M.A./ M.Sc. (Two Years Degree Program)
III Semester
Subject-Geography

Code of the Course	GEG9106P
Title of the Course	DIGITAL IMAGE PROCESSING FOR GEOGRAPHICAL APPLICATIONS
Qualification Level of the Course	NHEQF Level 6.5
Credit of the course	4
Type of the course	Discipline Specific Elective Practical Course in Geography
Delivery type of the Course	Practical (80+40). The 80 hours for content delivery include hands-on exercises, and 40 hours of diagnostic assessment, formative assessment, and subject/class activity, problem solving.
Pre-requisites	Fundamental understanding of geographical concepts and phenomena.
Co-requisites	Basic working knowledge of computer.
Objectives of the course	• To learn the various steps of image processing and information extraction workflow from satellite imageries. • To learn the various advanced techniques of GIS based analysis for applied research, decision making and planning. • To develop working skills in various open source and proprietary image processing and GIS softwares - ArcGIS, Erdas Imagine, ENVI, ILWIS, QGIS, SAGA, etc. • To produce professionals with an edge as researchers trained in state-of-the-art technology with sound theoretical base; planners and decision makers with thorough understanding of the capabilities and tools of geospatial technology; and avenues for self-employment as technical/geo-spatial consultants.
Learning outcomes	• Students will be trained in state-of-the-art geospatial technology. • Students will be introduced to the fundamental concepts of image processing. • Students will develop working skills in open source and proprietary GIS softwares. • Students will have awareness regarding the potential of geospatial technology in decision making and planning. • Students will foster technical skills for employment opportunities as GIS consultant/analyst/project associates/entrepreneurs across private and public sector.

	Syllabus **पाठ्यक्रम**
UNIT - I	Image statistics, feature space. Radiometric errors & corrections - Image normalization, Dark Object Subtraction (DOS), Relative and Absolute Corrections. Filtering techniques. छवि सांख्यिकी, वस्तु क्षेत्र। रेडियोमेट्रिक त्रुटियाँ और संशोधन - छवि नॉर्मलाइजेशन, डार्क ऑब्जेक्ट सबट्रैक्शन (डीओएस), सापेक्ष और पूर्ण संशोधन। फ़िल्टरिंग तकनीकें।
UNIT - II	Band ratioing- Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Built up Index (NDBI) and Normalized Difference Soil Index (NDSI). बैंड अनुपात - नॉर्मलाइज्ड डिफ़रेंस वेजिटेशन इंडेक्स (एनडीवीआई), नॉर्मलाइज्ड डिफ़रेंस वाटर इंडेक्स (एनडीडब्ल्यूआई), नॉर्मलाइज्ड डिफ़रेंस बिल्ट अप इंडेक्स (एनडीबीआई) और नॉर्मलाइज्ड डिफ़रेंस सोइल इंडेक्स (एनडीएसआई)।
UNIT - III	Unsupervised classification- Minimum distance, K-Means approach, ISODATA clustering. Supervised classification - training, signature evaluation, parametric (Maximum Likelihood) and non-parametric classifiers (Parallelepiped, Minimum Distance). अपर्यवेक्षित वर्गीकरण - न्यूनतम दूरी, के-मीन्स विधि, आईसोडेटा क्लस्टरिंग। पर्यवेक्षित वर्गीकरण - प्रशिक्षण, सिग्नेचर मूल्यांकन, पैरामेट्रिक (अधिकतम संभावना) और गैर-पैरामेट्रिक वर्गीकारक (सममित स्थैतिज, न्यूनतम दूरी)।
UNIT - IV	Fuzzy Classification. Accuracy assessment - overall, user's & producer's accuracy. Kappa coefficient. फ़ज़ी वर्गीकरण। शुद्धता मूल्यांकन - समग्र, उपयोगकर्ता की शुद्धता और उत्पादक की शुद्धता। कापा गुणांक।
UNIT - V	Image Fusion techniques – error evaluation Change detection: considerations, Binary change detection algorithms and Thematic change detection algorithms. छवि विलयन तकनीकें - त्रुटि मूल्यांकन। परिवर्तन का पता लगाना: विचाराधीन तथ्य, द्वि-आधारी परिवर्तन पहचान प्रक्रियाएँ और विषयगत परिवर्तन पहचान प्रक्रियाएँ।
Practical Exercises **(15 exercises)**	1. Calculate image statistics using satellite data. (1 exercise) 2. Draw feature space using satellite data. (1 exercise) 3. Radiometric correction of satellite images – DOS. (1 exercise) 4. Image enhancement – Filtering. (1 exercise) 5. Image ratioing - Generation and interpretation of NDVI image. (1 exercise) 6. Image ratioing - Generation and interpretation of NDWI image. (1 exercise) 7. Image ratioing - Generation and interpretation of NDBI image. (1 exercise) 8. Image ratioing - Generation and interpretation of NDSI image. (1 exercise) 9. Thematic map generation using unsupervised classification. (1 exercise)

	10. Thematic map generation using supervised classification. (1 exercise) 11. Accuracy assessment – Computation of Overall accuracy, User's accuracy, Producer's accuracy, Kappa Coefficient. (3 exercises) 12. Change detection (1 exercise) and Computation of change in area. (1 exercise) Exercises will be implemented in ERDAS, ENVI, Illwis, QGIS, SAGA GIS, ArcGIS or any other DIP and GIS Software as per availability.
	Suggested Readings सहायक ग्रन्थ / सामग्री
Text Books	• Lillesand, T.M. and Kiefer, R.W., 2015. *Remote Sensing and Image Interpretation*. 7th Edition, Wiley, New York. • Chang, Kang-tsung, 2003. *Introduction to Geographical Information Systems*. Tata McGraw Hill Publ. Co., New Delhi • Chauniyal, D.D., 2004. *Remote Sensing and Geographical Information Systems* (**in Hindi)**, Sharda Pustak Bhawan, Allahabad • American Society of photogrammetry: Manual of remote sensing, ASP, Falls Church, VA, 1983.
Reference Books	• Jensen, J.R., 2005. *Introductory Digital Image Processing: A Remote Sensing Perspective*. 3rd Edition, Prentice Hall, Upper Saddle River, 505-512. • Lo, C.P. and Yeung, Albert K. W., 2002. *Concepts and Techniques of Geographic Information Systems*. Prentice Hall of India, New Delhi. • Longley, P., Goodchild, M.F., Maguire, D. and Rhind, D., 1999. *Geographic Information Systems. Principles, Techniques, Management, Applications*. John Wiley, New York. • Reddy, M. Anji, 2001. *Textbook of Remote Sensing and Geographic Information Systems*. B. S. Publs., Hyderabad. • Vyas P.R., 2014. *Remote Sensing and Geographical Information System: Basics and Applications*, Rawat Publications, Jaipur.
Suggested E-resources	• *Ebook on Remote Sensing Applications,* www.**nrsc**.gov.in/ Learning_Centre_**EBook**.html • *E-Tutorial on Fundamentals of Remote Sensing*, Canada Centre for Mapping and Earth Observation, Natural Resources Canada, accessible at http://www.nrcan.gc.ca/earth-sciences/geomatics • www.qgistutorials.com • http://www.pasda.psu.edu/tutorials/gisbasics.asp • https://earth.google.com • bhuvan.nrsc.gov.in • india-wris.nrsc.gov.in • https://openstreetmap.org