EXAMINATION SYLLABUS

For applicants seeking registration as an

OREGON PROFESSIONAL ENGINEER

in FOREST ENGINEERING

THE PRACTICE OF FOREST ENGINEERING

Through engineering knowledge and specialized knowledge of forest resources, the Professional Forest Engineer serves: 1) to protect the public's health, welfare, safety, and property; 2) as well as the public's mutual interest in the protection of Oregon's forest resource amenities; and 3) to attain the employer's or client's forest resource management objectives. The Professional Forest Engineer applies engineering principles to the solution of forestry problems, including but not limited to:

- Harvesting and logging system design and applications;
- Forest road design and construction;
- Forest and land resource measurements;
- Environmental impact of forest operations; and
- Economic planning and operation of forest production systems

FOREST ENGINEERING EDUCATION AND EXPERIENCE

Beyond fundamentals in the sciences and humanities, the practice of forest engineering draws upon additional disciplines from which the examinee may be tested such as:

- Surveying, Volumes and Road Design;
- Road Structures including Road Stability Analysis;
- Hydrology, Hydraulics, Soil Engineering, and Drainage;
- Logging Mechanics including Vehicle Performance;
- Logging Operations;
- Forest Practices Act Regulations;
- Forest Occupational Safety (Oregon OSHA);
- Transportation System, Planning and Analysis;
- Operations Analysis / Operations Research;
- Engineering Economics;
- Mensuration and Aerial photogrammetry;
- Statistics; and
- Silviculture and Forest Appraisal.

An Outline of the major topic areas covered in forest engineering follows the References section.

EXAMINATION FORMAT

The examination consists of two, four-hour sections; one in the morning, the second in the afternoon after a one-hour lunch break. Both sections contain problems or questions for which the applicant's answers will be evaluated as to a professional quality answer and documented solution. The problem booklet for each section contains twelve (12) problems, from which you will be required to work five (5) problems. Each problem is equally weighted. Thus, the examinee's performance will be evaluated on ten (10) problem solutions in total.

Two Mandatory Questions

There will be two (2) mandatory questions which all examinees must answer, one in each of these topic areas:

- Oregon Forest Practices Act Regulations; and
- Oregon OSHA – Forest Activities

Three Mandatory Topic Area Questions

There will be three (3) mandatory topic areas from which the examinee must select and answer one question from a set of questions for each topic area. These mandatory topic – examinee selected questions will be, broadly, in these topic areas:

- Surveying and Road Design;
- Logging Mechanics; and
- Hydrology and Drainage

Additional Examinee Selected Questions

The remaining questions to be answered in a section are selected by the examinee, to attain the required five (5) worked problems in each section. These additional questions may be selected from any topic area.

EXAMINATION – OTHER INFORMATION

This is an open book examination. For permitted materials, see https://www.oregon.gov/osbeels/Documents/Form/201809_PermittedExamMaterials.pdf

Calculations and other solutions must show adequate professional documentation of the solution steps and techniques to receive credit.

REFERENCES

Following is a list of references in alphabetical order by author. Sequence does not indicate importance. No endorsement is intended, and other references may provide equivalent coverage. A number of the references are dated but still contain relevant and useful information. Web links are provided, but they can change without notice.

American Wood Council (AWC). National Design Specification (NDS) for Wood Construction. 2018 or later. 2024 edition available at https://awc.org/publications/2024-nds/

American Iron & Steel Inst. 2007. Handbook of Steel Drainage & Highway Construction Products. American Iron & Steel Institute. Wash. D.C. 1994. {also available from the Corrugated Steel Pipe Institute at: http://www.cspi.ca/node/158 }

B.C. Ministry of Forests. 2002. Forest road engineering guidebook. Forest Practices Code of British Columbia Guidebook. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/land-based-investment/forests-for-tomorrow/fre.pdf

Bell, John. 2015. Timber Cruising and Log Scaling. Oregon State University Bookstore, Corvallis, Oregon. https://www.johnbellandassociates.com/

BLM. Manual of Surveying Instructions For the Survey of the Public Lands of the United States, United States Department of the Interior Bureau of Land Management Cadastral Survey, 2009 and 1973. https://www.blm.gov/or/gis/geoscience/cadastralmanuals.php

Brooks, Ken. 2013. Hydrology and Management of Watersheds. John Wiley and Sons.

Burroughs, E. G. Chalfont, and M. Townsend. 1976. Slope Stability in Road Construction. USDI Bureau of Land Management. 102 p., Portland, OR. Available at Amazon.com.

Caterpillar Inc. Caterpillar Performance Handbook. Caterpillar Tractor Co., Peoria, IL or from local dealers. 2448 p. (49th edition available online at https://www.michigancat.com/parts-service/cat-performance-handbook/Caterpillar.com)

Conway, Steve. 1982. Logging Practices, Rev. ed. Miller-Freeman Publ. Inc., San Francisco. 432 p. Available at Amazon.com.

Das, Braja M. Principles of Geotechnical Engineering. Seventh edition. 2009. Cengage Learning. {the 4th through the 7th ed. are all adequate references}

Fitch, J. 1994. Motor Truck Engineering Handbook. Society of Automotive Engineers. Warrendale, PA. 443 pages.

Ghilani, C.D. and P. R. Wolf. 2011. Elementary Surveying: An Introduction to Geomatics, 13/E. Pearson Prentice Hall. 960 pp.

Kiser, J. D. 2010. Surveying for Forestry and the Natural Resources. 2nd edition. John Bell and Assoc. Corvallis, Oregon. 276 pages. https://www.johnbellandassociates.com/

Klemperer, W., S. Bullard, S. Grado, M. Measells, and T. Straka. 2023, Forest Resource Economics and Finance. Stephen F. Austin Press.

Mac Donald, A.J. 1999. Harvesting Systems and Equipment in British Columbia. FERIC Handbook, ISSN 0701-8355; no. HB-12. Available at https://www.for.gov.bc.ca/hfd/pubs/docs/sil/Sil468.pdf

Mannering, Fred L. and Washburn, Scott S. 2013. Highway Engineering and Traffic Analysis, 5th ed. John Wiley and Sons, Inc. 336 pages

Meyer, C.F. and D.W. Gibson. 1980. Route Surveying and Design. 5th ed. Harper & Row publishers, NY.

Oregon Department of Transportation, Highway Division. Hydraulics Manual. Current issue available at http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/hyd_manual_info.shtml#Hydraulics_Manual.

Oregon Department of Forestry, current issue (which incorporates Private Forest Accord changes effective January 2024). Oregon Forest Practice Rules and Statute. Rev. periodically. Available from Oregon State Department of Forestry field offices and headquarters, Salem.

Oregon Department of Forestry, Technical Notes Nos. 2 and 6. Landslides and public safety. https://www.oregon.gov/odf/Documents/workingforests/HighLandslideHazardLocationsTechNote2.pdf
https://www.oregon.gov/odf/Documents/workingforests/LandslideImpactRatingTechNote6.pdf

Oregon Occupational Safety and Health Administration. Division 7. Forest Activities Rules.. Division of Consumer and Business Services. State of Oregon. Salem, Oregon (latest edition) https://osha.oregon.gov/rules/final/pages/division-7.aspx

Paine, D.P. and J. D. Kiser. 2012. Aerial Photography and Image Interpretation (3rd ed.). John Wiley, Inc. New York. 632 pages.

Sessions, John. Logging Mechanics, current issue available electronically from Department of Forest Engineering, Resources, and Management, College of Forestry, Oregon State University or john.sessions@oregonstate.edu. 229 p.

Studier, Donald D. & Virgil W. Binkley. 1974. Cable Logging Systems. Division of timber Management, Forest Service Region 6, USDA.
https://ia801305.us.archive.org/7/items/CAT76674137/CAT76674137.pdf

Union Wire Rope User's Handbook or equivalent. Catalog of tables, data, and helpful information.
https://www.unionrope.com/Portals/0/Documents/Technical/Wire-Rope-Basics/wire-rope-handbook.pdf

Wenger, Karl F. 1984. Forestry Handbook. 2nd ed. John Wiley & sons, NY. 1335 p.

Worksafe BC., Cable Yarding Systems Handbook, current edition available online.
https://www.worksafebc.com/en/resources/health-safety/books-guides/cable-yarding-systems-handbook?lang=en

OUTLINE For MAJOR TOPIC AREAS

1. **Surveying**
    a. Traversing
        i. Stationing
        ii. Closure
        iii. Departure and Latitude computations
        iv. Coordinate computations
        v. Interior and exterior angle computations
    b. Coordinate Plane Geometry
    c. Horizontal Curves
        i. Curve geometry
        ii. Curve stationing
        iii. Design elements
            1. Sight distance
                a. Vehicle considerations
                b. Terrain considerations
            2. Radius design
                a. Vehicle considerations
                b. Terrain considerations
    d. Vertical Curves
        i. Curve geometry
        ii. Curve stationing
        iii. Design elements
            1. Sight distance
                a. Vehicle considerations
                b. Terrain considerations
            2. Radius design
                a. Vehicle considerations
                b. Terrain considerations
    e. Earthwork
        i. Cut/Fill computations
        ii. Slope staking
        iii. Shrink Swell of earth materials
        iv. Mass haul diagrams

    f. Public Land Survey in Oregon
        i. Principles
        ii. Procedures

2. **Logging Mechanics**
    a. Powertrains
        i. Torque, power, fuel consumption
    b. Truck transportation
        i. Uphill and downhill gradeability
        ii. Off-tracking of log trucks and trailer combinations
    c. Off-road vehicles
        i. Maximum speeds and loads for forwarders and skidders
        ii. Line tensions and speeds for tethered forwarders, skidders
        iii. Mobility of tethered harvesters and feller-bunchers
    d. Cable systems
        i. Maximum log loads and speeds for live, standing, running skylines
        ii. Minimum tail tree and intermediate support tree sizes
        iii. Guyline tensions
        iv. Mobile anchor and deadman design
    e. Loader and Yoader stability

3. **Safety Regulations and Safe Practices**
   Reference; https://osha.oregon.gov/OSHARules/div7/div7.pdf
    a. 437-007-0003 Scope of Rules & 437-007-0004 Applicability of Rules.
        i. Definitions
            1. Competent person
            2. Experienced person
            3. In the clear
            4. Potential failure zone
            5. Safety factor
            6. Stability (machine or vehicle)
        ii. 437-007-0110 Supervisory Responsibilities
        iii. 437-007-0140 Training.
        iv. 437-007-0200 Site Planning and Implementation.
        v. 437-007-0225 Working Near Unstable Objects and Danger Trees
        vi. 437-007-0405 Chain Saws.
        vii. 437-007-0500 Roads. And Bridges
    b. Rigging and Rigging Practices
        i. Chokers and Straps
        ii. Guylines – General Requirements / Tail Tree Guying
    c. Cutting Trees, pre-commercial thinning and slashing
    d. Cable Yarding & Ground Skidding
    e. Loading and Transportation
    f. Appendix-7B

4. **Hydrology**
    a. Watershed Analysis
        i. Peak flow probabilities
        ii. Interpretation of hydrographs
    b. Structures
        i. Calculation of open channel and pipe flow
        ii. Culvert design
        iii. Streambed simulation
        iv. Bridge foundation inspection

5. **Harvest Planning / Forest Operations**
    a. Average yarding distance
    b. Logging and transport productivity and costs
    c. Logging cost appraisal
    d. Optimal road density
    e. Bid evaluations
    f. Engineering economics
    g. Breakeven analysis
    h. Optimal bucking
    i. Network analysis
    j. Road construction/reconstruction
    k. Road management
    l. Wet season/dry season planning
    m. Rock Management

6. **Oregon Department of Forestry Regulations**
    a. Landslides and Public Safety (OAR Division 623)
        i. High Landslide Hazard Location criteria
        ii. Roads or residence within Further Review Area
        iii. Channelized debris flow per Technical Note 2 and 6.
        iv. Determination of Downslope Public Safety Risk
    b. Forest Roads (OAR Division 625)
        i. Culvert criteria for fills over 15’
        ii. Water crossing structures
        iii. Wet weather road use
        iv. Critical roads location
    c. Harvesting (OAR Division 630)
        i. Harvesting on High Landslide Hazard Locations and other steep slopes
        ii. Yarding near waters of the state
    d. Water protection (OAR Division 643)
        i. Vegetation retention requirements

7. Soil Engineering

a. Soil Phase Relationships and Compaction
    i. Manipulating phase relationships
    ii. Moisture content-dry unit weight compaction relationships (proctor compaction curves)
    iii. Estimating quantities of earthworks
b. Groundwater hydraulics – Darcy's Law
c. Mohr's Circle
    i. The pole method
    ii. Mohr-Coulomb Failure Criteria
d. Retaining Wall Design
    i. Gravity Walls
    ii. Reinforced soil walls
e. Slope Stability
    i. Free-body diagrams, static equilibrium
    ii. Infinite Slope
    iii. Planar Wedge
    iv. Bishop's Method
    v. Rock buttress design