Proposition: 26-16/17

Title: Proposed redesign of the Bachelor of Science in Surveying Engineering program for a Bachelor of Science in Geomatics

Date Submitted: 1/25/17

Sponsor(s): Rolfe Sassenfeld (Eng), Lynn Kelly (Eng), Thomas Jenkins, Department Head (Eng), Sonya Cooper, Associate Dean (Eng), Lakshmi Reddi, Dean (Eng)

Proposed Committee: Scholastic Affairs

Assigned Committee:

Prior Approvals: Academic Deans Council (ADC), Associate Deans Academic Council (ADAC), Engineering Technology Faculty.

Proposal: The Department of Engineering Technology and Surveying Engineering (ETSE) is requesting Faculty Senate approval to change the name of the Bachelor of Science in Surveying Engineering degree program to *Bachelor of Science in Geomatics.* Additionally, we seek to redesign the 4-year offering to a degree completion +2 format (58 credits on main campus and 62 preparatory credits available from Community College partners for a total of 120 credits).

Rationale: By rebranding (including name change), redesigning course content to better reflect industry requested knowledge and skill sets, offering courses online, partnering with Community Colleges in a degree completion 2+2 program (58 required credits at NMSU main), and maintaining a path to professional licensure, we believe we can offer an economically sustainable major that meets the needs of our students and industry constituencies**.**

Proposal Details:

A. **Name and Description:** Bachelor of Science (BS) in *Geomatics* will replace the current degree name of BS in Surveying Engineering.

   Geomatics involves the application of knowledge to the analysis, design and execution of mapping, geomatics, geospatial information systems, and surveying. When performing this work, professionals must have an understanding of: the science of geomatics measurement and analysis; the legal principles of boundary location; the laws related to boundaries and land use; and applicable mathematical and computational theories and principles. Geomatics is made up of positional accuracy, land planning and development concepts pertinent to subdivision science. Geomatics professionals work for private surveying and engineering firms, for City, County, State or Federal Highway Departments, for State Lands Commissions, for the US Forest Service and for the US Bureau of Land Management.

   The mission of the Department of ETSE is to provide men and women with the rigorous, fundamental education needed to enter and succeed in the Geomatics and related professions. To accomplish this mission, the department will introduce students to the theory and application of recognized geomatics principles.

B. **Rationale:** By rebranding (name change), changing course content to better reflect industry requested knowledge and skill sets, offering courses online, partnering with Community Colleges in a 2+2 format, and maintaining a path to professional licensure, we believe we can offer an economically sustainable major that meets the needs of our students and industry constituencies.

C. **Collaboration:**
   In the redesign of the major, the department looked closely at two year programs within New Mexico and regional areas for the purpose of articulation. The existing freshman and sophomore level courses will be taught in the two-year programs to provide the necessary foundation to the BS degree completion program at NMSU.

   Several upper division courses were added to take advantage of existing expertise. The GEOG, BLAW, PHIL, IE, ET, and MATH prefix courses offer a curriculum in a closely related or supplementary field as required courses.

D. **Potential of Current Student Interest**: The current degree program has averaged 30.3 students during the last six years. It is envisioned that with the rebranding and online delivery format, we can expect an increase to a sustainable level of ~50+ students. A current online program in Nevada has ~80 students.

   The current Industrial Advisory Committee which has members from professional organizations, private contractors, and public employers such as NM Department of

Transportation, have indicated a very strong market for entry level students and have been instrumental in their support for this redesign.

The program can also take advantage of the WICHE Student Exchange Program where "residents of WICHE states can gain affordable access to programs, states avoid costly and unnecessary duplication of programs and facilities, and colleges and universities can devote their resources to improving the quality of their educational offerings".

E. **Program Requirements**: This program will meet all NMSU requirements. Please see the degree completion program of study below and list of required courses with their descriptions.

F. **How and When Courses will be taught**: Courses will be offered during the regular semesters (fall and spring) during times when traditional undergraduate courses are offered and via a distance online methodology. For the online delivery courses, laboratories or applied sections may be offered off campus at industry sites, at contributing partner's locations, or during selected weekends and/or evenings.

G. **Credit hour requirements and other requirements:** The total credit hour requirement will be 120. Other requirements, as described in section E above, can be found in the attached program description.

H. **Resources:** No additional resources (including faculty, library, operating dollars, assistantships, classrooms or other space, etc.) are required.

I. **Administration:**
The program will be administered within Department of Engineering Technology and Surveying Engineering, College of Engineering.

Geomatics +2 Core Courses

Note: there is no prefix or course number changes; however, all courses will have some content change to meet the reduced credit count and student outcomes.

Fall I	**285, 312**
Spring I	**322, 328, 361, 351**
Fall II	**451, 461,464**
Spring II	**435, 452, 498**

SUR 222 3cr. **(2+3p)** Introduction to Geomatics (not part of +2 Core but still taught as service) Applications of geomatics in civil engineering projects.

Theory and practice of geomatics as applied to plane surveying in the areas of linear measurements, angle measurements, area determination, differential and trigonometric leveling, and topographic mapping.
Prerequisite: Math 190G

SUR 285 3cr. Precise Digital Mapping (fa)
Perform basic photogrammetric mapping, and create digital terrain models.

Photogrammetric Mapping Principles, Othorectification, Photogrammetric Mapping Principles, Optical camera, digital sensor including Terrestrial, Mobile digital cameras, surveying control, IMU & GPS integration, photogrammetric principles, stereo photography, analytical triangulation., precision and accuracy of each measurement system. sUAS (Small Unmanned Aerial Vehicles) applications to geospatial data collection and practical applications project fight/pre planning, sensor platform, FAA regulations and restrictions.
Co-prerequisite: SUR 222 (or equivalent)
(Needs one field visit if a UAV will be available)

SUR 312 3cr. Legal Principles and Boundary Law I (fa)
Legal principles of property boundary retracement, and rights-of-way. Systems of law and legal research. Principles of the U.S. Public Land Survey System and manual of Instructions
Cadastral Surveying & Public Land Survey System (PLSS): History and development of the PLSS, non-rectangular boundaries including Trust Lands and Grant, political, State and Federal, riparian, Indian Reservation, homestead entry, and mineral, easements, legal descriptions, conveyances, surveyor in a court of law, Research, Case Records, Research sources for recorded and un-recorded documents, historical documents, title reports, deed research, right of way research, research within governmental agencies, rail roads.
Prerequisite: SUR 222 (or equivalent)

SUR 322 3cr. (2+2p) Laser Scanning Mapping Technologies (sp)
Perform basic terrestrial & airborne LiDAR scan, LiDAR Technologies and Applications will include ranging technologies such as LiDAR, SAR, and Bathymetry, point cloud data management & extraction, scan registration and processing
Prerequisite: SUR 285
(Need two-three field labs to do terrestrial scans, the rest of the assignments are computer-based)

SUR 328 3cr. **(2+3p)** Construction Surveying & Automation Technologies (sp)

Construction Surveying Principles: conventional and machine controlled. Layout alignments, grades, various infrastructure, buildings. Understand error identification, common quality control checks and blunder identification.
Alignments and station/off set, types of construction layout of infrastructure: roads, bridges, utilities (including subsurface), buildings, industrial; reading and interpreting construction plans, data management, horizontal, vertical and spiral curves, slope staking, machine control basics, applications and data managements. Use of electronic files and liability issues. Layout alignments, grades, various infrastructure, buildings. Ability to understand data integration in automated machine control, work flow processes.
Prerequisites: SUR 222 and (Math 191 or Math 235)

SUR 351 3cr. Spatial Data Adjustment I (sp)
Theory of observations/measurements, random error theory, applications of statistical data analysis in surveying, confidence intervals and statistical testing, propagation of random errors.
Prerequisite: SUR 222 and (Math 191 or Math 235) and (ASTAT 311 or STAT 251) (Fa)
(Need computer based labs only)

ET 355 3cr **(2+2p)** Site & Land Development (sp)
Techniques, methods, and takeoffs for infrastructure layout, site plan design, grading, earthwork, utilities, road construction. Subdivision/Site Development concepts, jurisdictional approvals, existing property considerations. Process for development of land including subdivision platting, topographic surveying, existing infrastructure, subservice utilities, zoning and environmental considerations.
Prerequisite(s): DRFT (143 or 153 or 109) and SUR 222

SUR 361 3cr. **(2+2p)** Geodesy/Geodetic Control Surveying (sp)
Horizontal and vertical control network design and consideration.

Understand ellipsoid, geoid, horizontal and vertical datum, coordinates, precise leveling, astronomic, establishment of state plane zones, understanding reporting. Transform data between geodetic Latitude/Longitude, state plane, ground data, perform geodetic computations, ability to design GPS networks utilizing CORS stations, network adjustments. Perform a control survey, process data, adjust network, and prepare control report with Meta-data.
Prerequisites: SUR 222 and (Math 191 or Math 235)

SUR 451 3cr Spatial Data Adjustment II (fa)
Rigorous analysis of the theory of observations as applied to spatial data, application of least squares adjustments, ability to perform statistical analysis to determine accuracy of final product, constrained/free geospatial data integration, error ellipses, and pre-analysis of spatial data acquisition procedures.
Prerequisite: SUR 351 & Math (280 or 480)
(Need computer based labs only)

SUR 452 3cr (2+2P) Spatial Data Integration and Analysis (sp)
Methodologies of geospatial data acquisition and integration, knowledge of applications the source data is intended for, accuracies of acquired spatial data, types and analysis of coordinate transformation models. Integrating datasets for routing analysis, location study analysis, land management and long range plans as well as existing needs related to connectivity and safety.
Prerequisite: SUR 451
GEOG 585 Advanced Spatial Analysis (lecture and lab): Dr. Chris Brown
(Need computer based labs and three labs for route surveying)

SUR 461 3cr **(2+3p)** GNSS Positioning (fa)
Logistics of GNSS data collection, the GPS signal, codes and biases, error sources, differences between relative and autonomous GNSS positioning, code phase carrier phase, DGPS static and RTK surveys. Geodetic and GPS standards and specifications GNSS data processing, network adjustments, and evaluation of spatial data accuracy practical applications of GNSS
Prerequisites: SUR 361

SUR 464 (3cr.) Legal Principles and Boundary Law II (fa)
ALTA Surveys and Standards, boundary evidence, order of evidence, Subdivision and Platting Law, Mexican and Spanish land grants, water boundaries, sequential and simultaneous conveyances
Prerequisites: SUR 312 (Fa)

SUR 498 3cr Emerging Technology in Geomatics (sp)

Hydrographic/Bathymetric, Altimetry, Space borne Imaging Systems, Mobile Mapping Systems, Mining and Agriculture Surveying Principles, and advanced ranging data acquisition systems.
Prerequisites: senior standards or consent of instruction
(Need computer based labs only)

GEOG 481 4cr. Geographic Information Systems (GIS) Principles and Applications (fa)
Fundamental understanding of GIS software and practical applications for surveying and mapping, land information parcel management, basic geodatabase development.
Prerequisites: GEOG 381 (**or** CNM 10001 or 1006; **or** DACC OECS 146 or 187 or 231)

Math Elective (fa): Math 280 or 480

PHIL 323V 3cr. Engineering Ethics – meets one VWW requirement
The moral legal responsibilities of engineers to clients, employers, the public, and the environment. Topics include criteria for judging when risk is acceptable, the duty to safeguard public health and welfare, conflicts of interest, and whistle-blowing.

Viewing a Wider World – 3cr. students will choose from:
MGT (310Vor 315V or 335V or 360Vor 375Vor 388V) or FIN303V or ECON (337Vor 384V)

BLAW 325 (3cr.) Real Estate Principles and Law I
Real estate law and the fundamental aspects of the real estate purchase transaction and the real estate lease agreement. Topics include real estate brokerage, marketing of real estate, fundamental legal aspects of real estate, present and future interests, air and water rights, methods of transfer, basics of financing and liens, and real estate leases.

IE 451 3cr. Engineering Economy

ET 435 3 cr. Senior Project (sp)
Research project with formal presentations.

Prerequisite: Senior Standing

GEOMATIC Courses with lab components:

- **SUR 222 cr. (2+3p)**
- **SUR 285 3cr**. Precise Digital Mapping (fa) (only one field visit)
- **SUR 322 3cr. (2+2p)** Laser Scanning Mapping Technologies (sp) (~3 labs)
- **SUR 328 3cr. (2+3p)** Construction Surveying & Automation Technologies (sp)
- **ET 355** 3cr **(2+2p)** Site & Land Development (sp) (need DE)
- **SUR 361** 3cr. **(2+2p)** Geodesy/Geodetic Control Surveying (sp)
- **SUR 452** 3cr (**2+2p)** Spatial Data Integration and Analysis (sp) (~3 labs)
- **SUR 461** 3cr **(2+3p)** GNSS Positioning (fa) (~3 labs only)