Vel Tech
Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

DEPARTMENT OF CIVIL ENGINEERING

CURRICULUM & SYLLABUS

Minor: Remote Sensing and GIS & Open Electives

(Regulations –VTR UGE 2021)

VISION AND MISSION OF THE INSTITUTE

Vision:

To create, translate and share frontiers of knowledge embedded with wisdom and innovation for a positive transformation of emerging society.

Mission:

To nurture excellence in teaching, learning, creativity and research; translate knowledge into practice; foster multidisciplinary research across science, medicine, engineering, technology and humanities; incubate entrepreneurship; in still integrity and honour; inculcate scholarly leadership towards global competence and growth beyond self in a serene, inclusive and free academic environment.

VISION AND MISSION OF THE DEPARTMENT

Vision:

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build the nation.

Mission:

M1: To produce Civil Engineers of high calibre with advanced technical skills and ethical values to serve the society and the nation.

M2: To make the department as a centre of excellence in the field of Civil Engineering and allied research activities.

M3: To provide knowledge base and consultancy services to the community in all areas of Civil Engineering

M4: To promote innovative ideas which original thinking in the minds of budding Engineers to face the future challenges.

DEPARTMENT OF CIVIL ENGINEERING

B. TECH - CIVIL ENGINEERING

Programme Educational Objectives

- Provide Engineering design solutions for the real world problems in Structural, Environmental, Geotechnical, Water Resources, Remote Sensing and Transportation Engineering.
- Succeed and excel in their chosen professional practice/research and pursue higher education in the field of Civil Engineering in reputed Institutions in India/Abroad.
- Make ethical decisions and demonstrate a commitment to the profession and society.
- Acquire a position that values adaptability and innovation in their profession.
- Demonstrate leadership, both in their chosen profession and in other social responsibilities.

DEPARTMENT OF CIVIL ENGINEERING
POs & PSOs of B. TECH – CIVIL ENGINEERING

PO 1 Engineering Knowledge

Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

PO 2 Problem Analysis

Identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences

PO 3 Design/ Development of Solutions

Design solutions for complex engineering problems and design system components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations

PO 4 Conduct investigations of complex problems

using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions

PO 5 Modern Tool Usage

Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

PO 6 The Engineer and Society

Apply reasoning informed by contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

PO 7 Environment and Sustainability

Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development

PO 8 Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO 9 Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

PO 10 Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions

PO 11 Project Management and Finance

Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO 12 Life-long Learning

Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Minor: Remote Sensing and GIS

Minor: Remote Sensing and GIS (18 Credits)				
S.No	**Course Code**	**Course Name**	**Credits**	**Prerequisite**
1	10213CE107	Fundamentals of Remote Sensing	3	NIL
2	10213CE108	Geographic Information System	3	NIL
3	10213CE109	Satellite Image Processing	3	NIL
4	10213CE110	Spatial Data Modelling and Mobile Mapping	3	NIL
5	10213CE111	Remote Sensing and GIS Applications in Environmental Monitoring and Modelling	3	NIL
6	10213CE112	Geoinformatics for Agriculture and Forestry	3	NIL
7	10213CE113	Geoinformatics For Urban Planning and Management	3	NIL
8	10213CE114	Open-Source Software For GIS – QGIS	2	NIL

10213CE107	FUNDAMENTALS OF REMOTE SENSING	L	T	P	C
		3	0	0	3

Course Category / Type: Minor Course / Theory

A. Preamble:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: At the end of the course the student will be able to understand

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	The laws and basics of electromagnetic radiation principles	K2
CO2	The interaction of electromagnetic radiation with the atmosphere	K2
CO3	The interaction of electromagnetic radiation with the earth materials	K2
CO4	The satellite and sensors characteristics	K2
CO5	About the data products and interpretation techniques	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L										M	M	
CO2	M	M										H	M	
CO3	L			M	M							H	M	
CO4	L				H								M	
CO5	M	M		M	L		M		H				M	

F. Course Content:

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – wave theory, particle theory, Stefan – Boltzmann Law and Wien's Law – visible and non-visible spectrum – Radiation sources: active & passive; Radiation Quantities

UNIT II EMR INTERACTION WITH ATMOSPHERE 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere - Scattering (Rayleigh, Mie, non-selective scattering) absorption and refraction – Atmospheric effects on visible, infrared, thermal and microwave spectrum – Atmospheric windows.

UNIT III EMR INTERACTION WITH EARTH MATERIAL 9

Energy balance equation – Specular and diffuse reflectors – Spectral reflectance &emittance – Spectroradiometer / Spectrophotometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water body – Factors affecting spectral reflectance of vegetation, soil and water body.

UNIT IV PLATFORMS AND SENSORS 9

Ground based platforms –Airborne platforms – Space borne platforms – Classification of satellites– Sun synchronous and Geosynchronous satellites – Resolution concepts – Scanners - Along andacross track scanners – Orbital and sensor characteristics of different satellites – Airborne and Space borne TIR sensors – Calibration – S/N ratio – Passive/Active microwave sensing – Airborne and satellite borne RADAR –SAR –LIDAR , UAV – High Resolution Sensors.

UNIT V DATA PRODUCTS AND VISUAL INTERPRETATION 9

Photographic (film and paper) and digital products – quick look products - High Resolution data products data - ordering – interpretation – basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources.

TOTAL: = 45PERIODS

G. Learning Resources:

a) Text Books:

1. Richards, Remote sensing digital Image Analysis-An Introduction Springer - Verlag 1993.
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.

b) References:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.

c) Online Resources:

1. nptel.ac.in/courses/105/101/105101206/
2. nptel.ac.in/noc21_ce61/
3. https://nptel.ac.in/courses/105102015

10213CE108	GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

Course Category / Type: Minor Course / Theory

A. Preamble:

- Students undergoing this course are expected gain the knowledge of GIS concepts, data and applications.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Summarize the basic concepts, data types of GIS and Compare the Vector and raster database management system	K2
CO2	Classify the different types of data entry methods in terms of Digitization, Correction, Verification and output	K2
CO3	Compare the spatial interpolation methods and modeling the digital elevation	K2
CO4	Outline the data analysis and spatial modeling using natural language commands	K2
CO5	Show the advancements and application of GIS using software.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H				M						L		M	
CO2	M	M	M										M	
CO3	M	M		H									M	
CO4	M			H	H				M			M	M	
CO5	M			H					M			M	M	

F. Course Content:

UNIT I FUNDAMENTALS OF GIS AND DATA STRUCTURE 9

Definition - Usefulness of GIS - Components of GIS - Computer Hardware, Software Modules and Organizational Context of GIS. Data Structure in GIS - Types of Data, (Points, Lines and Polygons) - Data Base Structures (Raster and Vector data Structures) - Data Conversion (Vector to Raster and Raster to Vector).

UNIT II DATAINPUT,VERIFICATION,STORAGEANDOUTPUT 9

Spatial Data Input Processes and Devices (Sources of data, - Different Types of Data Entry methods, viz., Manual input, Run length code, Digitization - Correction (Rubber Sheet Transformation, Bilinear interpolation, Cubic Convolution, use of topology) - Entry of non-spatial data - Linking of Spatial & Non- spatial data - Data Verification (Errors of different types) - GIS capabilities for Data correction - Data output (Types of Output, GIS Capabilities for output, Output devices).

UNIT III SPATIALINTERPOLATIONANDDIGITALELEVATIONMODEL 9

SPATIAL INTERPOLATION: Basic Principles of Interpolation -Methods of Interpolation, (Interpolation by Joining Boundaries, viz., Simple vector maps, Theisson polygons)- Global Methods of Interpolation, Local Interpolation -Local Interpolation (Trend Surface Analysis & Splines)- Optimal Interpolation (Kriging).

DIGITAL ELEVATION MODEL: Need for Three Dimensional Models - Methods of DEM - Products of DTM, (Contour Maps, Shaded Relief Map, Maps Related to Slopes, Line of Sight Maps, Drainage Analysis, Volume Estimation, Fly-thru models, Anaglyph stereo images) - Usefulness of DEM/DTM

UNIT IV DATA ANALYSIS AND SPATIAL MODELING 9

Simple data retrieval - Data retrieval through Boolean Logic- Data Pre-processing - Map Overlaying and Cartographic Modeling, (Two layers, Multiple layers, Binary, Index, Regression, and Process Models) - Overlay analysis, Capabilities (Point Operations, Regional Operations, Neighborhood hood Operations) - Buffering - Cartographic Modeling using Natural Language Commands - Advantages and disadvantages of Cartomodeling - Post-processing of analysed outputs - Network analysis.

UNIT V APPLICATIONS OF GIS 9

Recent advancements in GIS; Application of GIS in automation, decision making and query building processes in Geological Technology; Modules and capabilities of QGIS, GRAM++, IDRISI software

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill, NewDelhi, 1998
2. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House New Delhi. 2003
3. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

b) References:

1. Yunus A Cengel and John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, (4th Ed.) Tata McGraw Hill, 2019
2. S K Som; GautamBiswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
3. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 1995.

c) Online Resources:

1. https://nptel.ac.in/courses/105102015/

10213CE109	SATELLITE IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Category / Type: Minor Courses / Theory

A. Preamble:

- To make the undergraduate students to understand the concepts, principles, processing of Satellite data in order to extract useful information from them.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to understand

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Various components and characteristics of image processing systems	K2
CO2	The concepts of image geometry and radiometry and corrections	K2
CO3	Various types of image enhancement techniques used for satellite image processing	K2
CO4	The concepts of Image classification and use of various classifiers	K2
CO5	The applications of digital Image processing in different civil engineering field.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H			M	H		M							
CO2	H	H		H	H		H							
CO3	H	H		M	M		H							
CO4	M	H		H	H		L							
CO5	L			M	H		H							

F. Course Content:

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Information Systems – Encoding and decoding – acquisition, storage and retrieval – data products – satellite data formats – Digital Image Processing Systems – Hardware and software design consideration Scanner, digitizer – photo write systems.

UNIT II SENSOR MODEL AND PRE PROCESSING 9

Image Fundamentals – Sensor model – Spectral response – Spatial response – IFOV, GIFOV and GSI Simplified Sensor Models – Sampling and quantization concepts – Image Representation & geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures – Atmospheric, Radiometric, Geometric Corrections – Image Geometry Restoration Interpolation methods and resampling techniques.

UNIT III IMAGE ENHANCEMENTS 9

Image Characteristics - Histograms – Scattergrams – Univariate and multi variate statistics enhancement in spatial domain – global, local and colour Transformations – PC analysis, edge detections, merging – filters – convolution – LPF, HPF , HBF, directional box, cascade - Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations – Fourier, wavelet and curvelet transformations.

UNITS IV IMAGE CLASSIFICATION 9

Spectral discrimination – pattern recognition concepts – Bayes approach – Signature and training sets – Separability test – Supervised Classification Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA, K – means – Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers – Accuracy assessment Error matrix – Kappa statistics – ERGAS, RMS.

UNIT V APPLICATION OF SATELLITE IMAGE PROCESSING FOR CIVIL ENGINEERING 9

landscape mapping - weather forecasting - urban and land development -3D city and urban modelling - disaster imaging - contaminant transportation -Traffic monitoring- case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 2005 3rd edition.
2. Robert, A. Schowengergt, Techniques for Image Processing and classification in Remote Sensing, 1983.

b) References:

1. Robert, G. Reeves,- Manual of Remote Sensing Vol. I and II – American Society of Photogrammetry, Falls, Church, USA, 1983.
2. Richards, Remote sensing digital Image Analysis – An Introduction Springer -Verlag 1993.
3. Digital Image Processing by Rafael C. Gonzalez,Richard Eugene Woods- Pearson/ Prentice Hall,2008
4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2007)

10213CE110	SPATIAL DATA MODELLING AND MOBILE MAPPING	L	T	P	C
		3	0	0	3

Course Category / Type: Minor course / Theory

A. Preamble :

- The objective is to provide the student with the ability to analyze GIS data of all sorts, and to understand the uses and limitations of GIS data.
- Emphasis is placed on both theoretical aspects of GIS data analysis and geo-computation, as well as hands-on familiarity with basic GIS software applications.

B. Pre-requisites:

- Nil

C. Link to other courses:

- Nil

D. Course outcomes:

On successful completion of this course, students will be able to

CO	COURSE OUTCOMES	K LEVEL
CO1	understanding of the nature of spatial data and the principles of GIS	K2
CO2	Understand the concepts of GPS and its applications	K2
CO3	Understand the basic, role and maintenance of geo database model	K2
CO4	Specify models and methodology for spatial analysis	K2
CO5	Known the uses and applications of web GIS	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L			M				M	
CO2	L				H	L			M			L	M	
CO3	L				H	L			M				M	
CO4	L				H	L			M				M	
CO5	L				H	L			M				M	

F. Course Content:

UNIT I GIS ANALYSES AND MODELING 9

Analysis Spatial Data: Definition, Analyses, Processes & Steps, Software and Tools for Performing Spatial Data Analyses. Spatial Modeling: Introduction, Raster-Based and Vector-Based GIS Modeling, Binary Models, Index Models, Regression Models.

UNIT II BASICS OF GPS AND ITS APPLICATIONS 9

GPS- Concepts- Different Segments - space, control and user segments - satellite configuration - GPS signal structure - Anti Spoofing and Selective Availability – Task of control segment - GPS receivers -static methods with GPS - semi Kinematic, pure Kinematic and Real time kinematic methods -basic constellation of satellite geometry & accuracy measures - applications- use of different softwares.

UNIT III GEODATABASE MODELS 9

Basics of Geodatabase Model (Object-oriented Concepts), Role of Databases in GIS, Creating, Editing and Managing Geo-databases, Creating and Editing Linearly Referenced Features, Case Study of Geodatabase Model.

UNIT IV SPATIAL MODELING 9

Model Conceptualization and Formulation, Network Analysis & Dynamic Segmentation, Watershed Analysis and Universal Soil Loss Equation (USLE), Cartographic Modeling: Descriptive and Prescriptive Cartographic Modeling, Error Propagation in Cartographic Modeling, Conflict Resolution.

UNIT V CUSTOMISATION, WEB GIS, MOBILE MAPPING 9

Customization of GIS: Need, Uses, Scripting Languages –Embedded scripts – Use of Python script - Web GIS: Web GIS Architecture, Advantages of Web GIS, Web applications- Location Based Services: emergency and business solutions - Big data analytics.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Burrough, Peter A. and Rachael McDonnell.,(1998), Principles of Geographical Information Systems. Oxford University Press, New York
2. Laurini, Robert and Derek Thompson. ,(1992), Fundamentals of Spatial Information Systems. Academic Pr., London.
3. Kluwer FotheringhamA S, O'Kelly M E., (1998), Spatial Interaction Models: Formulations and Applications.
4. SatheeshGopi, Rasathishkumar, N. Madhu, “Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007.

b) References:

1. Paul Longley, Michael Goodchild, David Maguire and David Rhind:, (Editors) (2005), Geographical Information Systems. Principles, Techniques, Applications and Management. John Wiley & Sons.

c) Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ce09/preview
2. https://nptel.ac.in/courses/105/107/105107155/
3. https://nptel.ac.in/courses/105/102/105102015/

10213CE111	REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MONITORING AND MODELLING	L	T	P	C
		3	0	0	3

Course Category / Type: Minor Course / Theory

A. Preamble:

This course aims to make the students get exposed to understand the various remote sensing and GIS technological applications in the field of Environmental Engineering.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Relate the concepts of water quality, sampling and testing with remote sensing application	K2
CO2	Outline the methods of soil sampling and testing in line with geoinformatics	K2
CO3	Illustrate the elements of remote sensing and GIS in solid waste management	K2
CO4	Compare the various geoinformatics tools in monitoring and management of air pollution	K2
CO5	Demonstrate the understanding on sensors and platforms deployed in remote sensing and geo information system	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				M	M	M					H	L	
CO2	M				M	H	H					H	L	
CO3	M				M	H	H					H	L	
CO4	M				M	H	H					H	L	
CO5	M				M	H	H					H	L	

F. Course Content:

UNIT I WATER AND THE ENVIRONMENT 9

Sources and demands of water - Characteristics of water- Point and non-point sources of water pollution - Spectral responses of clear and contaminated water - chlorophyll- Remote Sensing of Water quality assessment - Sampling procedure for water quality analysis, Data base creation and quality modeling using GIS.

UNIT II SOIL CONSERVATION AND MANAGEMENT 9

Formation of Soils- classification - land forms- soil erosion-factors influencing soil erosion, soil contamination - EMR responses with contaminated soil - modeling soil characteristics using satellite data-soil degradation assessment using Remote Sensing and GIS- Land reclamation.

UNIT III SOLID WASTE AND MANAGEMENT 9

Solid Waste management- sources and types of solid waste – waste generation rate- factors affecting waste generation - Design of collection network using GIS – disposal – site selection studies for solid waste using RS and GIS.

UNIT IV AIR POLLUTION 9

Air Pollutants- classification of air pollution – sources of air pollution – sampling and analysis of air pollution - Dispersion modeling, photochemical modeling, receptormodeling – limitations in dispersion modeling - Introduction to commonly used software-based models - case studies.

UNIT V SENSORS AND DATA FOR ENVIRONMENTAL MONITORING 9

Sensors for environmental monitoring - sensors - LIDAR- LASER Remote Sensing - EMR – absorption spectrometers - selection of ground truth sites-sea truth observation - Radar techniques for sensing ocean surface - thermal measurements- application of remote sensing for oil slicks mapping - Chlorophyll detection - Fisheries resources - Coastal marine studies - determination of temperature and sea state.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Allan Brimicombe, GIS, Environmental Modeling and Engineering, Second Edition, CRC Press, 2009.
2. Andrew Skidmore (Editor), Environmental Modelling with GIS and Remote Sensing, CRC Press), 2017.
3. Ian L. Pepper, Charles P. Gerbaand Mark L. Brusseau, Environmental and Pollution science, Academic Press, 2nd Edition, 2011. ISBN: 978-0125515030
4. David N. Miclsen, Environmental Site Characterization and Ground water Monitoring, 2nd edition, CRC Press, 2005, ISBN: 978-1566705899

b) References:

1. Roger D. Griffin, Principles of Air Quality Management, 2nd edition, 2006, CRC Press 2016.
2. Donald L. Wise, Remediation for Hazardous waste contaminated soils, CRC Press; 1st Edition (1994)
3. Michele Campagna, GIS for sustainable development, CRC Press; 1st Edition, 2005.
4. Tchobanoglous George, Hilary Theisen, Samuel Vigi, Integrated Solid Waste Management, McGraw – Hill Inc, Singapore. 1993.
5. Dr Owen Harrop, "Air Quality Assessment & Management", CRC Press; 1st edition, 2001.
6. Robert Scally, "GIS for Environmental Management", ESRI Press, 2006.
7. Shukla P.R, Subobh K Sarma, NH Ravindranath, AmitGarg and Sumana Bhattacharya, Climate Change and India: Vulnerability assessment and adaptation, University Press (India) Pvt Ltd, Hyderabad, 2003.

c) Online Resources:

1. NPTEL :: Civil Engineering - NOC:Remote Sensing: Principles and Applications
2. NPTEL :: Civil Engineering - NOC:Remote Sensing and GIS
3. NPTEL :: Civil Engineering - NOC:Digital Image Processing of Remote Sensing Data

10213CE112	GEOINFORMATICS FOR AGRICULTURE AND FORESTRY	L	T	P	C
		3	0	0	3

Course Category / Type: Minor course / Theory

A. Preamble:

- This course enables the students to understand and apply remote sensing and GIS techniques in various fields of agriculture, soil, land and forest resources.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand about the characterization of crops using remote sensing tools.	K2
CO2	Summarize the concepts of soil mapping through remote sensing.	K2
CO3	Discuss the evaluation of land capability for better land use planning.	K2
CO4	Understand the concept of damage assessment using remote sensing.	K2
CO5	Summarize the concepts of forest management.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				L								L	
CO2	L				M	L							L	
CO3	L				L		M						L	
CO4	L				H	L	L					L	L	
CO5	L				H	M	M					M	L	

F. Course Content:

UNIT I CROP INVENTORY AND REMOTE SENSING 9

Introduction - leaf optical properties, identification of crops and crop inventorying - crop acreage estimation - vegetation indices, yield estimation - crop production forecasting through digital analysis - crop monitoring and condition assessment in command areas - case studies.

UNIT II REMOTE SENSING FOR SOIL 9

Introduction - soil survey, types of soil surveys - soil genesis and soil classification - soil taxonomy - soil reflectance properties - soil mapping using remote sensing - problem soils - saline, alkali soil characteristics - mapping of saline alkaline soils - soil erosion and sedimentation - assessment of soil erosion - estimation of reservoir capacity.

UNIT III LAND EVALUATION AND MANAGEMENT 9

Introduction - land use / land cover definition, land use / land cover classification - concepts and approaches of land evaluation - Change dynamics - Land capability assessments - decision support system for land use planning - optimum land use planning for sustainable agriculture.

UNIT IV DAMAGE ASSESSMENT 9

Introduction - damage by pests and diseases - crop loss assessment by floods - flood hazard zone mapping - remote sensing capabilities and contributions for drought management - land degradation due to water logging and salinity - crop stress - reflectance properties of stressed crops - identification of crop stress - Agricultural insurance in India - CCIS,ECIS, FIIS and NAIS

UNIT V FOREST MANAGEMENT 9

Introduction - forest taxonomy - inventory of forests - forest type and density mapping-biomass assessment - timber volume estimation - factors for forest degradation-mapping degraded forests - deforestation and afforestation - forest fire mapping and damage assessment – species mapping - sustainable development of forests.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Srinivas, M.G., Remote Sensing Applications, Narosa Publishing House, New Delhi, 2001.
2. Andrew Rencz, Manual of Remote Sensing. Vol.3. Edn.3. Remote Sensing for the Earth Sciences, American Society for Photogrammetry and Remote Sensing, John Wiley & Sons, New York, 1999.

b) References:

1. Jensen, J.R., Remote Sensing of the Environment - An Earth Resource Perspective. Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2001.
2. Agarwal, C.S. and P.K.Garg, Textbook on Remote Sensing in Natural Resources Monitoring and Management. Wheeler Publishing, New Delhi, 2000.
3. Narayan, L.R.A., Remote Sensing and its Applications. Universities Press (India) Ltd.,Hyderabad, 2001.
4. B. K. Ranganath, Lecture notes on Application of Remote Sensing and GIS in Forestry, RRSC, ISRO, 40th Main, Eshwamagar, Bangalore.
5. Akbar Sha, A. Geographical Information System in Forestry Management, Conservation of Forests, Kamataka Forest Dept.

c) Online Resources:

1. https://nptel.ac.in/courses/105/103/105103193/

2. https://nptel.ac.in/courses/102/104/102104082/
3. https://nptel.ac.in/courses/126/104/126104002/

10213CE113	GEOINFORMATICS FOR URBAN PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Minor Course/ Theory

A. Preamble:

This course aims to introduce the students the latest developments in Geoinformatics techniques useful for planning and management of urban development.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Relate the relevance and limitations of various remote sensing data products in urban planning	K2
CO2	Outline the utilization of remote sensing for urban elements mapping	K2
CO3	Illustrate the preparation of urban development plans using geoinformatics	K2
CO4	Compare the methods for urban infrastructure and facility planning	K2
CO5	Demonstrate the understanding on tools for urban modelling	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				H	H						H	L	
CO2	L				H	H	H					H	L	
CO3	M				H	H					H	H	L	
CO4	L				H	H	H					H	L	
CO5	M				H	H	H					H	L	

F. Course Content:

UNIT I INTRODUCTION 9

Remote Sensing – Developments - Relevance in Urban Planning - Scope and Limitations Scale and Resolution requirements – Spectral characteristics of Urban Features– High Resolution, Thermal, Hyperspectral and Microwave Remote Sensing for Urban Analysis –Stereo Data - Products – Aerial and Ground based Sensors – UAVs – Laser Scanners.

UNIT II REMOTE SENSING FOR URBAN MAPPING 9

Urban Area Definition and Characterization–Base Map Preparation – Urban Landuse Classification – Visual and Digital Techniques for Landuse Mapping - Urban Structure and Patterns – Urban Land Cover Classification – Feature Extraction techniques – Change Detection – Sprawl Detection and Characterization - Mapping of Urban Morphology - Urban Heat Island – Building Typology.

UNIT III GEOMATICS FOR URBAN PLANNING 9

Urban Information System– Master and Detailed Development Plans - Objectives and Contents of Plans – Role of Geomatics in Plan Formulation and Review - Urban Solid Waste Management Planning –Urban Renewal Planning – Utility Network Planning and Management – case studies.

UNIT IV GEOMATICS FOR URBAN ANALYSIS 9

Geodemographic Analysis – Land Value Analysis - Optimization of Facility Locations - Site suitability Analysis for Infrastructure – Optimal Route Analysis - Accident Analysis – Road Alignment Planning - Traffic and Parking Studies - case studies.

UNIT V VISUALIZATION, SIMULATION AND MODELING OF URBAN AREAS 9

Urban Growth Modelling - Air quality indexing and mapping - 3D City Modelling – Flood Modeling in Urban Areas - Geomatics for Smart Cities – Recent Advancements - Case Studies

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Netzband, Maik; Stefanov, William L.; Redman, Charles (Eds.), Applied Remote Sensing for Urban Planning, Governance and Sustainability, Springer, 1st Edition, 2007
2. Rashed, Tarek; Jürgens, Carsten (Eds.), Remote Sensing of Urban and Suburban Areas, Springer, 1st Edition. 2010
3. Ian L. Pepper, Charles P. Gerbaand Mark L. Brusseau, Environmental and Pollution science, Academic Press, 2nd Edition, 2011. ISBN: 978-0125515030

b) References:

1. QihaoWeng, Dale A. Quattrochi (Eds), Urban Remote Sensing, 2nd edition, CRC Press, 2018.
2. Soergel, Uwe (Eds.), Radar Remote Sensing of Urban Areas, Remote Sensing and Digital Image Processing, Vol. 15, 1st Edition, Springer, 2010
3. BasudebBhatta, Analysis of Urban Growth and Sprawl from Remote Sensing Data, 1st Edition, Springer-Verlag, 2010

c) Online Resources:

1. NPTEL :: Architecture - NOC:Introduction to Urban Planning
2. NPTEL :: Civil Engineering - NOC:Geo Spatial Analysis in Urban Planning
3. NPTEL :: Architecture - NOC:Urban governance and Development Management (UGDM)

10213CE114	OPEN SOURCE SOFTWARE FOR GIS – QGIS	L	T	P	C
		0	0	2	2

Course Category / Type: Minor Course / Laboratory

A. Preamble

- This course aims to introduce the students the latest developments in Geoinformatics techniques useful for planning and management of urban development.
- Hands on experience of basics of cartography and GIS.
- Designing the map
- Development of GIS database and populating attributes data

B. Prerequisite

- Nil

C. Links to other Courses

- Nil

D. Course Outcomes

At the end of the course the student will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Generate thematic maps with suitable projection, symbols and color codes	K3
CO2	Formulate spatial database and nonspatial databases in GIS environment	K3
CO3	Develop spatial database and generate reports, maps	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H													
CO2	M	H	M		H							M		
CO3		H	L		M	H					M	M		

F. Course Content

LIST OF EXPERIMENTS

1. Georeferencing a Toposheet using QGIS
2. Projection by Using QGIS
3. Digitization of a Toposheet Using QGIS
4. Map Preparation using QGIS
5. Image Registration Using QGIS
6. Data Exploration Using QGIS
7. Working with tables Using QGIS
8. Data Query – 1 (Spatial Querying)
9. Data Query - 2 (Attribute Querying)
10. Multi-Criteria Analysis
11. Interpolation Techniques

TOTAL: 30 PERIODS

G. Reference:

1. Lillesand, T.M. & Kiefer R.W. (1998), Remote Sensing and image interpretation, John Wiley & Sons, Newyork.
2. Burrough P.A. (2000), Principle of Geographical Information Systems for land resources assessment, Clarendon Press, Oxford.
3. C.P. Lo Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall of India Publishers, 2006

OPEN ELECTIVES

Open Electives			
S.No	**Course Code**	**Course Name**	**Credits**
1	10213CE101	Building Materials	3
2	10213CE102	Environmental Conservation	3
3	10213CE103	Intellectual Property and Innovation	3
4	10213CE104	Startup Essentials	3
5	10213CE105	Air Pollution Management	3
6	10213CE106	Applications of Remote Sensing and GIS in Disaster Management	3

10213CE101	BUILDING MATERIALS	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:

- To acquire knowledge of the materials used for construction.
- To acquire knowledge of the cement, stone, bricks and concrete.
- To understand about the various types of timber and steel used in construction.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the properties and testing of bricks and stones.	K2
CO2	Learn the properties and uses of cement.	K2
CO3	Learn the properties and testing of aggregates and concrete.	K2
CO4	Understand the application of timber and other materials.	K2
CO5	Understand the importance of modern materials for construction.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					L	L	M	M			M		H
CO2	L					M		M						H
CO3	L					L	L	H	H					H
CO4	L					L	L					M		H
CO5	L						M	M				M		H

F. Course Content:

UNIT I CONSTRUCTION BLOCKS 9

Bricks - Classification - Qualities - Tests on bricks - Uses of bricks - Pollution absorbing brick - Wool brick - Fly ash bricks - Refractory bricks - stones - Qualities - Tests on stones - Use of stones - Blocks - Hollow - Solid - Concrete blocks - Compressed mud blocks - C.L.C blocks - A.A.C blocks.

UNIT II CEMENT 9

Cement - Ingredients - Chemical composition - Manufacturing process - Types and Grades - Tests on cement - Properties of cement - Uses of cement - Fly ash - Ground granulated blast furnace slag - Silica fume.

UNIT III AGGREGATES AND CONCRETE 9

Aggregates - Fine aggregates - River sand - M sand - P sand - Properties - Coarse aggregate - Properties - Grading – Tests on coarse aggregate - Recycled aggregate - Concrete - Ingredients - Grades - Types - Manufacturing Process - Application of concrete - Admixture - Self-healing concrete - Light-generating concrete.

UNIT IV TIMBER AND OTHER MATERIALS 9

Timber - Laminated timber - Market forms - Plywood - Translucent wood - Veneer - PVC - UPVC - WPC - Thermocol - Steel - Aluminium - Composition - Aluminium composite panel - Transparent aluminum - Aluminum form - Uses - Market forms - Paints - Varnishes - Flooring.

UNIT V MODERN MATERIALS 9

Glass - Manufacturing of glass - Properties - Types and uses - Industrial form of glass - Ceramics - Sealants for joints - Plaster of paris - Fibres - Types - Uses - Glass fibre reinforced polymers - Carbon Fibre reinforced polymers - Clay products - Composite materials - Types - Applications of laminar composites - Graphene - Bamboo - Recycled plastic - Reclaimed wood - Recycled steel.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Varghese. P.C, “Building Materials”, PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K, “Engineering Materials”, S. Chand and Company Ltd. New Delhi, 2008.
3. Duggal. S.K, “Building Materials”, 4th Edition, New Age International Publishers, New Delhi, 2012.
4. Gambhir. M.L, “Concrete Technology”, 5th Edition, Tata McGraw Hill Education, New Delhi, 2017.

b) References:

1. Jagadish. K.S, "Alternative Building Materials Technology", New Age International Publishers, New Delhi, 2017.
2. Gambhir. M.L and NehaJamwal, "Building Materials: Products, Properties and Systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2017.
3. Santhakumar. A.R, "Concrete Technolgy", Oxford University Press, India, 2016.
4. Shetty. M.S, "Concrete Technology: Theory and Practice", S. Chand and Company Ltd., New Delhi, 8th Edition, 2018.
5. IS:383-2016, Specification for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi.

c) Online Resources:

1. https://nptel.ac.in/courses/105/102/105102088/
2. https://nptel.ac.in/courses/124/105/124105013/

10213CE102	ENVIRONMENTAL CONSERVATION	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:

- To provide a basic understanding of the occupancy of the ecosystem in line with Biodiversity. Its conservative measures are taken by the agencies as well as the federal Government.

B. Prerequisite:

- NIL

C. Link to other Courses:

- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Illustrate the elements and types of biodiversity.	K2
CO2	Contrast the threats and damages to biodiversity.	K2
CO3	Classify the bio diversity conservation and protection measures.	K2
CO4	Outline the sustainable management of biodiversity.	K2
CO5	Summarize the legal aspects of environmental conservation.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M	H	M						
CO2					M	M	H	L	M			M		
CO3						M	M	H	M	M		M		
CO4							M	H	M	M		M		
CO5						L	M	M	M	M		M		

F. Course Content:

UNIT I TYPES, FUNCTIONS AND BENEFITS OF BIODIVERSITY 9

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Mega diversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - Use of Biodiversity: Source of food, medicine, raw material, aesthetic and cultural uses – Biodiversity Prospecting: Significance of Indigenous Knowledge Systems

UNIT II THREATS TO BIODIVERSITY 9

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

UNIT III CONSERVATION STRATEGIES 9

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agroforestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies.

UNIT IV SUSTAINABLE MANAGEMENT OF BIO RESOURCES 9

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

UNIT V POLICIES, PROGRAMMES AND ACTS FOR CONSERVATION 9

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9 th Ed.) Tata McGraw Hill, NewDelhi, 1998
2. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House New Delhi. 2003
3. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
4. Basanta Kumara Behera, Ram Prasad Environmental Technology and Sustainability – Physical, Chemical and Biological technologies for clean Environmental Management - Elsevier – April 5 2020 – First Edition.

b) References:

1. Yunus A Cengel and John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, (4th Ed.) Tata McGraw Hill, 2019
2. S K Som; GautamBiswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012
3. Kumar K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., New Delhi, 1995.
4. Jason Hendon - Environmental Conservation and management – Syrawood Publishing House (28 June 2019)

c) Online Resources:

1. http://nptel.ac.in/courses/112105171/1
2. http://nptel.ac.in/courses/103104043/1
3. https://nptel.ac.in/courses/105103095/
4. http://nptel.ac.in/courses/112105183/

10213CE103	INTELLECTUAL PROPERTY AND INNOVATION	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:
This course deals about the fundamentals of intellectual property and their role in engineering domain.

B. Prerequisite:
- Nil

C. Link to other Courses:
- Startup Essentials (Open Elective)

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Outline the overview of intellectual property and creativity theories.	K2
CO2	Extend the definition and types of patents.	K2
CO3	Explain the fundamentals of copyright, trademarks and design.	K2
CO4	Demonstrate the role of IP in engineering career.	K2
CO5	Apply the knowledge of intellectual property with case studies.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			M			M		H		M		M		
CO2			M			M		H		M		M		
CO3			M			M		H		M		M		
CO4			M		M	M		H		M	M	M		
CO5			M			M		H		M		M		

F. Course Content:

UNIT I INTRODUCTION 9

Intellectual property – Characteristics of IP – Intellectual property rights: Types, IP Acts – Creativity - Lucid dreaming – Mental blocks - Vertical and lateral thinking – Stenberg's theory of creativity – The 10000 hours rule – Theories of motivation – Traits of a creative engineer – Ways to improve creativity - Role of IP in global economy.

UNIT II PATENT 9

Definition – Patentability tool – Indicators for patentability - Procedure for patent filing: Indian and international application – Opposition - Forms – Inventions not patentable in India – Role of patents in entrepreneurship.

UNIT III COPY RIGHT, TRADEMARK AND DESIGN 9

Copyright: Origin and evolution, International arrangements, History in India, Criteria for protection and registration – Trademark: History and origin, International arrangements, History in India, types of trademarks, Criteria for protection and registration - Design: Meaning, Criteria for protection – Geographical Indication: Meaning, Characteristics – Geographical Indication in India.

UNIT IV ROLE OF INTELLECTUAL PROPERTY IN ENGINEERING CAREER 9

Engineering projects – Problem-based Vs people-based projects – Projects to patent creation – Incubation: Startupvs Entrepreneurship - Edison's 15 lessons for innovation - Case studies of engineering-led startups.

UNIT V CASE STUDIES ON IPR 9

Low-cost sanitary pad making machine – Environment-friendly paper – Plastic Road construction – Implantable biosensors for diabetes monitoring – Location tracking without GPS – Offline internet - Pharmaceutical case studies – Case studies from digital market.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Stephen Johnson, Guide to Intellectual Property: What it is, how to protect it, how to exploit it? Economist Books, 2015.

b) References:

1. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Cengage Learning, 2014.

c) Online Resources:

1. https://nptel.ac.in/courses/109106137/
2. https://nptel.ac.in/courses/127105008/

10213CE104	STARTUP ESSENTIALS	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:

This course deals about the fundamentals of startups and its initial requirements.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Intellectual Property and Innovation (Open Elective)

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Contrast the fundamentals of entrepreneurship.	K2
CO2	Relate the concepts of creativity with the context of entrepreneurship.	K2
CO3	Outline the structure of a startup from definition to registration.	K2
CO4	Illustrate the fund generation ways for a startup.	K2
CO5	Compare the various Indian and foreign startups as case studies.	K2

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1								L	L	L	H	H		
CO2								L	L	L	H	H		
CO3								L	L	M	H	H		
CO4								L	L	M	H	H		
CO5								L	L	M	H	H		

F. Course Content:

UNIT I ENTREPRENEURSHIP 9

Definition of creativity / invention / innovation / entrepreneurship / startup – Entrepreneurship: types of entrepreneurs, corporate entrepreneurship – Contributions of entrepreneurs – Characteristics of entrepreneurs – Starting entrepreneurial journey – Risks in entrepreneurship – 10 success lessons from giants for entrepreneurs.

UNIT II CREATIVITY 9

Relationship between happiness and stress – Mental blocks – Lucid dreaming – How to be creative? – Creativity: different types of thinking – Theories for creativity: Stenberg's theory, the 1000 hours rule – Techniques for creativity – Traits of a creative engineer – Ways to improve creativity, Maslow's theory of motivation.

UNIT III ELEMENTS OF A STARTUP 9

Definition of a startup – Startup ecosystem – Role of intellectual property in startups – MSME registration in India – How to startup: identifying market potential pain point, IP capable idea generation, achieving minimum viable product, business model canvas, fund raising – Startup lifecycle – Emergence of startup culture in India.

UNIT IV FINANCE 9

Startup funding – Why is funding required for startup? – Types of startup funding – Stages of startup and source of funding – Steps to startup fund raising – What do investors look for in a startup? – Various funding schemes.

UNIT V CASE STUDIES 9

Success and failure case studies of domestic and international startups.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Robert D. Hisrich., VelandRamadani,Effective Entrepreneurial Management: Strategy, Planning, Risk Management, and Organization, Springer, 2017.
2. Kuratko & Hodgetts., Entrepreneurship - Theory, Process Practice, Third Edition, Thomson South-Western Publication.

b) References:

1. Robert D. Hisrich., Entrepreneurship, Tata McGraw Hill Publications, Edition-10, 2017.

c) Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ge08/course

10213CE105	AIR POLLUTION MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:
Candidates/Students are introduced to act/Knowledge is for the prevention, control and abatement of air pollution.

B. Prerequisite:
- NIL

C. Link to other Courses:
- NIL

D. Course Outcomes: Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Able to classify, understand and identify the source of air pollution and its brief impact on mankind.	K2
CO2	Able to segregate the air pollutants and its principles with application	K3
CO3	Understanding the air quality control and its techniques for measurements	K3
CO4	Understanding the air pollution managements and its control measurements	K3
CO5	Humanizing the effects of air pollution on human and their habitats	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L					M	H	M						
CO2	M					M	H	M				M		
CO3	H					M	H	M	L			M		
CO4						M	H	M	L			M		
CO5	L					L	H					M		

F. Course Content:

UNIT I INTRODUCTION TO AIR POLLUTANTS 9

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis.

UNIT II DISPERSION OF POLLUTANTS 9

Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles. Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications**.**

UNIT III AIR POLLUTION CONTROL 9

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.

UNIT IV AIR QUALITY MANAGEMENT 9

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of New Industries – Legislation and Enforcement.

UNIT V HUMAN AND ENVIRONMENTAL HEALTH EFFECTS 9

Hazardous effects of air pollutants on human body systems-Transport and Dispersion of Air Pollution, Indoor Air Pollution- NCAP role in Air Pollution Management.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 1996

b) References:

1. Heumann. W.L., "Industrial Air Pollution Control Systems", McGraw Hill, New Yark, 1997.
2. Mahajan S.P., "Pollution Control in Process Industries", Tata McGraw Hill Publishing Company, New Delhi, 1991.
3. Peavy S.W., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", McGraw Hill, New Delhi, 1985.
4. Garg, S.K., “Environmental Engineering Vol. II”, Khanna Publishers, New Delhi,1998
5. Mahajan, S.P., “Pollution Control in Process Industries”, Tata McGraw Hill, New Delhi, 1991.
6. ThodGodesh, "Air Quality, Lewis India Edition, 2013.

c) Online Resources:

1. https://nptel.ac.in/courses/105/104/105104099/
2. https://onlinecourses.nptel.ac.in/noc22_ce22/preview

10213CE106	APPLICATIONS OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

Course Category / Type: Open Elective / Theory

A. Preamble:

- Students undergoing this course are expected to understand the basic concept of remote sensing and Geographical Information System applications in various disaster mitigation studies.

B. Prerequisite:

- Nil

C. Link to other Courses:

- Nil

D. Course Outcomes: After the completion of the course the students will be able to

CO Nos.	Course Outcomes	Bloom's Taxonomy level
CO1	Understand the basic concept of Remote Sensing	K2
CO2	Understand the different sensors and satellites characteristics	K2
CO3	Understand the fundamentals of GIS and Data Base Management Systems in GIS.	K2
CO4	Understand the basics of disaster mitigation system	K2
CO5	Understand the application of remote sensing and GIS in various disaster mitigation studies.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M				M		L					L	L	
CO2	M				H		M					M	L	
CO3	L				M		M					L	L	
CO4	M				H		M					M	L	
CO5	L				M	M	H						L	

F. Course Content:

UNIT I PRINCIPLES OF REMOTE SENSING 9

Definition of Remote sensing, Types - based on wavelength - sensors - platform, components of Remote Sensing , Electromagnetic spectrum - Wavelength regions important to remote sensing, EMR interaction with atmosphere, EMR interaction with earth surface, Spectral reflective characteristics of water, vegetation and soil.

UNIT II PLATFORMS AND SENSORS 9

Platform - types, Sensor -types and their characteristics, across track (whiskbroom) and along track (pushbroom) scanning, Orbit - Sun-synchronous and geosynchronous, Concept of resolution - spatial, spectral, temporal, radiometric, Satellite Characteristics: Earth Resources Satellites - LANDSAT, SPOT, IRS, IKONOS satellite series, Meteorological satellites - INSAT, NOAA, GOES.

UNIT III FUNDAMENTALS OF GIS 9

GIS, Components of a GIS - Hardware and software requirements for GIS, Coordinate system and projections in GIS – conic, cylindrical and planner, Standard GIS software packages, Spatial data models – raster and vector, Data base design - editing and topology creation in GIS, linkage between spatial and non-spatial data, Measurement scales - Data base management systems in GIS (DBMS).

UNIT IV DISASTER MANAGEMENT SYSTEM 9

Disaster – classification of disasters, types of Disaster, importance of RS and GIS in Disaster Management, Basic components and principles of disaster - Needs and approach towards prevention - Role of Government administration - NGO's - International disaster assistance - Prediction & mitigation - Disaster legislation and policy - Use of Internet - Communication Network - Warning system - Post disaster review – Case studies.

UNIT V APPLICATIONS OF GIS 9

Disaster management cycle and role of remote sensing and GIS in disasters management, Remote sensing and GIS application in hazard zonation mapping, Vulnerability analysis of infrastructure and settlements - Potential of GIS application in forest management - urban planning, agriculture and soil, Potential of GIS application in development planning and Disaster management plan - Case studies.

TOTAL: 45 PERIODS

G. Learning Resources:

a) Text Books:

1. Lillesand,T.M., Kiefer, R.W. and J.W.Chipman. "Remote Sensing and Image Interpretation" 6th Edition. John Willey and Sons Asia Pvt. Ltd., New Delhi, 2008.
2. Anji Reddy .M, “Remote sensing and Geographical information system”, B.S Publications, 2011.

b) References:

1. Jeffrey Star and John Estes, “Geographical Information System – An Introduction”, Prentice Hall, 1990.
2. Mohamed Gad Large scale disasters: prediction, control and mitigation, Cambridge university press, 2008.
3. NDM – National Disaster Management guidelines. Includes SDM plans.

c) Online Resources:

1. https://nptel.ac.in/courses/105103193