Course title: Geoinformatics for land resources			
Course code: NRG 182	**No. of credits:** 3	**L-T-P:** 16-10-38	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Natural and Applied Sciences			
Course coordinator(s): Dr. Ayushi Vijhani	**Course instructor(s):** Dr. B.K. Bhadra		
Contact details: ayushi.vijhani@terisas.ac.in			
Course type: Elective	**Course offered in:** Semester 3		

Course description

This course is designed for students to learn applications of geospatial technology for land resources. The course is designed to quantify different landscape elements using remote sensing. It also introduces mapping of agriculture, forest, soil and minerals using remote sensing and GIS.

Course objectives:

1. To gain broad understanding of the geospatial approaches for detecting and characterizing landscape pattern and the causes of landscape pattern
2. To study utility of geospatial technology for agriculture, forest, soil and minerals detection

Course content (max 15)

Module	Topic	L	T	P
1.	Introduction: Landscape, landscape characterization, patterns and changes, Concepts of landscape Elements and quantification analysis	4		
2.	Quantification of landscape using landscape metrics and remote sensing, Scale issues in landscape observation,	2		
3.	Applications of Geoinformatics (Case studies): land use/land cover mapping, vegetation mapping: Forest type, density and biomass assessment, Change detection, crop type, crop stress due to disaster, habitat suitability mapping	2	3	
4.	Introduction to soils, soil formation models/processes, soil profile, soil classification, spectral reflectance of soil, models of radiation scattered by soil, factors affecting soil spectra, soil mapping	4	4	
5.	Spectroscopy; emission and reflectance spectra, Spectroscopic processes, electronic and vibrational processes, spectral library of minerals; silicates, carbonates, sulphides, arsenates, etc and spectral library of rocks; igneous, sedimentary and metamorphic rocks, alteration minerals	4	3	
	LABS			
1.	Defining Landscape			2
2.	Quantifying patch mosaic: landscape metrics using FragStats			4
3.	Quantifying point and pattern in landscape			2

4.	**Group project:** This will be hands-on training for students. Students will do group project with group size of 2-3 on relevant topics taught in the course			30
	Total	**16**	**10**	**38**

Evaluation criteria:

- Assignments/Tutorials: 20% (All learning outcomes)
- Minor test 1 [Module 1, 2, 3]: 20% (Learning outcome 1 and2)
- Minor test 2 [Module 4, 5]: 20% (Learning outcome 3 and4)
- Concept Note for research project:10%

  (a) Title:5%
  (b) Introduction:15%
  (c) Literature review: 20%
  (d) Aim and objectives, research questions:25%
  (e) Data and method:15%
  (f) Potential outcomes:15%
  (g) References:5%

- Final Presentation:10%

  (a) Defining the problem (10%)
  (b) Objectives are framed to address the problem (10%)
  (c) Methodology addresses the issue (15%)
  (d) Results orient towards the problem (10%)
  (e) Appropriate findings (15%)
  (f) Presentation (formatting/style/clarity) (10%)
  (g) Viva (30%)

- Final Report:20%

a) Abstract (clarity and comprehensiveness)(5%)
b) Introduction (scientific background and rationale of study is properly stated, statements are referenced properly)(15%)
c) Literature review (Structure and logic of argument, statements are properly referenced) (15%)
d) Objectives (Logic of argumentation, justification of hypothesis/research questions, Link to actual scientific knowledge)(15%)
e) Material and method (Choice of methodology and their appropriate application Structure, link to objectives, Referencing and use of methodology outlined in literature) (15%)
f) Results (Completeness and clarity, Structure, link to objectives, Tables and figures and their link to the text)(15%)

g) Discussion and Conclusion (Linkage with previous sections, clarity in findings from the study and based on literature, proper interpretation, understanding of limitation of study) (15%)
h) List of references (proper formatting) (5%)

Learning outcomes (Connect with the evaluation criteria mentioned above)

The student will be able to

1. Able to apply different landscape metrics to quantify land scape pattern
2. Use geospatial technology for vegetation mapping
3. Understand spectral properties of soil and mineral geological applications
4. Apply Advanced techniques for soil and mineral mapping
5. Ability to conceptualize and perform a research project

Pedagogical approach:

Lectures, Lab exercises, Tutorials

Course Reading Materials (* = compulsory readings)

Module 1:

Gergel, Sarah E., and Monica G. Turner, eds. *Learning landscape ecology: a practical guide to concepts and techniques*. Springer, 2017.

Turner, M. G., Gardner, R. H., O'neill, R. V., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape ecology in theory and practice* (Vol. 401). New York: Springer.

Module 2:

Gergel, Sarah E., and Monica G. Turner, eds. *Learning landscape ecology: a practical guide to concepts and techniques*. Springer, 2017.

Turner, M. G., Gardner, R. H., O'neill, R. V., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape ecology in theory and practice* (Vol. 401). New York: Springer.

Module 3:

Gergel, Sarah E., and Monica G. Turner, eds. *Learning landscape ecology: a practical guide to concepts and techniques*. Springer, 2017.

Turner, M. G., Gardner, R. H., O'neill, R. V., Gardner, R. H., & O'Neill, R. V. (2001). *Landscape ecology in theory and practice* (Vol. 401). New York: Springer.

Module 4:

Wulder, M. A., & Franklin, S. E. (Eds.). (2012). *Remote sensing of forest environments: concepts and case studies*. Springer Science & Business Media.

Steven, M. D., & Clark, J. A. (Eds.). (2013). *Applications of remote sensing in agriculture*. Elsevier.

Module 5:

Diwedi, R.S. (2017). *Remote Sensing of Soils*. Springer

Module 6:

Prost, G. L. (2002). *Remote sensing for geologists. A guide to image interpretation*. CRC Press

Borengasser,M.,Hungate,W.S.andWatkins,R.,2007.*Hyperspectralremotesensing:principles and applications*. CRC press.

Advanced Reading Material Lu, D., Chen, Q., Wang, G., Liu, L., Li, G., & Moran, E. (2016). A survey of remote sensing- based aboveground biomass estimation methods in forest ecosystems. *International Journal of Digital Earth*, *9*(1), 63-105. White, J. C., Coops, N. C., Wulder, M. A., Vastaranta, M., Hilker, T., & Tompalski, P. (2016). Remote sensing technologies for enhancing forest inventories: A review. *Canadian Journal of Remote Sensing*, *42*(5), 619-641. Tang, L., & Shao, G. (2015). Drone remote sensing for forestry research and practices. *Journal of Forestry Research*, *26*(4), 791-797. Healey,S.P.,Cohen,W.B.,Yang,Z.,Brewer,C.K.,Brooks,E.B.,Gorelick,N.,...&Loveland, T. R. (2018). Mapping forest change using stacked generalization: An ensemble approach. *Remote Sensing of Environment*, *204*,717-728. Cohen, W. B., Yang, Z., Healey, S. P., Kennedy, R. E., & Gorelick, N. (2018). A LandTrendr multispectral ensemble for forest disturbance detection. *Remote Sensing of Environment*, *205*, 131-140. Khanal, S., Fulton, J., & Shearer, S. (2017). An overview of current and potential applications of thermal remote sensing in precision agriculture. *Computers and Electronics in Agriculture*, *139*, 22-32. Gago, J., Douthe, C., Coopman, R., Gallego, P., Ribas-Carbo, M., Flexas, J., ... & Medrano, H. (2015). UAVs challenge to assess water stress for sustainable agriculture. *Agricultural water management*, *153*, 9-19. Mulder, V.L., De Bruin, S., Schaepman, M.E. and Mayr, T.R., 2011. The use of remote sensing in soil and terrain mapping—A review. *Geoderma*, *162*(1-2), pp.1-19. Metternicht, G.I. and Zinck, J.A., 2003. Remote sensing of soil salinity: potentials and constraints. *Remote sensing of Environment*, *85*(1), pp.1-20. Clark, R.N. and Roush, T.L., 1984. Reflectance spectroscopy: Quantitative analysis techniques for remote sensing applications. *Journal of Geophysical Research: Solid Earth*, *89*(B7), 6329- 6340. Van der Meer, F.D., Van der Werff, H.M., Van Ruitenbeek, F.J., Hecker, C.A., Bakker, W.H., Noomen, M.F., Van Der Meijde, M., Carranza, E.J.M., De Smeth, J.B. and Woldai, T., 2012. Multi-and hyperspectral geologic remote sensing: A review. *International Journal of Applied Earth Observation and Geoinformation*, *14*(1), pp.112-128. Cracknell, M.J. and Reading, A.M., 2014. Geological mapping using remote sensing data: A comparison of five machine learning algorithms, their response to variations in the spatial distribution of training data and the use of explicit spatial information. *Computers & Geosciences*, *63*,pp.22-33. **Recommended journals for reference** Remote Sensing of Environment Computer andGeosciences Geoderma
Additional information (if any)
Student responsibilities

Course reviewers:

Dr. Benidhar Deshmukh, IGNOU, New Delhi

Dr. P. L. N Raju, NESAC