

Industrial Hygiene

Degree Offered:

- Masters of Science, Industrial Hygiene (M.S.)

The Master's of Science with a major in Industrial Hygiene is accredited by the Applied Science Accreditation Commission of ABET, <http://www.abet.org>.

PROGRAM EDUCATIONAL OBJECTIVES

Drawing from the university's mission, the program mission, the needs of our constituents, and the Applied Science Accreditation Commission Criteria of ABET, the following educational objectives were developed for the Masters of Science program in Industrial Hygiene:

1. Practice Industrial Hygiene and to initiate and develop leadership roles in business, industry, and/or government.
2. Continue professional development and life-long learning.
3. Interact in society and business in a professional, ethical manner to promote occupational and environmental health.
4. Be proficient in written and oral communication and to utilize people-oriented skills in individual and team environments.
5. Apply the skills from Industrial Hygiene to be proficient in his or her chosen field or doctoral studies.

STUDENT OUTCOMES

In order to meet the Program Educational Objectives of the Industrial Hygiene program, students must be able to meet the following educational outcomes at the time of their graduation:

1. An ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice such as:
 - Principles and methods of industrial hygiene
 - Principles and methods of ergonomics
 - Principles and methods of safety
 - Principles of environmental sciences
 - Principles of epidemiology and biostatistics
 - Principles and methods of control of physical and chemical hazards
2. The ability to apply knowledge of math, science, and Industrial Hygiene;
3. The ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, and shape recommendations so that results will be achieved and findings will be communicated effectively;
4. The ability to work individually, in teams, and/or in multi-disciplinary teams to identify, formulate, and solve problems using Industrial Hygiene, safety, and ergonomics knowledge, skills, and tools;
5. An ability to formulate or design a system, process, or program to meet desired needs;
6. An understanding of professional and ethical responsibility and the broad education and a knowledge of contemporary issues necessary to understand the impact of solutions in a global and societal context; and
7. A recognition of the need for and an ability to engage in life-long learning.
8. The professional characteristics expected of a successful Industrial Hygienist.

For admission into the M.S. Industrial Hygiene Program, applicants must meet department admission standards and ABET/ASAC prerequisite course requirements which are currently a minimum of sixty-three credit hours of approved science, mathematics, and other technical courses. Of these, at least fifteen credit hours must be junior or senior level. Specific pre/corequisite course requirements include two semesters of general/inorganic chemistry and two semesters of physics. On an individual basis, the faculty may identify additional pre/corequisite coursework, often including organic chemistry and biology. Applicants will be advised about their specific requirements at the time of admission. Applicants not meeting all of the listed requirements may be considered for admission as provisional students.

Curriculum in Masters of Science – Industrial Hygiene

A candidate for the M.S. degree with a major in industrial hygiene must comply with the rules and regulations as outlined in the WVU Graduate Catalog and the specific requirements of the Statler College and the Industrial and Management Systems Engineering Department.

Program Requirements

All M.S. degree candidates follow a planned program of study. The student's research advisor, in conjunction with the student's Advising and Examining Committee (AEC) will be responsible for determining the plan of study appropriate to the student's needs. Students must select a track (thesis or

coursework only) by the end of their second semester in the program. Changes in track may be made later as needed. The underlying principle of the planned program is to provide the students with the necessary support to complete their degree and prepare them for their career.

Curriculum Requirements

A minimum cumulative GPA of 3.0 is required in all courses

A minimum of 60% of courses must be from 500 level or above

Course Requirements *

STAT 511	Statistical Methods 1	3
IH&S 460	Ergonomics	3
IH&S 527	Noise Measurement and Control	3
IH&S 528	Industrial Ventilation Design	3
IENG 561	Industrial Hygiene Engineering	3
IH&S 725	Industrial Hygiene Sampling and Analysis	4
OEHS 622	Public Health Toxicology	3
EPID 601	Public Health Epidemiology	3

Online short course : Basic Course in the Protection of Human Research Subjects - Biomedical Focus <https://www.citiprogram.org/default.asp>

Complete 1 of the following options:

9-11

Thesis Option (9 Hours)

IH&S 693	Special Topics (Aerosol Mechanisms)
IH&S 697	Research (6 hours)
Written Proposal/Oral Presentation	
Thesis	
Final Oral or Written Examination	

Coursework Option (11 Hours)

IENG 662	Systems Safety Engineering
OEHS 601	Environmental Health
IH&S 685	Internship
Environmental or Safety Elective: (choose one) **	
ENVP 515	Hazardous Waste Training
ENVP 555	Environmental Sampling and Analysis
SAFM 580	Fundamentals of Environmental Management
SAFM 470	Managing Construction Safety
SAFM 533	Disaster Preparedness
SAFM 534	Fire Safety Management
Final oral or written examination	

Total Hours

34-36

* Students who do not hold a baccalaureate degree in industrial hygiene may be required to take a set of undergraduate courses above and beyond the minimum coursework requirements. Students must complete those courses and earn at least a "C" in each before completing the 18th credit hour in the industrial hygiene curriculum.

** All courses contributing to Environmental or Safety Elective are three hours.

Final Examination

M.S. students following the thesis option must prepare a written research proposal. The proposal must be approved by the student's AEC at least one semester prior to the final oral examination.

All students, regardless of option, are required to pass a final oral or written examination, administered by their AEC, covering the thesis and/or related course material.

Suggested Plan of Study

The plan below illustrates the Thesis Option. It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical M.S.I.H. degree program that completes degree requirements in two years is as follows.

First Year

Fall	Hours Spring	Hours
STAT 511	3 IH&S 725	4
IH&S 528	3 IH&S 527	3
IENG 561	3 IH&S 697	3
	9	10

Second Year

Fall	Hours Spring	Hours
IH&S 460	3 OEHS 622	3
IH&S 693	3 EPID 601	3
IH&S 697	3	
	9	6

Total credit hours: 34

Major Learning Goals

INDUSTRIAL HYGIENE

- An ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice such as:
 1. Principles and methods of industrial hygiene
 2. Principles and methods of ergonomics
 3. Principles and methods of safety
 4. Principles of environmental sciences
 5. Principles of epidemiology and biostatistics
 6. Principles and methods of control of physical and chemical hazards
- The ability to apply knowledge of math, science, and Industrial Hygiene;
- The ability to design and conduct experiments, analyze and interpret data, develop implementation strategies, and shape recommendations so that results will be achieved and findings will be communicated effectively;
- The ability to work individually, in teams, and/or in multi-disciplinary teams to identify, formulate, and solve problems using Industrial Hygiene, safety, and ergonomics knowledge, skills and tools;
- An ability to formulate or design a system, process, or program to meet desired needs;
- An understanding of professional and ethical responsibility and the broad education and a knowledge of contemporary issues necessary to understand the impact of solutions in a global and societal context;
- A recognition of the need for an ability to engage in life-long learning;
- The professional characteristics expected of a successful Industrial Hygienist.

INDUSTRIAL ENGINEERING COURSES

IENG 502. Advanced Manufacturing Processes. 3 Hours.

PR: IENG 302 and IENG 303. Metal cutting economic models, solidification processes, bulk deformation, sheet metal and drawing, joining design, and economics. Overall view of manufacturing systems. Introduction to numerical control programming and projects on numerical control equipment.

IENG 505. Computer Integrated Manufacturing. 3 Hours.

PR: Graduate standing. Several aspects of computerized manufacturing systems will be covered. Emphasis will be placed on computer fundamentals, computer-aided design and manufacturing, numerically- controlled (NC) machine tools, part programming, system devices, and direct digital control. (2 hr. lec., 1 hr. lab.).

IENG 506. Computer Aided Process Planning. 3 Hours.

PR: Consent. Computer aided process planning for manufacturing applications; selection of processes and parameters; machining, casting, and forming; development of process plans from design data; and analysis of effect of changes in design on manufacturability in concurrent engineering.

IENG 507. Robotics and Flexible Automation. 3 Hours.

PR: Graduate standing. This course will provide an understanding of the principles, capabilities, and limitations of industrial robots and other flexible automation tools. Emphasis will be placed on kinematic analysis, trajectory planning, machine vision, and manufacturing automation. (2 hr. lec., 1 hr. lab.).

IENG 508. Advanced Problems in Manufacturing Engineering. 1-3 Hours.

PR: IENG 593 or IENG 502; Graduate standing. Special problems relating to one of the areas of manufacturing engineering, such as manufacturing processes, robotics, CAD/CAM, group technology, and manufacturing systems engineering.

IENG 514. Design of Industrial Experiments. 3 Hours.

PR: IENG 314 or Consent. Continuation of IENG 314. More complex experimental design especially useful to engineering and industrial researchers, including factorials and optimum-seeking design. Emphasis on use of existing digital computer routines and interpretation of results.

IENG 518. Technology Forecasting. 3 Hours.

PR: IENG 213 or Consent. Various procedures used in forecasting technical developments.

IENG 542. Advanced Production Control. 3 Hours.

PR: IENG 350. Different mathematical models useful in the design of effective production control systems. The various models include: static production control models under risk and uncertainty, dynamic models under certainty, and under risk.

IENG 551. Quality and Reliability Engineering. 3 Hours.

PR: Graduate standing. Introduction to quality and reliability engineering. Special emphasis on Taguchi Design and Markov Models for determining system reliability and availability.

IENG 553. Applied Linear Programming. 3 Hours.

PR: IENG 350 or Consent. Application of the assignment, transportation, and simplex algorithms to typical industrial problems. The methods and computational efficiencies of the revised simplex and other algorithms are also studied.

IENG 554. Applied Integer/Heuristic Programs. 3 Hours.

PR: IENG 350 or IENG 553 and knowledge of a computer programming language. Applications of integer and heuristic programming techniques for solving combinatorial optimization problems. Topics include computational complexity, relaxations, branch and bound, cutting planes, simulated annealing, tabu search, and genetic algorithms.

IENG 555. Scheduling and Sequencing Methods. 3 Hours.

PR: IENG 350. Theory and applications of analytical models used in the scheduling models; flow shop models; job shop models; and assembly line balancing methods.

IENG 556. Supply Chain Management. 3 Hours.

PR: IENG 350 or IENG 553. Principles and methods for designing and managing supply chain systems. Topics include: forecasting demand, strategies, aggregate planning, inventory control, outsourcing, transportation networks, and locating facilities within the supply chain network.

IENG 557. Geometric Programming. 3 Hours.

PR: IENG 350 or Consent. Introduction to the primal and dual solution techniques for geometric programming problems. Focus on the development of design relationships for cost optimization or profit maximization problems.

IENG 561. Industrial Hygiene Engineering. 3 Hours.

Introductory course in industrial hygiene with laboratory. Topics include: recognition, evaluation, and control of occupational and environmental contaminants and physical agents; basic IH quantitative analysis; PPE selection and evaluation.

IENG 564. Industrial Ergonomics. 3 Hours.

PR: IENG 360 or Consent. Practical experience in the application of ergonomic principles to industrial problems. Safety and production implications of work physiology, industrial biomechanics, and circadian rhythms, as well as current interest topics.

IENG 577. Advanced Engineering Economy. 3 Hours.

PR: IENG 377 or Consent. Special emphasis on depreciation, engineering and economic aspects of selection and replacement of equipment; relationship of technical economy to income taxation; and effect of borrowed capital and project cost control.

IENG 578. Costing and Estimating. 3 Hours.

PR: IENG 377 or Consent. Analysis of overhead, cost indexes, cost capacity factors; improvement curves; costing for materials with design considerations, conceptual cost estimating; costing for machining, joining, casting and forming; and facility cost estimation.

IENG 593A-Z. Special Topics. 1-6 Hours.

A study of contemporary topics selected from recent developments in the field.

IENG 660. Human Factors System Design. 3 Hours.

PR: IENG 360 or Consent. Theoretical aspects and practical applications of man/machine relationships as they influence future system design. The student will examine human limitations with respect to acceptance of information, decision making, and ability to transmit the result of such decisions to controlled equipment systems to obtain design optimization. (2 hr. lec., 3 hr. lab.).

IENG 662. Systems Safety Engineering. 3 Hours.

PR: IENG 461 or Consent. Analysis of manufacturing methods, processes, and properties of materials from a system safety engineering viewpoint. Emphasis will be on hazard analysis techniques (fault tree, MORT, failure modes, and effects) and machine guarding methods.

IENG 668. Advanced Problems in Human Factors. 1-3 Hours.

PR: IENG 360 or IENG 660 and graduate standing. Special problems relating to one of the areas of human factors, such as ventilation, ergonomics, controls, vigilance, safety, and occupational health.

IENG 691. Advanced Topics. 1-6 Hours.

PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

IENG 693A-Z. Special Topics. 1-6 Hours.

A study of contemporary topics selected from recent developments in the field.

IENG 695. Independent Study. 1-6 Hours.

Faculty supervised study of topics not available through regular course offerings.

IENG 697. Research. 1-15 Hours.

PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

IENG 698. Thesis or Dissertation. 1-6 Hours.

PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

IENG 754. Inventory Theory. 3 Hours.

PR: IENG 213 and IENG 350 or Consent. Techniques used in optimization of inventory systems. Elements of static, deterministic inventory models, and static, stochastic inventory models. Selected inventory models. Selected topics related to inventory analysis.

IENG 756. Applied Stochastic Processes. 3 Hours.

PR: Consent. Stochastic systems with emphasis on application to inventory and queueing theory. Conditional probability, Poisson processes, renewal processes, Markov chains with discrete and continuous parameters.

IENG 790. Teaching Practicum. 1-3 Hours.

PR: Consent. Supervised practice in college teaching of industrial and management systems engineering. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be S/U.).

IENG 791. Advanced Topics. 1-6 Hours.

PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

IENG 792. Directed Study. 1-6 Hours.

Directed study, reading, and/or research.

IENG 793. Special Topics. 1-6 Hours.

A study of contemporary topics selected from recent developments in the field.

IENG 794A-Z. Seminar. 1-6 Hours.

Seminars arranged for advanced graduate students.

IENG 795. Independent Study. 1-9 Hours.

Faculty supervised study of topics not available through regular course offerings.

IENG 796. Graduate Seminar. 1 Hour.

PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

IENG 797. Research. 1-15 Hours.

PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

IENG 798. Thesis or Dissertation. 1-6 Hours.

PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

IENG 799. Graduate Colloquium. 1-6 Hours.

PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use the University's facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department's 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is S/U; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

INDUSTRIAL HYGIENE SAFETY COURSES**IH&S 527. Noise Measurement and Control. 3 Hours.**

PR: Senior or graduate standing. Includes noise physics, effects of noise on hearing and well-being, noise exposure regulations, and engineering of noise control. Practical experience with noise dosimeters and sound level meters is provided by a field trip.

IH&S 528. Industrial Ventilation Design. 3 Hours.

PR: Senior or graduate standing. Design of industrial exhaust ventilation for contaminant control. Includes dilution ventilation, hood design, duct system design, selection of fans and air-cleaning devices, and measurement of flows and pressures.

IH&S 627. Industrial Hygiene-Noise Assessment and Control. 3 Hours.

PR: Consent. Industrial hygiene aspects of assessing and controlling noise induced hearing loss. Practical experience with noise dosimeters, sound-level meters and instrumentation used to assess human noise exposure is provided by field trips and case studies.

IH&S 628. Ventilation Control Technology. 3 Hours.

PR: IMSE 561 or consent. The course will demonstrate techniques for the recognition, evaluation, and control of noise and ventilation problems. Students will use monitoring equipment to evaluate situations and perform several design projects.

IH&S 685. Internship. 3-6 Hours.

PR: Consent. (May be repeated) Professional internship providing on-the-job training under supervision of a previously approved environmentalist in settings appropriate to professional objectives.

IH&S 689. Professional Experience in Industrial Hygiene. 2 Hours.

PR: Consent. Experiential learning program planned by the student and evaluated for credit by faculty. Involves field experience from an IH or safety job, or shadowing IH or safety personnel. Student must write an acceptable report on his or her experiences and defend it in a verbal presentation.

IH&S 691A-Z. Advanced Topics. 1-6 Hours.

PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

IH&S 692. Directed Study. 1-6 Hours.

Directed study, reading, and/or research.

IH&S 693A-B. Special Topics. 1-6 Hours.

A study of contemporary topics selected from recent developments in the field.

IH&S 694. Seminar. 1-6 Hours.

Special seminars arranged for advanced graduate students.

IH&S 695. Independent Study. 1-6 Hours.

Faculty supervised study of topics not available through regular course offerings.

IH&S 696. Graduate Seminar. 1 Hour.

PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

IH&S 697. Research. 1-15 Hours.

PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

IH&S 698. Thesis or Dissertation. 1-6 Hours.

PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

IH&S 699. Graduate Colloquium. 1-6 Hours.

PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use the University's facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department's 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is S/U; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirement of registration in the semester in which graduation occurs.

IH&S 725. Industrial Hygiene Sampling and Analysis. 4 Hours.

PR: IENG 561 and Consent. Calibration and use of sampling and analytical equipment used by industrial hygienists to evaluate the work environment. Advantages and disadvantages of different equipment under various conditions. Biological monitoring as an evaluation tool.

IH&S 797. Research. 1-15 Hours.

PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

SAFETY MANAGEMENT COURSES

SAFM 501. Safety Management Integration. 3 Hours.

Consideration of integrated arrangements, staff roles, management theory, staff liaison, project improvement, effectiveness, audits, and collaboration needed to assure success of the safety function.

SAFM 502. Controlling Environmental and Personnel Hazards. 3 Hours.

Investigation of hazard control principles relating to environmental facilities and equipment including control procedures recommended by authorities from the fields of engineering, medicine, and public health as well as from the field of safety.

SAFM 505. Safety Legislation and Compliance. 3 Hours.

Comprehensive study and analysis of federal and state legislation which mandates compliance with certain safety conditions and practices related to work performed in occupational and comparable settings.

SAFM 528. Economic Aspects of Safety. 3 Hours.

PR: Graduate standing. An overview of economic factors that must be considered when justifying the development and implementation of safety initiatives, including examining published research, cost estimating, ROI, risk assessment, benefit-cost analysis, and project planning.

SAFM 533. Disaster Preparedness. 3 Hours.

Major elements involved in disasters and emergencies, preparedness planning, systems utilization, and attention to essential human services, with emphasis on community action.

SAFM 534. Fire Safety Management. 3 Hours.

Analysis of fire services usually provided under safety manager jurisdiction, with special attention to legal bases, organizational structure, services rendered, training needs, and management techniques.

SAFM 539. Security Management. 3 Hours.

Safety manager responsibilities for security of persons and property including organizational patterns, personnel competencies expected, surveillance and monitoring methods, and occupational problems among security personnel.

SAFM 550. Loss Control and Recovery. 3 Hours.

Identifying and elimination areas of loss or recovering from losses of people, property, and efficacy via management practices, insurance and worker's compensation, and other management techniques and resources effective in controlling those losses.

SAFM 552. Safety and Health Training. 3 Hours.

Analysis of safety and health performance discrepancies, developing and conducting training programs to eliminate those discrepancies and the evaluation of program effectiveness in terms of cost effectiveness and organizational impact.

SAFM 578. Substance Abuse in the Workplace. 3 Hours.

The problem, nature, and effects of alcohol and drug use in the workplace; approaches for treatment and avoidance such as EAP's, community programs, and testing; development of management approaches and programs.

SAFM 580. Fundamentals of Environmental Management. 3 Hours.

An introductory but comprehensive overview of topics related to environmental technology as it applies to safety management. Focuses on regulation and technology relative to environmental management. Includes field trip.

SAFM 640. Instrumentation for Safety Managers. 3 Hours.

Anticipation, recognition, and evaluation of industrial hygiene topics encountered by safety managers. Fundamental instrumentation techniques are presented in laboratory and lecture formats. Management-oriented control and remediation programs are developed.

SAFM 641. Leadership Development for Safety Management. 3 Hours.

PR: SAFM 501 and SAFM 505. This course presents concepts in ethics, leadership in crisis and non-crisis modes, experiential training, and creating a values-congruent workplace even under conditions of non-support by upper management.

SAFM 642. Biomechanics of Safety Management. 3 Hours.

Applying the laws of physics to describe the abilities and limitations of the human body biomechanically and physiologically in order to maintain safety, quality, and productivity objectives; based on safety management principles.

SAFM 689. Professional Field Experience. 1-18 Hours.

PR: Must have completed 12 hours in SAFM and consent. Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

SAFM 691A-Z. Advanced Topics. 1-6 Hours.

Investigation of advanced topics not covered in regularly scheduled courses.

SAFM 692A-Z. Directed Study. 1-6 Hours.

Directed study, reading, and/or research.

SAFM 693A-Z. Special Topics. 1-6 Hours.

A study of contemporary topics selected from recent developments in the field.

SAFM 695. Independent Study. 1-6 Hours.

Faculty supervised study of topics not available through regular course offerings.

SAFM 697. Research. 1-6 Hours.

PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading will be S/U.).

SAFM 699. Graduate Colloquium. 1-6 Hours.

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SAFM 790. Teaching Practicum. 1-3 Hours.

PR: Consent. Supervised practice in college teaching of safety and environmental management. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading will be S/U.).

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