may be made by mutual written agreement of the Presidents of UK, WKU, and CPE and the Engineering Deans at UK and WKU.

UNIVERSITY OF KENTUCKY

Lee T. Todd, Jr., President — Date 3/5/04

Thomas W. Lester, Engineering Dean — Date 3/5/04

WESTERN KENTUCKY UNIVERSITY

Gary A. Ransdell, President — Date 1/9/04

Blaine R. Ferrell, Dean
Ogden College of Science and Engineering — Date 1-9-04

COUNCIL ON POSTSECONDARY EDUCATION

Thomas D. Layzell
President — Date

UNDERGRADUATE COUNCIL — 3-9-2004