



10, INSTITUTIONAL AREA, VASANT KUNJ, NEW DELHI

44th MEETING OF THE ACADEMIC COUNCIL

MINUTES OF THE FORTY FOURTH MEETING OF THE ACADEMIC COUNCIL HELD ON 13 NOVEMBER, 2018 AT 11.00 A.M.

PRESENT

The following members of the Academic Council attended the meeting:

Members

Prof Leena Srivastava
Prof Rajiv Seth
Prof Arun Kansal
Prof TC Kandpal
Prof Vivek Suneja
Dr J K Garg
Mr Rakesh Mehrotra
Prof Manipadma Datta
Prof Anandita Singh
Prof Atul Kumar
Dr Sapna A Narula
Dr Vishnu Konoorillam
Dr Nandan Nawn
Dr Sudipta Chatterjee
Dr Chaithanya Madhurantakam
Dr Smriti Das
Dr Vinay Shankar P Sinha
Dr Sukanya Das
Capt. Pradeep Kumar Padhy (Retd.) Secretary

Chairperson

Invitees

Dr Ritika Mahajan
Dr Neeti

Prof Malathi Lakshmikumaran, Prof Anubha Kaushik, Prof Prateek Sharma, Prof Ramakrishna Sitaraman and Dr Akash Sondhi could not attend the meeting.

The Chairperson welcomed the new members and placed on record the contributions made by the outgoing members.

Item No. 1. To confirm the minutes of the forty third meeting of the Academic Council held on 12 June 2018. The Registrar informed that the minutes of the 43rd meeting of the Academic Council, held on 12 June 2018, were circulated to the members and no comments have been received so far.

TS/AC/44.1.1The Council resolved that the minutes of the meeting of the 43rd Academic Council held on 12 June 2018 be confirmed.

Action Taken Report

Item No.2(i) A report on the structured feedback from various stakeholders in respect of the revised structure of MBA (Business Sustainability). A report on structured feedback for MBA (Business Sustainability) programme collected from different stakeholders including academia, industry, alumni and students was presented by Dr Ritika Mahajan on behalf of the Department of Business and Sustainability. Key findings from the survey for revision of the curriculum, and improving the pedagogy were presented. These findings form the basis of changes made in the MBA (BS) program from January 2018 onward. A snapshot of the changes was also presented.

TS/AC/44.2(i).The council made following recommendations: -

- To reconsider total credits for the program to provide an opportunity to the students to opt for open electives.
- To consider increasing the number of feedbacks from peers and employers in such stakeholder surveys in future, not just for MBA (BS) but as a principle.
- To take into account continuous engagement of the faculty members with different stakeholders for revising the program structure and curriculum.
- Segmentation, targeting and positioning of the MBA (Business Sustainability) program for big multinational companies and corporates.

Item 2(ii) A report on the structured feedback from various stakeholders in respect of the revised structure of MSc Economics: A report on the structured feedback sought from the stakeholders on the matter of modification in the structure of the MSc Economics programme was placed on the table by Dr Nandan Nawn. The salient points from the report were presented by Head of the Department of Policy Studies and Programme Coordinator, MSc Economics. It was emphasized that during the restructuring the features which form the backbone of the programme were given priority and they are: to include all the core courses offered in competing programmes from institutions elsewhere in the city of Delhi; Master's Thesis; and specialization of Environment and Resource Economics. He informed that these have resulted in limiting the credit for optional Courses only to 8. Prof. Kandpal commented that, similar to MBA (BS), participation of peers and employers in the survey is low and this may be given due importance in such surveys in the future.

The Academic Council noted the action taken.

Item No.3: To consider and approve the outlines of a few courses proposed by Department of Business and Sustainability. The outlines of a few courses proposed by the Department of Business and Sustainability were placed before the Council for

approval. A presentation was given by Dr Ritika Mahajan regarding the proposed courses and following which a detailed discussion was held. The following suggestions were provided by the members: -

(i) **Management Information System:-**

- To reconsider the content and distribution of hours in the course as it seems quite extensive to be covered in 28 hours.
- To include the topic of ‘Cyber Security’.
- More focus on practical applications, less on theory.
- More focus on the last module.
- Some hours to be devoted to Practicals/Tutorials for the last module.

(ii) **Legal Aspects of Business:-**

- Introduce a module on Introduction to Social and Environmental Laws.
- Retitle ‘Module 1’ as it also includes Fundamental right to carry on business-constitutional aspects.
- Provide editions of the books.
- Reconsider evaluation criteria and propose at least three Tests- Test 1, Test 2, and Test 3
- Total credits be reduced from 3 to 2. The objective is to trim the course and make it more focused. There could be a different course on social and environmental laws.
- ‘Fundamental right to carry on business’ be removed.
- In case of legal subjects, books are always to be of latest edition.

TS/AC/44.3.1 The Council resolved that the Course outline of the following courses submitted by Dept of Business and Sustainability placed at Annexure 1 be accepted and approved as amended: -

Ser No.	Course	Type	Cr
(i)	Management Information System	Core	2
(ii)	Legal Aspects of Business	Core	2

Item No.4: To consider and approve the outline of a few courses for MSc (Geoinformatics) Programme. The outlines of the few courses proposed by the Department of MSc (Geoinformatics) were presented by Dr Neeti. A detailed discussion was held and following suggestions were made: -

- (i) In the Photogrammetry course, Satellite Photogrammetry and satellite (e.g., Cartosat) based data lab assignment needs to be added.
- (ii) Prof. Kandpal suggested that the following aspects regarding course outlines be considered.
 - a) Typo errors to be checked.
 - b) LTP distribution structure to be looked at.

- c) Writing the specific name of course coordinator and instructor can be omitted.
- d) Semester in which course offered need not be mentioned.
- e) Sub-division of time for topics would be enough.
- f) Evaluation of two tests not enough.
- g) Specific material details can be deleted.

TS/AC/44.4.1 The Council resolved that the Course outline of following courses in MSc (Geoinformatics) placed at Annexure 2 be accepted and approved as amended: -

Ser No.	Course	Type	Cr
i	Photogrammetry (3)	Core	3
ii	Digital Image Processing and Information Extraction (4)	Core	4
iii	Spatial Data Modelling and its Applications (4)	Core	4
iv	Programming in Geoinformatics (3)	Core	3
v	Law and Policy for Maps and Remote Sensing (2)	Core	2

Item No 5(a). Convocation 2018. The Registrar briefed the Council about the 11th Convocation of the TERI School of Advanced Studies to be held on 15th Nov 2018. He intimated that Shri Adi Godrej, Chairperson, Godrej Group would be the Chief Guest at the Convocation and mentioned that a total of 01 PG Diploma, 249 masters and 12 doctoral students would receive their diploma/degrees. He also informed the council that Mr Adi Godrej would be conferred the degree of Doctor of Philosophy, honoris causa.

The Council noted the matter.

Item No 5(b) NAAC Accreditation. The Registrar informed the Council about the 2nd Cycle accreditation by the NAAC. He further stated that the University has been awarded with B++ grading in its 2nd Cycle accreditation by NAAC. The Chair informed that an appeal is being submitted to NAAC by 02nd December 2018 for reassessment of the grades.

The Council agreed and recommended that an appeal for reassessment of GPA be submitted.

Item No 6. Extension of maximum period for submission of Thesis. The Registrar informed the Council that a doctoral candidate is expected to submit his/her thesis within five years from the date of registration and the period might be extended by Academic Council as a special case. He stated that Ms. Sneha Singh (1036 RBB) who had registered for PhD programme in Department of Biotechnology completed her five-year period in September 2017 and was given one-year extension by AC upto 28 Sep 2018. He submitted that the DRC has recommended a post facto sanction of six months for the submission of the thesis, for consideration of Academic Council.

TU/AC/44.6.1 The Council resolved that six months extension be accorded to Ms Sneha Singh.

Item No.7. Independent Study. Dr. Nandan Nawn informed that the ‘Independent Study’ was discussed internally in the executive committee of the Academic Council and a process of grading the same had been worked out. He stated as suggested by the EC, a DPEC consisting of one representative from each department had been constituted at University level to supervise the PhD programme issues. He stated that the University offers ‘Independent Study’ to PhD Students like all other courses and it had been decided that the its would be approved by the DPEC provided the method of evaluation was in consonance with the assessment criteria. He sought the approval of the Academic Council for the process recommended by the EC. Members opined that ‘Independent Study’ would vary from student to student and if a PhD student had to complete core credit then s/he should be allowed to do a course from the list of courses, as decided by the SRC. It was felt that if a new topic had to be decided for ‘Independent Study’ then there would be grey areas in respect of course contents, performance evaluation modalities etc. which would have to be taken care of. Members opined that ‘Independent Study’ should not be offered to PhD students.

TS/AC/44.6.1The Council resolved that ‘Independent Study’ will not be offered to doctoral students.

There being no other items for discussion, the meeting ended with vote of thanks to all present.

Sd/
Capt Pradeep Kumar Padhy (retd.)
Registrar

Enclosures:-
Annexure 1
Annexure 2

Distribution: -
Electronic Copy:
1. Vice Chancellor, TERI School of Advanced Studies
2. All members of Academic Council
3. Website

Printed Copy:
Registrar Office

Annexure 1

(Refer to TS/AC/44.3.1)

Course title: Management Information System				
Course code: PPM 171	No. of credits: 2	L-T-P distribution: 22-6-0	Learning hours: 28	
Pre-requisite course code and title (if any):				
Department: Department of Business & Sustainability				
Course coordinator (s)			Course instructor (s):	
Contact details:				
Course type	Core	Course offered in: Semester 2		
Course description The objective of this course is to introduce the students to the Management Information System (MIS) and its application in organizations. The course would expose the students to the managerial issues relating to information systems and help them identify and evaluate various options.				
Course objectives				
<ul style="list-style-type: none"> • To provide students an understanding about the the usage of Information Systems in management • To make them familiar with activities that are undertaken for acquiring an Information System in an organization • To make them aware of various Information System solutions like ERP, CRM, Data warehouses and the issues in successful implementation of these technology solutions in any organization 				
Course content				
Module	Topic	L	T	P
1.	Introduction Meaning and Role of Information Systems, Constituents, and Characteristics of MIS	2	0	0
2.	Classification of Information Systems Operations Support Systems, Management Support Systems, Expert Systems, Decision Support System, and Knowledge Management Systems	2	0	0
3.	Planning, Implementation and Maintenance of MIS Identification of Applications, Business System Planning, Critical Success Factors, Nolan Stage Model in MIS, System Implementation, Maintenance, and Risks	4	0	0
4.	Enterprise Systems Enterprise Data Warehousing, Enterprise Resource Management Systems, Supply Chain Management, Customer Relationship Management; Developing Business Intelligence from these systems	4	0	0
5.	Introduction to Big Data Big Data, Big Data Analytics, Relationship of Data warehousing	4	4	

	and Big Data Analytics			
6.	Introduction to Other Latest Development for MIS Data Mining and Analytics, Artificial Intelligence and Machine Learning, Blockchain Applications	6	2	
	Total	22	6	0
Evaluation criteria				
<ul style="list-style-type: none"> • Test 1 30% • Test 2 30% • Test 30 40% 				
Learning outcomes				
By the end of the course, the student will be able to:				
<ul style="list-style-type: none"> • Develop an exhaustive understanding of the usage of MIS in organizations. • Demonstrate an ability to explain the classifications of MIS and linking MIS to business strategy for strategic advantage. • Develop an ability to assess the requirements of MIS design in different organizations including functions and issues at each stage of system development. 				
Suggested readings:				
1. Kenneth, Laudon and Jane Laudon (2006). MIS: Managing the Digital Firm. Pearson Education.				
2. James, A. O'Brien (2006). Introduction to Information Systems. Tata McGraw Hill.				
3. Goyal, D.P. (2007). Management Information Systems, Macmillan India Ltd.				
4. Turban, E., McLean, E. and Wetherbe, J. (2001). Information Technology for Management: Making Connections for Strategic Advantage. John Wiley and Sons.				
5. Jawadekar, W. S. (2004). Management Information Systems. Tata McGraw Hill.				
Pedagogical approach				
The course will involve a mix of instructor led training and case studies.				
Required textbooks				
Kenneth, Laudon and Jane Laudon (2006). MIS: Managing the Digital Firm. Pearson Education.				
Additional information (if any):				
Student responsibilities				
Attendance, feedback, discipline: as per university rules.				

Course reviewers:

Ashwani Kumar, General Manager, Delhi Metro Rail Corporation
Sanjeeva Shivesh, Founder, The Entrepreneurship School

Course title: Legal Aspects of Business				
Course code: PPM 146	No. of credits: 2	L-T-P distribution: 24-4-0	Learning hours: 28	
Pre-requisite course code and title (if any):				
Department: Department of Business & Sustainability				
Course coordinator (s): Prof. Manipadma Datta			Course instructor (s): Prof. Manipadma Datta	
Contact details: manipadma.datta@terisas.ac.in				
Course type	Core	Course offered in: Semester 2		
Course description Law and legal institutions play a major role in the conduct of business. The purposes of laws relating to business in India are mainly twofold: To create an environment conducive to the growth of business; and to make sure that business operates within the larger framework of governance in the country. There are a number of laws that have a bearing on the conduct of business. These cover broadly areas relating to corporate legal framework; business transactions; labour; environment; dispute resolution etc. In this course an attempt is made to introduce the students to certain important legal aspects of business. The course is divided into four modules dealing with formation of contract, breach of contract and its remedies; competition; formation of companies and its management; and dispute resolution. In addition to the relevant statutory provisions, important case laws would be discussed under each module.				
Course objectives				
<ul style="list-style-type: none"> To provide an overview of important laws that have a bearing on the conduct of business in India To examine the various legal forms that a business entity can take and the relative advantages and disadvantages of each of these forms 				
Course content				
Module	Topic	L	T	P
7.	Module 1: Contract Laws a. The Indian Contract Act, 1872: Essential elements of a contract; Formation of contracts; Void agreements and Voidable contracts; Discharge of contracts; Specific type of contracts- Agency, Guarantee, Indemnity, Bailment, Pledge, Hypothecation under Transfer of Property Act, 1882. b. The Sale of Goods Act, 1930: Transfer of title; Caveat Vendor; Conditions and Warranties; Rights of an unpaid seller; Hire purchase and Installment sale. c. The Consumer Protection Act, 1986: Caveat vendor; Consumer Protection Councils and Consumer Disputes Redressal mechanism. d. The Negotiable Instruments Act, 1881: Basic definitions; Recent amendments; Dishonour of certain cheques for insufficiency of funds; Offences under the Act.	10	2	0

8.	Module 2: Competition and Insolvency Laws in Business The Competition Act, 2002: Objectives and evolution; Definitions; Salient features; Role of Competition Commission of India; Insolvency and Bankruptcy Code, 2016	4	0	0
9.	Module 3: Company Law Definition-features-concept of limited liability-different types of companies. Formation-Memorandum and Articles- commencement of business-registration- conversion of companies already registered. Prospectus and allotment of securities- Public offer and Private placement. Share Capital and Debentures- kinds of shares and debentures-variation of shareholders' rights-sweat equity- bonus-buyback- buyback prohibition. Acceptance of deposits by companies. Management and Administration of companies-declaration of beneficial interests- AGM-Report on AGM-EGM- ascertaining the sense of the meeting –ordinary and special resolution and their scope– notice, quorum, proxies, voting, poll. Appointment and remuneration of managerial personnel- key managerial personnel (KMP)- limit to remuneration-Central Government's power to fix limit- calculation of profit for the purpose.	10	2	0
	Total	24	4	0
Evaluation criteria Test 1: 40% Test 2: 20% Test 3: 40%				
Learning outcomes After completing this course the students would be: <ul style="list-style-type: none"> • able to appreciate the importance of law and legal institutions in business • able to have a basic understanding of the laws relating to contract, consumer protection, competition, companies and dispute resolution. 				
Pedagogical approach A combination of class-room interactions, case studies, tutorials, and assignments.				
Materials Suggested readings : <ol style="list-style-type: none"> 1. Kapoor, N.D., Elements of Mercantile Law, Sultan Chand & Sons, New Delhi.* 2. Ramappa, T., Competition Law in India, Oxford Books.* 3. Agarwal, Anurag K., Business Law for Managers, IIM Ahmedabad Books, Ahmedabad.* 4. Singh, A., Law of Contract & Specific Relief, Eastern Book Company. *Latest editions as available Additional Readings: Occasional reading materials as delivered by the faculty from time to time.				
Additional information (if any)				
Student responsibilities Attendance, feedback, discipline, guest faculty etc.				

Course reviewers:

MV Shiju, Associate Professor, Christ University
MP Ram Mohan, Associate Professor, IIM Ahmedabad

Annexure 2

(Refer to TS/AC/44.4.1)

Course title: Photogrammetry				
Course code: NRG 170		No. of credits: 3	L-T-P: 26-2-28	Learning hours: 42
Pre-requisite course code and title (if any): NRG 178 Principles of remote sensing, NRG 176 Principles of GIS and GPS				
Department: Department of Natural Resources				
Course coordinator: Dr Anu Rani Sharma			Course instructor: Dr Anu Rani Sharma	
Contact details:				
Course type: Core			Course offered in: Semester 2	
Course Description This course introduces photogrammetry as a data acquisition tool and provides a general overview of its theory and working principles. This course covers the factors that influence the formation of the photographs, and the process of reconstructing the three-dimensional model for the real world. Students will gain the ability to extract data from aerial photography.				
Course objectives 1. To develop understanding about basic concepts of image geometry and measurement of aerial photograph. 2. To get acquainted with image interpretation and information extraction				
Course content				
SNo	Topic	L	T	P
1	Introduction to Photogrammetry History of Aerial Photographs, Fundamentals of Aerial Photographs, Basics concepts of Perspective projection and Orthographic projection	2		
2	Aerial Cameras and Photographs (Types, acquisition, scanning)	2		
3	Planning Aerial Photography and elements of aerial photograph	4	2	
4	Stereoscopic photographs and Parallax	4		
5	Geometry of Aerial Photograph Basic of Optics: Reflection, refraction and lens distortion Photographic scale; Object height and Length	2 2		
6	Introduction to Ortho-photos and DEM/contour extraction Photo mosaic, Ortho photo, Photograph co-ordinate and ground coordinate of Vertical photograph Digital Photogrammetry: Block adjustment, Ortho-rectification Digital Terrain Model and Terrain editing, Satellite Photogrammetry	2 2 2		
7	Interpretation techniques and tools Aerial Photo Interpretation techniques and tools	2		
8	Applications and limitation of Aerial Photography	2		

PRACTICALS			
1	Interpreting an Aerial photograph		2
2	Stereovision exercise and 3D model perception in stereoscope		4
3	Photo and Image coordinate calculation for vertical photographs		2
4	Parallax bar operation and height calculation		4
5	Introduction to Leica Photogrammetry suite (LPS)		2
6	Orthorectification of aerial photographs / satellite datasets		8
7	DEM generation using ortho images and Flight map generation		4
8	Introduction to Stereoanalyst		2
	Total		28

Evaluation criteria

- **Test1: 10%**
- **Test2: 10%**
- **Practical (Lab exercise and viva) (Practical is conducted at the end of the semester and includes evaluation of the lab exercises student carry out throughout the semester): 30%**
- **Test 3 (Test 3 is conducted after completion of the course, at the end of the semester): 50%**

Learning outcomes

Upon completion of the course, student will be able to:

1. Extract data from aerial photography
2. Understand the process of reconstructing three-dimensional model for the real world

Pedagogical approach

The course will be delivered through class lectures, lab exercise and tutorials.

Materials

Required text

1. Moffitt F.H. (1980) Photogrammetry, 3rd Ed, Harper & Row, NY.
2. *Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.*
3. Paine D. P., Kiser J. D. (2012) Aerial Photography and Image Interpretation, John Wiley & Sons, Inc.
4. Wolf P.R. (1983) Elements of Photogrammetry, McGraw-Hill, NY
5. Joseph, G. and Jeganathan, C. (2018) Fundamentals of Remote Sensing. By. Universities Press (India) Private Limited, Hyderabad, India. ISBN 978-93-86235-46-6.

Suggested readings

1. George J. (2005) Fundamentals of Remote Sensing Universities Press India
2. *Lillesand T.M., Kiefer R.W. and Chipman J.W. (2003) Remote Sensing and Image Interpretation, 5th ed., Wiley.*
3. Floyd F.S. (2007) Remote Sensing: Principles and Interpretation New York, WH Freeman and Company.
4. Zorn H.C. (1980) Introductory Course in Photogrammetry, 6th Ed. ITC, Netherlands.

Journals

1. Asian Journal of Geoinformatics
2. Geocarto International
3. International Journal of Geoinformatics

4. International Journal of Remote Sensing 5. ISPRS Journal of Photogrammetry and Remote Sensing 6. Journal of Indian Society of Remote Sensing
Additional information (if any) Magazines 1. Coordinates 2. Geospatial today 3. GIM International 4. GIS World 5. GIS development 6. GPS World
Student responsibilities Attendance, feedback, discipline, guest faculty etc.

Course Reviewer:

- Prof. J. K. Garg, Indraprastha University, Dwarka
- Dr. P.L.N. Raju, NESAC, Shillong

Course title: Digital Image Processing and Information Extraction				
Course code: NRG 172		No. of credits: 4	L-T-P: 28-10-36	Learning hours: 56
Pre-requisite course code and title (if any): NRG 178 Principles of remote sensing				
Department: Department of Natural Resources				
Course coordinator: Dr Chander Kumar Singh			Course instructor: Dr Chander Kumar Singh	
Contact details:				
Course type: Core			Course offered in: Semester 2	
Course Description This course will introduce fundamental technologies for digital image, compression, analysis, and processing. Students will gain understanding of algorithm, analytical tools, and practical implementations of various digital image applications.				
Course objectives 1. Fundamental technologies for digital image, compression, analysis, and processing 2. Gain understanding of algorithm, analytical tools, and practical implementations of various digital image applications				
Course content				
SNo	Topic	L	T	P
1	Introduction to Digital Image Processing & Information Extraction	2		
2	Digital Data Formats; Image data storage and retrieval; Concepts about digital image and its characteristics, Spectral, Spatial, Radiometric and Temporal resolution,	2		
3	Types of image displays, Colour port and spectral band, B/W image, Gray Image, True/Pseudo Image and Standard FCC.	2		2
4	Radiometric and Geometric correction technique, Atmospheric correction	2	2	2
5	Interpolation methods – linear and non linear transformation for geometric corrections. Spatial and Spectral interpolation	2		
6	Look-up Tables (LUT) and Image display, Radiometric enhancement techniques, Spatial profile and Spectral profile, Spatial enhancement techniques,	2	2	
7	Contrast stretching: Linear and non-linear methods.	2	2	2
8	Low pass filtering: Image smoothing, High pass filtering: Edge enhancement and Edge detection, Gradient filters, Directional and non-directional filtering.	4		2
9	Band ratio, NDVI, NDBI, VCI, EVI, SAVI, NDSI etc, TCA	2		2
10	Principal component analyses; Texture analysis	2	2	2
11	Concept of pattern recognition, Multi-spectral pattern recognition; Spectral discrimination, Signature bank, Parametric and Non-Parametric classifiers	2		4
12	Unsupervised classification methods, Supervised classification techniques, Limitations of standard classifiers	2		6
13	Artificial intelligence, Fuzzy logic, Neural networks, Expert systems	2		6
14	Accuracy Assessment: User and Producer accuracy, Kappa accuracy.	2	2	4
	Total	30	10	32
	List of Experiment			

	Lab 1. Study of the various contrast enhancement techniques			2
	Lab 2. Haze and Noise reduction			2
	Lab 3. Stacking, Mosaic and Subset of imagery, geometric and radiometric correction			4
	Lab 4. Perform the various band ratio calculation			2
	Lab 5. Low Pass Filter: Compression of the high frequency component and enhancement of the low frequency component			2
	Lab 6. High Pass Filter: Compression of the low frequency component and enhancement of the high frequency component			2
	Lab 7. Data compression techniques			1
	Lab 8. Resolution merging			1
	Lab 9. Supervised classification			3
	Lab 10. Unsupervised classification			3
	Lab 11 Knowledge base classification			6
	Lab 12. Accuracy Assessment			3
	Lab 13. Visualisation and presentation			1
	Total Hours			32

Evaluation criteria

- **Test 1: 10% (Learning outcomes 1)**
- **Test 2: 10% (Learning outcomes 1)**
- **Test 3: 40% (Learning outcomes 1 and 2)**
- **Practical: 40% (Learning outcomes 1 and 2)**

Learning outcomes

1. Gain knowledge and practical experience in digital image processing
2. Learn practical skills and analytical background for information extraction from digital data and its application

Pedagogical approach

The course will be delivered through class lectures, lab exercise and tutorials.

Materials

Required text

1. Jensen J.R. (2016) Introductory Digital Image Processing: Remote Sensing Perspective New Jersey, Prentice Hall.
2. Umbaugh S.E. (2005) Computer Imaging: Digital Image Analysis and Processing.
3. Wilhelm B. and Burge M.J. (2007) Digital Image Processing: An Algorithmic Approach Using Java, Springer.

Suggested readings

1. Bart M.R. (2003) Front-End Vision and Multi-Scale Image Analysis.
2. Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
3. Lillesand T.M. Kiefer R.W. and Chipman J.W. (2003) Remote Sensing and Image Interpretation, 5th ed., Wiley.
4. William K.P. (1978) Digital Image Processing.

Case studies

Websites

Journals

- | |
|--|
| <ol style="list-style-type: none">1. International Journal of Applied Earth Observation and Geoinformation2. ISPRS Journal of Photogrammetry and Remote Sensing3. International Journal of Remote Sensing4. Journal of Indian Society of Remote Sensing5. Remote Sensing of Environment6. Geocarto International7. International Journal of Geoinformatics |
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Additional information (if any)
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Magazines

- | |
|---|
| <ol style="list-style-type: none">1. Coordinates2. GIM International3. GIS World4. GIS@development5. Geospatial today |
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Student responsibilities

Attendance, feedback, discipline, guest lecture etc

Course Reviewer:

- Prof. Javed Mallick, King Khalid University, Saudi Arabia
- Prof. Saumitra Mukherjee, Jawaharlal Nehru University

Course title: Spatial Data Modeling and Applications				
Course code: NRG 174		No. of credits: 4	L-T-P: 32-08-32	Learning hours: 56
Pre-requisite course code and title (if any): NRG 176 Principles of GIS and GPS				
Department: Department of Natural Resources				
Course coordinator: Dr Vinay Sinha			Course instructor: Dr Vinay Sinha	
Contact details:				
Course type: Core			Course offered in: Semester 2	
Course Description The course covers fundamental aspects of spatial data modeling specifically to enhance the capability of spatial modelling, spatial database analysis concept, design and format under different natural resource assessment planning and monitoring. It introduces the participant to the basic concepts of Matrix & PCA, map algebra, decision making criteria, spatial analysis of discrete and continuous datasets, geo-statistics, decision-making, conflict resolution. It also considers integration of non-spatial data and application developed based on the concepts by software developers, photogrammetrists, land surveyors, mapping specialists, researchers, post-graduate students, and lecturers.				
Course objectives 1. To introduce fundamental aspects of spatial data modeling. 2. To understand the natural and social resource assessment, planning and monitoring for National development process. 3. To create a firm basis for successful integration of natural / human resources using spatial modelling in any field of application.				
Course content				
SNo	Topic	L	T	P
1	Introduction to geospatial modeling and interpretation	2		
2	Raster data and Matrix application: Addition, subtraction, multiplication, Identity and Inverse for Spatial analysis concept;	2		
3	Raster and Vector data Geometry and Intensity transformation using Principle Component Analysis: Eigenvectors and Eigen values	2		
4	Applications of GIS models, case exercise	2	2	
5	Geospatial models – types and Modelling: Descriptive, prescriptive and predictive; Normalization, level of measurement	2		
6	Spatial analysis concept: Distance, Adjacency, Interaction and neighbourhood	2		
7	Introduction to modeling & flowcharting, Map algebra-operators & operations, Functional operations, Spatial interaction models	2		
8	Point Analysis: Coordinate, Distance – Nearest Neighbour Distance, Density – Quadrant and other methods, Clustering - K- mean, Thiessen and Buffer	2	2	
9	Address Geocoding, Optimum Routing Closest facilities, Resource Allocation, Network Analysis	2		
10	Dynamic Segmentation: Route, Section, Events and its application.	2		
11	Local neighbourhood operation – Reclassification, filter, slope, Aspect, curvature, view shed	2		

12	Spatial Interpolation and Geostatistics: Local and global methods, Gravity model, Regression model, Pattern analysis, Moran’s I, Cluster analysis, Trend surface Analysis,	2	2	
13	Thiessen polygon, Density estimation, Inverse Distance Weight (IDW), Thin – plate Spline,	2		
14	Kriging – ordinary and Universal, Semivariogram; Spatial Autocorrelation	2	2	
15	Single criteria vs. Multiple criteria, Decision-making, Conflict resolution and Prescriptive modeling, Model verification	2		
16	Spatial decision support system and thematic areas (application of MCDM/AHP in spatial modeling)	2		
Exp	PRACTICALS			
1	Lab 1. Performing various actions over table			2
2	Lab 2. Merging of tables by using primary key			
3	Lab 3. Maintaining database			2
4	Lab 4. Point pattern analysis			2
5	Lab 5. Terrain Analysis			2
6	Lab 6. Hydrological modelling			4
7	Lab 7. Geostatistics (Surface generation)			6
8	Lab 8. Cluster Analysis			4
9	Lab 9. Site suitability analysis			4
10	Lab 10. Network analysis			2
11	Lab 11. Dynamic segmentation			4
	Total	32	08	32
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Test1: 10% ▪ Test2: 10% ▪ Practical: 40% ▪ Test3: 40% 				
Learning outcomes				
<ol style="list-style-type: none"> 1. Equip with analysis, description and modeling of geospatial data. 2. The practical applications of software tools, underlying theory, and the correct application of 				

these tools to analyze and model data

Pedagogical approach

The course will be delivered through class lectures, lab exercise and tutorials.

Materials

Required text

1. O’ Sullivan D. and Unwin D. (2003) Geographical Information Analysis, John Wiley and Sons.
2. Verbyla D. L. (2002) Practical GIS Analysis, London and New York, Taylor and Francis.
3. Burrough P.A. and McDonnell R.A. (1998) Principles of Geographical Information Systems, Oxford University Press, Oxford, 327 pp.
4. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) Geographic Information Systems and Science, Chichester, Wiley, 2nd edition.
5. Longley P.A., Goodchild M.F., Maguire D.J. and Rhind D.W. (2005) Geographic Information Systems and Science, Chichester, Wiley, 2nd edition.

Suggested readings

1. Andrew S. (2002) Environmental Modeling with GIS and Remote Sensing, Taylor and Francis.
2. David W. and Mark G. (2002) Spatial Technology and Archaeology, The Archaeological Application of GIS. London, New York, Taylor & Francis.
3. Goodrich M. (2000) Data Structures and Algorithms in Java, 2nd Edition Wiley.
4. Malczewski J. (1999) GIS and Multicriteria Decision Analysis, New York, John Wiley and Sons.
5. Michael W. and Duckham M. (2004) GIS: A Computing Perspective, Boca Raton, CRC Press, Asrar Ghassem Theory and Applications of Optical Remote Sensing New York, John Wiley and Sons.
6. Ott T. and Swiaczny F. (2001) Time-integrative GIS, Management and Analysis of Spatio-temporal Data, Berlin/Heidelberg/New York, Springer.
7. Steven M.D. and Clark J.A. (1990) Applications of Remote Sensing in Agriculture London Butterworths.
8. Johnson L. E (2009) Geographical Information System in Water Resource Engineering, Taylor and Francis.
9. Thurston J., Poiker T.K. and Moore J.P. (2003) Integrated Geospatial Technologies: A Guide to GPS, GIS, and Data Logging, Hoboken, New Jersey, Wiley.
10. Vincent R.K. (1997) Fundamentals of Geological and Environmental Remote Sensing New Jersey, Prentice Hall.

Case studies

Websites

Journals

11. Advances in Water Resources
12. Agricultural and Forest Meteorology
13. Asian Journal of Geoinformatics
14. Ecological Modelling
15. Geocarto International
16. International Journal of Geoinformatics
17. International Journal of Remote Sensing
18. ISPRS Journal of Photogrammetry and Remote Sensing

19. Journal of Indian Society of Remote Sensing 20. Remote Sensing of Environment
Additional information (if any) Magazines 6. Coordinates 7. GIM International 8. GIS World 9. GIS@development 10. Geospatial today 11. GPS World
Student responsibilities Attendance, feedback, discipline, guest faculty etc

Course Reviewer:

- Prof M P Punia, Head & Sr Scientific Officers, Department of Remote Sensing, BIT, Mesra- Jaipur
- Prof P K Joshi, SES, JNU, New Delhi

Course title: Programming in Geoinformatics				
Course code:	No. of credits: 3	L-T-P: 12-3-54	Learning hours: 42	
Pre-requisite course code and title (if any): NRG 176: Principles of GIS and GNSS, NRG 178: Principles of Remote Sensing, NRG 106: Fundamentals of Computers and Programming				
Department: Department of Natural Resources				
Course coordinator(s): Dr. Neeti		Course instructor(s): Dr. Neeti		
Contact details:				
Course type: Core		Course offered in: Semester 2		
Course Description The course introduces programming required for both GIS and remote sensing analysis to the students. The fundamentals of programming in GIS using Python language. The coding for analysis of remotely sensed dataset will be taught using Google Earth Engine.				
Course objectives				
<ul style="list-style-type: none"> ▪ To introduce Python programming ▪ To integrate programming with GIS analysis ▪ To introduce Google Earth Engine for Image processing 				
Course content				
SNo	Topic	L	T	P
1.	Introduction: Automation in GIS, Introduction to Python, variables, object oriented programming, classes	2		
2.	Basics of Python programming: List, loops, decision structures, string manipulation, debugging in Python	2	1	
3.	GIS Data Access and manipulation with Python: Raster and Vector	2	1	
4.	GIS analysis using Python	2	1	
5.	Functions and Modules in Python, Python dictionaries, writing geometries, Batch files, working with map documents	2		
6.	Introduction to Google Earth Engine for image processing	2		
PRACTICALS				
1	Writing first programme in Python			2
2.	Passing a value to a script as a parameter, reporting spatial reference of feature class, creating buffers			4
3.	Performing map algebra			2
4.	Creating a script using multiple GIS operation			4
5.	Creating and combining list			2
6.	Working with different types of loop			4
7.	Looping over records in shapefile in Python			2
8.	String manipulation in a shapefile in Python			2
9.	Debugging a programme			2
10.	Reading and Writing vector data in Python			4
11.	Query and updation of vector data using cursor in Python			4
12.	Raster based analysis in Python			2
13.	Writing functions and creating modules in Python			4
14.	Creating dictionary, reading and writing text using Python csv module			2
15.	Writing geometry of point, polygon and line shapefile			4
16.	Running python script in batch file, scheduling tasks			2

17.	Updating map document (mxd file) using Python			2
18.	Writing first programme in GEE			2
19.	Display of an image, image computation, spatial reducer using GEE			2
20.	Creating a composite image, creating profile, vegetation indices creation using GEE			2
	Total	12	3	54
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Assignments: 20% ▪ Test 1: 20% (Learning Outcome 1) ▪ Test 2: 20% (Learning Outcome 2) ▪ Test 3: 40% (All the learning outcomes) 				
Learning outcomes				
At the end of the course, students will be able to:				
<ol style="list-style-type: none"> 1. Automate geoprocessing tasks using Python 2. Understand, write, debug and execute python programme 3. Write and execute basic image analysis using GEE 				
Pedagogical approach:				
The course will be delivered through class lectures, lab exercise and tutorials.				
Materials				
Required text				
<ol style="list-style-type: none"> 1. Gries, P., Campbell, J., and Montojo, J. (2013) Practical Programming: An Introduction to Computer Science Using Python, Pragmatic Programmers. 2. Zandbergen, Python Scripting for ArcGIS, Esri Press, 2013. 				
Suggested readings				
<ol style="list-style-type: none"> 1. Python official homepage - http://www.python.org/ 2. Python document - http://www.python.org/doc/ 3. The Python Tutorial - http://docs.python.org/tutorial/ A Byte of Python (an online wikibook) - http://swaroopch.com/notes/Python/ How to think like a computer scientist: learning with Python, 2nd edition by Jeffrey Elkner et. al. - http://openbookproject.net/thinkCSpy/ ArcGIS 10 Desktop Help: Geoprocessing with Python - http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/What_is_Python/002z00000001000000/ Geoprocessing Model and Script Tool Gallery - http://blogs.esri.com/Dev/blogs/arcgisdesktop/archive/2010/11/09/Geoprocessing-Model-and-ScriptTool-Gallery.aspx 4. Lutz, M. and Ascher, D. (1999) Learning Python, O'Reilly Media. 5. Zelle, J. M. (2003) Python Programming: An Introduction to Computer Science, Franklin Beedle & Associates. 7. Tucker (2004) Writing Geoprocessing Scripts in ArcGIS, ESRI Press (available online). 				
Journals				
<ol style="list-style-type: none"> 1. International Journal of Applied Earth Observation and Geoinformation 2. ISPRS Journal of Photogrammetry and Remote Sensing 3. International Journal of Remote Sensing 4. Journal of Indian Society of Remote Sensing 5. Remote Sensing of Environment 6. Geocarto International 				
Additional information (if any)				
Student responsibilities				
The students are expected to submit assignments in time and come prepared with readings when				

provided.

Course Reviewer:

1. Dr. Kangping Si, Big Data Software Engineer, TiVo Inc., San Jose, USA
2. Mr. Ujaval Gandhi, Google Earth Engine, Hyderabad

Course title: Law and Policy for Maps and Remote Sensing				
Course code: NRG 160		No. of credits: 2	L-T-P: 28-0-0	Learning hours: 28
Pre-requisite course code and title (if any):				
Department: Department of Natural Resources				
Course coordinator:			Course instructor:	
Contact details:				
Course type: Core			Course offered in: Semester 2	
<p>Course Description: This course focuses on the evolving laws, policies, and institutions that have long-term ramifications for earth mapping and remote Sensing. It also deals with legal systems, related linkages with land use/cover systems, remote sensing & map policy. It provides an overall guiding framework for development and implementation of remotely sensed data to make it useful in geographic information systems. The course structure further helps to critically assess the strengths and weaknesses of legal instruments of remote sensing and platforms for a variety of application scenarios viz; geosciences, water resources, land use planning, forests, Agriculture and Environmental Management.</p>				
Course objectives				
<ol style="list-style-type: none"> 1. To introduce the law and policy both at the national and international level relating to remote sensing and maps. 2. To explain the role of legal regulations, policy and institutions in the conservation and management of natural resources. 3. To understand the significance of regulations on remote sensing and mapping and its impact on regional and international discourses/debates. It will appraise the students about government policies both macro and micro to deal with the issues of environmental monitoring and assessment. 				
Course content				
SNo	Topic	L	T	P
1.	Introduction to the Legal System: Meaning and functions of Law, Difference between International Law & Municipal Law; Introduction to Primary and Secondary Sources of Law; Introduction to different types of laws (Criminal Law, Civil Law, Torts, Human Rights etc.)	5		
2.	<p>Relevant Laws:</p> <ul style="list-style-type: none"> • Forest and Wildlife Law: Indian Forest Act, 1927- Legal classification of forests, Restrictions on the rights, Forest Conservation Act, 1980; Wildlife Protection Act 1972. • Land Law: Concepts in land related rights; easement rights-tenured rights–community rights–restrictions on the rights relating to land, National Land Use Policy • Intellectual Property Law: Relevant to maps, information and data 	5		
3.	National Law and Policy on Remote sensing and Mapping: National Drone Policy, The National Geospatial Policy-2016, Geospatial Information Regulations Bill- 2016, The National Map Policy -2005, Guidelines for Implementing National Map Policy, Civil	5		

	Aviation Rules, The Civil Aviation Requirements- 2012, The Remote Sensing Data Policy 2001-2011, National data Sharing and Accessibility Policy-2012.			
4.	Application of Remote sensing in Natural Resources & Natural hazards: Law relating to renewable and non-renewable Resources, the Environment Protection Act, 1986; Disaster Management Act, 2005; Coastal Regulation Zone Notification/Draft-2018; Use of Remote sensing in exploration of minerals and mining law and policies; Use of Remote Sensing in other areas such as wetlands, water resources etc.	5		
5.	International Instruments relating to law and policy on Remote Sensing & Mapping: The Convention on International Liability and Damage caused by Space objects, 1972; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967; Montreal Convention on Unification of Certain Rules for International Carriage by Air, 1999; UN Principles relating to Remote Sensing of the Earth from Outer Space, Laws in other Jurisdictions: U. K. National Remote Sensing Policy 1984, U.S., Canada, Security Issues & Evidentiary value (Case studies- <i>Dow v. U.S.</i> , <i>EOSAT v. NASA & NOAA.</i>)	8		
	Total	28		
Evaluation criteria				
<ul style="list-style-type: none"> ▪ Test 1: 15% ▪ Test 2: 15% ▪ Assignments: 20% ▪ Test 3: 50% 				
Learning outcomes				
By the end of the course, the students are expected to:				
<ol style="list-style-type: none"> 1. be familiar with the laws, policies and institutions in the field of maps and remote sensing both at the national and international level 2. understand the significance of regulations on remote sensing and mapping in the conservation of natural resources, land use & planning, agriculture, forests and overall environmental monitoring & assessment 3. acquire the ability to critically evaluate the role of law and policy in conservation and management of environment 				
Pedagogical approach				
The course will be delivered through class lectures.				
Materials				
Required text				
<ol style="list-style-type: none"> 1. Patricia Birnie, Alan Boyle, and Catherine Redgwel (2009) <i>International Law and the Environment</i>, 3rd Ed. Oxford University Press. 2. James B. Campbell & Randolph H. Wynne., <i>Introduction to Remote Sensing</i>, The Guilford Press, 2011. 3. Ackerman B., Ellickson R. and Rose C.M. (2002) <i>Perspectives on Property Law</i>, 3rd ed. Aspen Law and Business. 				

4. Stoebuck W.B. and Dale A.W. (2000) *The Law of Property*, 3rd. ed. St. Paul MN, West Group Publishing.
5. Gurdip Singh (2016) *Environmental Law*, 2nd ed. Eastern Book Company.

Suggested readings

1. A. Orhan, R. Backhaus, P. Boccardo, S. Zlatanova (eds.), *Geoinformation for Disaster and Risk Management* Examples and Best Practices, Joint Board of Geospatial Information Societies and United Nations Office for Outer Space Affairs, Denmark, 2010.
2. *Unmanned Aircraft in the National Airspace: Critical Issues, Technology and the Law* by Donna A. Dulo, Editor, 2015, 1st Edition. Publisher: ABA Publishing. ISBN 13: 978-1-62722-998-2
3. E.C. Barrett & L.F Curtis, *Introduction to Environmental Remote Sensing*, Chapman and Hall, London.
4. George Cho, *Geographic Information Systems and the Law: Mapping the Legal Frontiers*, Wiley, 1998

Case studies

1. *Dow v. U.S.*
2. *EOSAT v. NASA & NOAA*
3. *J. Mohanraj v. Google and Others*

Websites

Web resources of Govt. Of India, Ministries of S&T, Earth Sciences, IMD, ISRO, Env,& Forest etc.

Journals

1. Journal of Environmental Law
2. Journal of Environmental Law & Policy
3. Asian Journal of Geoinformatics
4. Geocarto International
5. International Journal of Geoinformatics
6. International Journal of Remote Sensing
7. ISPRS Journal of Photogrammetry and Remote Sensing
8. Remote Sensing of Environment

Additional information (if any)

Magazines

1. Coordinates
2. GIM International
3. GIS World
4. GIS@development
5. Geospatial today
6. GPS World

Student responsibilities

Attendance, feedback, discipline, guest faculty etc.

Reviewers:

Dr. Shiju MV, Associate Professor, Christ University, Bangalore
Dr. Risham Garg, Associate Professor, National Law University, Delhi