

Department of Industrial and Management Systems Engineering

Degrees Offered

- Masters of Science, Industrial Engineering (M.S.I.E.)
- Masters of Science, Industrial Hygiene (M.S.)
- Masters of Science, Safety Management (M.S.)
- Doctor of Philosophy, Industrial Engineering (Ph.D.)
- Doctor of Philosophy, Occupational Safety and Health (Ph.D.)

One of the defining attributes in the success of the department is the dedication and talent of its fifteen faculty and three staff members. The aggregate careers of our faculty and staff represent over 250 years of service to students at WVU. In these 250 years of service is embodied the wisdom and experience to successfully prepare industrial engineers and occupational health and safety professionals to address ever-changing societal needs. The faculty and staff typically educate nearly 300 undergraduate, 100 to 120 M.S., and fifteen to twenty-five Ph.D. students. The department is in the unique position in the United States of having two complimentary graduate programs in industrial hygiene and safety accredited by the Applied Science Accreditation Commission (ASAC) of ABET. The combined resources and faculty talents of these two programs create synergies that provide our students with outstanding academic and research experiences in the field of occupational safety and health. Excellent academic and research opportunities are also available for students in the areas of healthcare systems, supply chain optimization, energy systems, smart manufacturing, occupational safety/health, and ergonomics.

Faculty Research

The department has quality research laboratories in smart manufacturing, operations research, production planning and control, data analytics and visualization, ergonomics, industrial hygiene, and safety. Graduate students are encouraged to utilize these resources to explore and develop their capabilities.

FACULTY

CHAIR

- Kenneth R. Currie - Ph.D. P.E., (West Virginia University)
Manufacturing systems design, Optimization, Automation & Controls, Healthcare Systems Engineering

PROFESSORS

- Rashpal Ahluwalia - Ph.D., P.E. (Western Ontario University)
Manufacturing Systems, Quality and Reliability Engineering, Robotics and Automation
- Jack Byrd Jr. - Ph.D., P.E. (West Virginia University)
Operations Research, Workforce Development, Work Design, Integrated Product Development
- Bhaskaran Gopalakrishnan - Ph.D., P.E., CEM. (Virginia Polytechnic Institute and State University)
Manufacturing Processes and Production Systems, Artificial Intelligence Applications, Expert Systems Development, Industrial Energy Efficiency, Building's Energy Efficiency, Industrial Energy and Waste Minimization, Productivity Improvement
- Steven Guffey - Ph.D., C.I.H. (North Carolina State University)
Ventilation Systems Theory and Design, Noise Measurement and Control, Exposure Assessment
- Majid Jaridi - Ph.D. (University of Michigan)
Statistics, Quality Control, Forecasting and Transportation Research
- Gary Winn - Ph.D. (Ohio State University)
Construction Safety, Transportation Safety and Program Evaluation, Total Quality Management, Theory of Paradigm Shifts
- David A. Wyrick - Ph.D., P.E., P.E.M. (University of Missouri-Rolla)
Engineering Management, Engineering Education, Appropriate Management of Technology in SMEs

ASSOCIATE PROFESSORS

- Elyce Biddle - Ph.D. (West Virginia University)
Business economics; Behavioral economics; Healthcare safety; Data Surveillance: classification systems, data and system quality
- Alan McKendall, Jr. - Ph.D. (University of Missouri, Columbia)
Operations Research, Meta-heuristics, Facilities Layout and Materials Handling, Project Scheduling, Integrated Production Systems
- Ashish Nimbarte - Ph.D. (Louisiana State University)

Work Related Musculoskeletal Disorders, Occupational Biomechanics and Biomechanical Modeling

- Feng Yang - Ph.D. (Northwestern University)
Simulation, Applied Statistics, Stochastic Processes

ASSISTANT PROFESSORS

- Leily Farrokhvar - Ph.D. (Virginia Tech)
Supply Chain Optimization, Large Scale Optimization, Transportation & Logistics
- Xinjian "Kevin" He - Ph.D., (University of Cincinnati)
Respiratory protection, air purification and filtration, aerosol measurement, characterization of particles in indoor and outdoor air, occupational exposure assessment
- Xiaopeng Ning - Ph.D. (Iowa State University)
Safety Engineering, Biomechanics, Ergonomics, Human Factors Engineering
- Thorsten Wuest - Ph.D. (University of Bremen)
Smart Manufacturing, Machine Learning/Artificial Intelligence, Conceptual Design, Process and Information/Data Management

PROFESSORS EMERITI

- Robert C. Creese - Ph.D., P.E. (Pennsylvania State University)
Manufacturing processes/systems, Foundry engineering, Cost engineering, Engineering economics
- Daniel E. Della-Giustina - Ph.D. (Michigan State University)
Playground and recreation safety, Sport safety, Highway and traffic management, Safety, fire, and emergency response
- Wafik H. Iskander - Ph.D., P.E. (Texas Tech University)
Operations research and optimization, Simulation modeling and analysis, Production planning and control, Applied statistics, Energy efficiency
- Warren Myers - Ph.D. (West Virginia University)
Exposure Assessment and Modeling, Aerosol Filtration, Occupational Respiratory Protection Design and Testing
- Ralph Plummer - Ph.D., P.E. (West Virginia University)
Systems Safety Engineering, Energy Conservation, Human Factors, Ergonomics

ASSOCIATE PROFESSOR EMERITUS

- Andrew J. Sorine - Ed.D. (West Virginia University)
Benchmarking, Safety and Health Programs, Safety Management Information Systems

VISITING AND ADJUNCT PROFESSORS

- Christopher Coffey - Ph.D. (West Virginia University)
Occupational Safety and Health, Assessment, Evaluation of Respiratory Protective Equipment
- John R. Etherton - Ph.D. (West Virginia University)
Safety Engineering, Human Factors
- Martin Harper - Ph.D. (London School of Hygiene and Tropical Medicine)
Industrial Hygiene, Exposure Assessment
- James R. Harris - Ph.D., P.E. (West Virginia University)
Safety Research, Human Factors
- Hongwei Hsiao - Ph.D. (University of Michigan)
Safety Engineering, Human Factors
- Kevin Michael - Ph.D. (Pennsylvania State University)
Acoustics, Hearing Protection, Industrial Hygiene
- Christopher Pan - Ph.D. (University of Cincinnati)
Industrial Hygiene, Exposure Assessment
- Ju-Hyeong Park - Sc.D. M.P.H., C.I.H. (Harvard University)
Industrial Hygiene, Exposure Assessment
- Ziqing Zhuang - Ph.D. (West Virginia University)
Exposure Assessment, Assessment and Evaluation of Respiratory Protective Equipment

LECTURER

- Shanti Hamburg - M.S. (Aerospace Engineering)
Design/Build/Fly UAV Design and Construction; Prototyping; Digital Manufacturing

Admission

To qualify as a regular graduate student, applicants must have as a minimum the equivalent of a 3.0 GPA. Applicants with a minimum 2.75 GPA (or the equivalent) may be admitted on a provisional basis. Applicants with GPA below 2.75 would need approval of the dean or his designee. International students must demonstrate proficiency in communicating in English (a minimum TOEFL Score of 550, or IBT Score of 79, or IELTS Score of 6.5). Students must comply with the rules and regulations as outlined in this catalog for graduate work in the College of Engineering and Mineral Resources and meet individual major and degree admission standards.

Applicants to graduate programs in the IMSE department are required to provide the following.

- A completed application submitted to the WVU Admissions Office
- Official transcripts of all previous college course work
- TOEFL scores for international students as stated above
- GRE General Test scores (not required for the M.S. in Safety Management Program)
- Three letters of recommendation (required for the Ph.D. programs only).

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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Directed study, reading, and/or research.

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