TOTAL EXAMINATION PROGRAM

PEO Syllabus of Examinations, 2007 Edition

SPACE ENGINEERING

PROFESSIONAL EXAMS – SPECIFIC TO SPACE ENGINEERING

GROUP A

07-Space-A1 Signals and Communications (16-Elec-A3) SEE 22-ELEC-A3 FOR UPDATE

Amplitude and frequency modulation systems: signals, spectra, implementation. Sampling of continuous signals and the Nyquist sampling theorem. Fourier series and transforms, spectral concepts. Discrete signals and systems: the sampling theorem, time and frequency response, the Z-transform. PCM and simple baseband pulse code modulation systems.

07-Space-A2 Electronics (16-Elec-A5) (22-ELEC-A5)

Semiconductor devices; diodes and thyristors. Bipolar and field effect transistors as linear devices and switches. Small signal amplifiers. Operational amplifiers and comparators. Digital circuits and logic families. + CMOS

07-Space-A3 Geodesy and Positioning (18-Geom-A3)

Concepts of geodesy; size and shape of the Earth; geoid and ellipsoid; terrestrial, celestial and orbital coordinate systems; coordinate transformations; computations of positions in three dimensions; computations of positions on the ellipsoid and on a conformal mapping plane; azimuthal, conic and cylindrical projections, UTM and 3TM; Canadian horizontal and vertical datums; height determination. Static and kinematic positioning with the Global Positioning System (GPS). Elements of inertial positioning; time systems; astronomic positioning; VLBI positioning; orbit computations; satellite laser ranging. Horizontal, vertical and three-dimensional networks; pre-analysis and post-analysis; theory of heights; gravimetry; global and local geoid determination; astrogeodetic, gravimetric and combined methods; levelling by GPS and the geoid.

07-Space-A4 Photogrammetry (18-Geom-A4)

Airborne, space and terrestrial data acquisition systems. Metric and non-metric cameras, digital cameras, linear sensors, and non-conventional imagery. Fundamental coordinate systems and mathematical relationships between image, model and object space. Direct and inverse problems of projective and similarity coordinate transformations. Correction of photogrammetric measurements. Geometry of vertical and tilted aerial photographs. The collinearity and coplanarity conditions; analytical space resection and space intersection. Interior and exterior orientation; relative and absolute orientation of single model; stereomodel formation and error analysis. Flight project planning. Multi-image processing, mathematical models for image-triangulation for strip and block adjustment including self calibration and direct georeferencing. Concepts of terrain extraction from airborne sensors. Principles of digital photogrammetry, digital image acquisition, scanning and sampling; resampling, image enhancement; image matching, spatial filtering, stereo-vision techniques; digital rectification and orthorectification and their error analysis.

07-Space-A5 Remote Sensing and Image Analysis (18-Geom-A5)

Basic physical principles of electro-optical, infra-red and microwave remote sensing; space- and air-borne sensor systems, active and passive sensors; properties of digital image data; radiometric processing including correction of instrumental artifacts and atmospheric corrections; geometric corrections and registration. Concepts of terrain extraction from space-borne sensors. Image statistics. Radiometric enhancement

including histogram matching; Fourier representation of image data; image pyramids; geometric enhancement including spatial filtering, edge detection and enhancement; multispectral transformations including IHS, principle component analysis and vegetation indices; overview of remote sensing image interpretation; thematic classification and clustering; supervised classification including minimum distance and maximum likelihood classification; accuracy assessment of classification. Concepts of hyderspectral image analysis.

07-Space-A6 Algorithms & Data Structures (19-Soft-A1)

Fundamental data structures and their associated algorithms. Stacks and queues, trees, tables, lists, arrays, strings, sets; files and access methods. B-trees, multi-key organizations. Searching. Sorting.

Algorithm design techniques, such as divide and conquer, the greedy method, balancing, dynamic programming. Algorithms related to set operations, Graphs, graph algorithms: depth-first and breadth-first search, minimum spanning tree, shortest path. Empirical and theoretical measures of the efficiency of algorithms.

Complexity analysis. Hard problems, NP-completeness, and intractable problems

GROUP B

07-Space-B1 Computer Control and Robotics (17-Comp-B6) (25-COMP-B6)

Discrete-time and quantized data control systems. Z-transform and state space methods. Principles of digital control. Digital controllers and components. Controller software. Industrial and robotic systems. Descriptions of 3D space, geometry of robotics manipulators. Transducers and interfacing. This syllabus requires knowledge of linear systems as described in 98-Elec-A1.

07-Space-B2 Digital Communications Systems (16-Elec-B3) (22-ELEC-B3)

Sampling, A/D conversion, source coding; signal sets, line codes, modulation, optimal reception, demodulation, performance in noisy channels, error detecting and correcting codes. Public Switch Telephone Networks, television standards. Radio communications; link analysis and performance, terrestrial and satellite communications; personal communication networks; cellular telephone networks.

07-Space-B3 Gravity and Magnetic Fields (18-Geol-B10-1)

Theory and quantitative interpretation of the gravity and magnetic fields in geophysical exploration. Interpretation of regional gravity and magnetic maps. Identification of local anomalies. Data acquisition and data reduction for gravimeters and magnetometers. Design and conduct of field surveys. Potential field, Fourier, forward modeling and inversion methods in data interpretation and analysis.

07-Space-B4 Surveying (18-Geom-A1)

Basic principles; instruments and procedures for angle, distance and height measurements; plane coordinate computations such as intersections, resections, traverses; coordinate transformation; simple horizontal and vertical curves; area and volume computations; cross-sections and profiles; setting-out surveys; pre-analysis, design and planning of precise surveys for horizontal and vertical control; principles of

electronic distance and angle measurements; total stations; propagation of EM energy in the atmosphere and its application to EM ranging; theodolite observations and precise positioning systems; sources of errors in angle, distance and precision levelling surveys; influence of atmospheric refraction. Systematic and random errors, design, processing and analysis of angle, distance, and height difference measurements. Route survey and design; surveys for route planning, setting-out and as-built surveys, easement curves, alignment and grade for roads, sewers and pipelines, bridges, buildings, dams, tunnels, mining.

07-Space-B5 Applied Geophysics (18-Geol-A7)

Basic principles, interpretation, and limitations of geophysical methods applied to the exploration for coal, oil and natural gas, minerals, groundwater, and for geotechnical studies of the surface and subsurface. Introduction to electrical, electromagnetic, and magnetotelluric surveys; magnetic and gravity surveys; seismic reflection and refraction surveys; radiometric methods. Introduction to geophysical well logging techniques. Case histories of applications to engineering problems.

07-Space-B6 Satellite Navigation (18-Geom-B2)

Performance requirements, mathematical models, observation methods, processing strategies, uncertainties and other characteristics associated with moving marine, land airborne, and space vehicle positioning, orientation and attitude applications. Description of GPS signal structure and derivation of observables; characteristics of instrumentation; analysis of atmospheric, orbital, random and non-random effects; derivation of mathematical models used for absolute and differential static and kinematic positioning; pre-analysis methods and applications; software considerations; introduction to GPS quality control; static and kinematic survey procedures and operational aspects; integrated GPS-INS systems.