

TO: The Engineering Faculty

FROM: The School of Mechanical Engineering

RE: New Concentration in Microelectronics and Semiconductors for Mechanical Engineering

The Faculty of The School of Mechanical Engineering has approved the following new concentration from the College of Engineering. This action is now submitted to the Engineering Faculty with a recommendation for approval.

Description:

Microelectronic chips and systems form the foundations of computing and communication technologies. This concentration in Microelectronics and Semiconductors provides translatable, specialized training in the design, analysis, and manufacturing of advanced semiconductor chips, packages and their assemblies with coursework focused on core areas of **manufacturing/control strategies, materials and mechanical analyses, and thermal transport processes** involved in the fabrication and packaging of microelectronics systems and semiconductor devices.

Reason: Advanced semiconductor chips form the backbone of the entire computing and communication industries. A vulnerable manufacturing supply chain for semiconductor chips and their packaging has brought into sharp focus the need for more design, engineering, and manufacturing capacity (especially domestically in the US) to keep pace with the demand for semiconductor-based products and services. Thanks to this demand, the semiconductor industry needs a lot more workforce-ready engineers (50,000+ new jobs in the coming decade, as per some industry forecasts) to ramp up such capacity and the proposed minor will help position Purdue as a national leader in workforce development in this crucial field.

See the appended documentation which provides the specifics of the concentration.



Jitesh Panchal
Associate Head for Undergraduate Studies
Professor of Mechanical Engineering

Concentration in Microelectronics and Semiconductors for Bachelor of Science in Mechanical Engineering

Focus of the Concentration: Fundamentals of manufacturing/control strategies, materials and mechanical analyses, and thermal transport processes involved in the fabrication and packaging of microelectronics systems and semiconductor devices.

Proposing [Sub] Area: Justin Weibel proposed the concentration on the recommendation of the College of Engineering Semiconductor Talent Development Steering Committee.

Target Degree: BSME

Concentration Requirements: 9 credit hours (at least 6 credit hours in ME) from the following list of courses, plus *required* participation in 1 credit hour seminar course ENGR 10301 Introduction to Semiconductors.

Mechanical Engineering (ME) Electives:

- *Required Core Course for Concentration*
 - ME 597 Introduction to Electronics Packaging and Heterogenous Integration
- Manufacturing/Control Strategies:
 - ME 363 Principles and Practices of Manufacturing Processes
 - ME 475 Automatic Control Systems
 - ME 576 Computer Control of Manufacturing Processes
 - ME 586 Microprocessors in Electromechanical Systems
- Materials and Mechanical Analyses
 - ME 489 Introduction to Finite Element Analysis
 - ME 563 Mechanical Vibrations
 - ME 571 Reliability in Engineering Design
- Thermal Transport Processes
 - ME 415 Energy Systems Engineering
 - ME 503 Micro-and-Nano Scale Energy Transfer Processes
 - ME 511 Heat Transfer in Electronic Systems

Technical (TE) Electives:

- ECE 305 Semiconductor Devices
- ECE 362 Microprocessor Systems and Interfacing
- IE 370 Manufacturing Processes I (IE 370 and ME 363 cannot both be taken)
- IE 470 Manufacturing Processes II
- IE 570 Manufacturing Process Engineering
- MSE 260 Thermodynamics of Materials
- MSE 330 Processing and Properties of Materials
- MSE 335 Materials Characterization Laboratory
- MSE 370 Electrical, Optical, and Magnetic Properties of Materials

Experiential Learning (up to 3 credit hours with relevance to Microelectronics and Semiconductors as approved by the Associate Head of Undergraduate Studies):

- ME 497 Mechanical Engineering Projects [variable credit hours]
- ME 498 Research in Mechanical Engineering I [variable credit hours]
- ME 499 Research in Mechanical Engineering II [variable credit hours]
- ENGR 37920 Junior Part in VIP [2 credits]
- ENGR 47920 Senior Part in VIP [2 credits]

Appendix:

*Other Semiconductor-related 300, 400, and 500-level courses in the Schools of Engineering can be taken as approved by the Associate Head of Undergraduate Studies):

- CHE 320 Statistical Modeling and Quality Enhancement
- CHE 420 Process Safety Management and Analysis
- CHE 456 Process Dynamics and Control
- CHE 564 Organic Electronic Materials and Devices
- CHE 597 Manufacturing Advanced Composites
- ECE 337 ASIC Design Laboratory
- ECE 362 Microprocessor Systems and Interfacing
- ECE 453 Fundamentals of Nanoelectronics
- ECE 455 Integrated Circuit Engineering
- ECE 456 Digital Integrated Circuit Analysis and Design
- ECE 50616 Physics and Manufacturing of Solar Cells
- ECE 50631 Fundamentals of Current Flow
- ECE 50653 Fundamentals of Nanoelectronics
- ECE 51220 Applied Algorithms
- ECE 557 Integrated Circuit Fabrication Laboratory
- ECE 559 MOS VLSI Design
- ECE 568 Embedded Systems
- ECE 59500 Essentials of Transistors [1 credit]
- ECE 59500 MEMS I: Microfabrication and Materials for MEMS [1 credit]
- ECE 59500 MEMS II: Fundamentals of MEMS Design [1 credit]
- ECE 59500 MEMS III: Applications in MEMS [1 credit]
- ECE 59500 Semiconductor Fundamentals [1 credit]
- ECE 59500 Theory and Practice of Solar Cells: a Cell to System Perspective [1 credit]
- ECE 59500 Advanced Lithography [1 credit]
- ECE 59500 Microfabrication Fundamentals [1 credit]
- ECE 59500 Semiconductor Manufacturing [1 credit]
- IE 383 Integrated Production Systems I
- IE 484 Integrated Production Systems II
- IE 490 Supply Chain Engineering
- IE 566 Production Management Control
- IE 579 Design and Control of Production and Manufacturing Systems
- IE 583 Design and Evaluation of Material Handling Systems
- ME 572 Analysis and Design of Robotic Manipulators
- ME 559 Micromechanics of Materials
- MSE 367 Materials Processing Laboratory
- MSE 510 Microstructural Characterization Technique
- MSE 530 Materials Processing in Manufacturing
- MSE 547 Introduction to Surface Science
- MSE 548 Deposition Processing of Thin Films and Coatings
- MSE 555 Deformation Mechanisms in Crystalline Solids
- MSE 59700I Introduction to Computational Materials Science
- MSE 69700C Materials Issues in Microelectronics and Nanoelectronics
- MSE 69700T Principles and Methods of Nanofabrication
- NUCL 42001 Radiation Interaction with Materials and Applications