।। सा विद्या या विमुक्तये ।।

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade

ACADEMIC (1-BOARD OF STUDIES) SECTION

Phone: (02462) 229542
Fax : (02462) 229574

Website: www.srtmun.ac.in

E-mail: bos.srtmun@gmail.com

प्रस्तुत विद्यापीठीय संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील M. Phil. अभ्यासक्रमाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२० च्या ठरावानुसार प्रस्तुत विद्यापीठीय संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील M. Phil. अभ्यासक्रमाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

01. M.Phil. - Geology
02. M.Phil. - Geography
03. M.Phil. – Environmental Science
04. M.Phil. – Computer Sceicne (Common To Camus & Sub Campus)
05. M.Phil. – Chemistry
06. M.Phil. – Physics

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर(संकुल)–सीबीसीएस अभ्यासक्रम/२०२०–२१/५९१

दिनांक : २४.०८.२०२०.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. संचालक, सर्व संबंधित संकुले, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

Master of Philosophy (M.Phil)

in

ENVIRONMENTAL SCIENCE

Syllabus

(*with effective from 2020 - 2021*)

School of Earth Sciences
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY
NANDED

Master of Philosophy (M.Phil)

ENVIRONMENTAL SCIENCE

School of Earth Sciences

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED

Course Code	Title of Paper	Marks	Credits
MES-101	Compulsory Paper Research Methodology in Environmental Science	100	4
MES-102	Compulsory Paper Information Technology	100	4
MES-103	Optional (Any one paper) A) Microbial Environment & Biotechnology B) Air Pollution & Control Technology C) Natural Resources Management D) Solid Waste Management	100	4
MES-104	Optional (Any one paper) E) Environmental Hazards & Toxicology F) Water Pollution & Control Methods G) Instrumental Techniques in Environmental Sciences H) Geographic Information Technologies	100	4
MES-105	Dissertation	150	6
MES-106	Viva Voce	50	2
MES-107	Seminar	25	1
	TOTAL	**625**	**25**

Master of Philosophy (M.Phil)

ENVIRONMENTAL SCIENCE
School of Earth Sciences
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

MES-101 Compulsory Paper (100 Marks) 4 Credits

Research Methodology in Environmental Science

Objectives:

- To enable to student to understand and work with methods and concepts related to Research.
- To enable the student to develop research proposal and to work with research problem.
- To develop broad comprehension of research area.

Unit-I: Introduction:

- Meaning, concept, nature steps types and their characteristics.
- Approaches and theories of paradigm and theirs implications in research.
- Philosophical and sociological foundations of research.
- Interdisciplinary approach and its implications in various research area.

Unit-II: Methods of Research:

- Qualitative and quantitative methods of research like
  Historical, case study, ethnography, expost facto, documentary and content analysis, survey (Normative, descriptive, evaluative etc.), field and laboratory experimental studies.
- Characteristics of methods and their implications in research area.

Unit-III: Development of research proposal:

- Research proposal and its elements
- Formulation of research problem-criteria of sources and definition.
- Development of objectives and characteristics of objectives
- Derivation and operationalization of variables.
- Developing assumptions and applications.

Unit-IV: Methods of data collection

- Concept of sampling and other concepts related to sampling
- Probability and non-probability samples, their characteristics and implications
- Tools of data collections, their types, attributes and uses
- Redesigning, research tools-like-questionnaire, opinnaere, observation, interviews, scales and tests etc.

Unit-V: Methods of data analysis

- Analysis of qualitative data based on various tools.
- Analysis of quantitative data and it presentation with tables, graphs etc.
- Statistical tools of data analysis – measures of central tendency, dispersion, relative position etc.
- Decision making with hypothesis testing through parametric and non parametric tests.

- Validity and delimitations of research findings

Unit-VI: Report writing and evaluations

- Principles of report writing and guide lines according to style manuals
- Writing and presentation of preliminary, main body and reference section of report
- Evaluation of research report.

Home assignment: How to submit research proposals? How to file patents?

MES-102 Compulsory Paper (100 Marks) 4 Credits

Information Technology

1. Knowing basics of computers for research applications
2. Introduction to Operating Systems
    i) MS Windows
    ii) Linux
3. Introduction to software
    i) Application software
    ii) Software related to research
4. Using Internet for research
    i) Internet ethics and information reliability
    ii) Finding authenticated information on www
    iii) Finding research related resources on www
    iv) Knowing research journals on www
5. Introduction to research related software
    i) Statistical data analysis software: SPSS, MS-Excel
    ii) Core calculations software: Mata-lab
6. Developing utility programs for research Programming languages C, Fortran
7. Research related tools and utilities
    i) Research publishing tools: MS-Word, Adobe Acrobat, LaTex etc.
    ii) Graphic tools: MS-Excel (Graphs), Hayward Graphics
    iii) Presentation tools: MS-PowerPoint
    iv) Subject/field specific research tools on WWW (Freeware)
8. Introduction to advance research IT related technologies
    i) Simulation
    ii) Modeling
    iii) Cluster Computing

Home assignment:

Study of at least two softwares associated with concern subject.

MES-103 (A) Optional (Any one paper of 100 Marks) 4 Credits

A) Microbial Environment & Biotechnology

Environmental Microbiology, Interrelations, Eukaryotes and Prokaryotes; Microbiology–Tools and Techniques: Microscopy, Staining methods: Monochrome, Differential, Negative, Acid fast. Growth Curve, Continuous Culture, Synchronous Culture, Quantitative Measurement of Bacterial Growth, Physical Conditions Required for Growth. (10)

Microorganisms in Soil, Functions of Microorganisms in Soil; Humus Formation; Functions of Humus; Nitrogen Fixation. Pasteurization of Milk, Manufactured Dairy Products; Food Microbiology: Initial Contamination of Fresh food, Microbial spoilage of Foods, Preservation, Industrial Process, Manufacture of Various Chemicals and Microbial Enzymes. (10)

Biotechnology Significance, Biotechnology and Environmental Protection, Sustainable Development, Biological Treatment, Bio-treatment Impact, Biodegradation of Pollutants. Biomass, Biogas Generation and its Significance in Waste recycling, Process of Biogas Production, Advantages and Disadvantages. Bio-ethanol, Bio-diesel, Agricultural wastes, Bio-fertilizer Applications. (10)

Vermi Composting Technology, Maintenance and Limitations of Vermi Composting, Merits and Demerits. Heavy Metal Contamination, Soil Pollutants. Biosensors and Environmental Pollutants, General Features, Aerobic Biological Treatment, Advanced Activated Sludge Process, Biological Filters, Xenobiotic compounds and Recalcitrance, Bioremediation, Bio-remedial uses. (10)

References:

01. Environmental Biotechnology: S. N. Jogdand, Himalaya Publishing House, Mumbai (2006).
02. A Textbook of Biotechnology: R. C. Dubey, S. Chand & Company, New Delhi (2002).
03. Environmental Biology: P S Verma & V K Agarwal, S. Chand & Co, New Delhi (2004).
04. Toxicology – Principles & Methods: M. A. Subramanian, MJP, Publishers, Chennai (2004).
05. Environmental Science: S.C. Santra, New Central Book Agency, Kolkata (2001).
06. General Microbiology Vol. I&II: C. B. Powar & H.FDaginawala, (Himalaya pub. House, Mumbai, 2002.
07. Fundamental principles of Bacteriology (TMH Edition): A. J. Salle, (Tata McGraw-Hill

Publishing Company Limited, New Delhi), 1974.
08. Microbiology: P. D. Sharma (Rastogi publication Meerut)
09. Soil Microbiology: Martin Alexander, Wiley Eastern Limited, 1981
10. Text Book of Microbiology: Anantnarayan & Paniker, Orient Longman Pvt. Ltd., 2005

B) Air Pollution & Control Technology

Air Pollution Scope, Natural Air Contaminants: Aerosols, Dust, Smoke, Fumes, Particulate Matter (PM), Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Fly ash, Photochemical smog; Gaseous air pollutants: Sulphur dioxide, Carbon monoxide, Organic vapors. Volcano, Accidental Fires in Forests, Thermal Power Stations, Automobile Exhaust, Climate Change Effect study. (10)

Effects of Air pollution on Human Health, Vegetation, Animals and Material. Greenhouse Gases and Remedies, Technological options, Kyoto protocol, Ozone depletion, Sources and Effects, Control efforts. (10)

Ambient Air Sampling, Analysis and Measurement, High Volume Air Sampler; Particulate Emission Control: Fabric Filters, Electrostatic Precipitators, Wet Scrubbers; Principles of Absorption and Adsorption; Packed Towers, Plate Towers, Spray Towers. (10)

Climate, Major Climatic Regions of the World based on Latitude and Distribution of Vegetation, Climatogram Studies. Meteorological Factors Influencing Air Pollution, Wind Velocity, Atmospheric Stability, Temperature Inversion, Temperature Measurement, Solar Radiation Measurement and its Uses. (10)

References:

01. Air Pollution: M. N. Rao (Tata McGraw – Hill publishing company, New Delhi)
02. Air Pollution: B. K. Sharma, H. Kaur (Krishna prakashan media, Meerut)
03. Fundamentals of Air Pollution: Richard W. Bowbel, Donald L. Fox, D. Bruce Tunner, & A.C. Stern (Academic Press, California)
04. Air Pollution control Engineering: Noel De Nevers, Mc Graw – Hill Int, New York)
05. Air Pollution: V. P. Kudesia (Pragati Prakashan, Meerut)
06. Climatology: Fundamentals and Applications: Mater J. R.

07. Introduction to Weather and Climate: Trewartha
08. The Atmosphere: An Introduction to Meteorology: Fedrik K. Lutgen, E. J. Tarbuck
09. Air Pollution (Volume I to X): A. C. Stern (Academic Press)
10. General Meteorology: H. R. Byers (Tata Mc Grew – Hill Publications, New Delhi)

C) Natural Resources & Management

Environmental Management Application, Objectives and Component. Fertilizer Management: Chemical and Bio-fertilizers; Pest Management: Chemical, Biological, Integrated Pest Management; Integrated Forest Management, Wildlife Management and Protection; Waste Management, Disposal of Solid and Liquid Waste. (10)

Global Environmental Policies and National Strategies for Protection of Environmental Quality, Agenda 21 of Earth Summit, Major International Organizations and Agencies Involved in Environmental Management. National Environmental Policy and its Practices. (10)

Environmental Legislation in India and its History; Scope for improvement; National Environmental Appellate Authority; Environmental Tribunal; Green Benches; Role of Central Pollution Control Board and State Pollution Control Boards. (10)

Air Pollution Prevention and Control Act (1981); Environmental Protection Act (1986); Convention of Biodiversity Act (1992); Salient Features of Wild Life Protection Act (1972) and Forest Conservation Act, 1980, Water Pollution Prevention and Control Act 1974. (10)

References:

01. Environmental Law and Policy in India: Divan S & Rosencraz A, Oxford Uni. Press, New Delhi. (2001)
02. Environmental Laws of India - An Introduction: CPR Environmental Education Centre, Chennai (2001).
03. Environmental Awareness and Education: V. P. Kudesia, Educational Publishers, Meerut Uttar Pradesh.
04. Biodiversity: V. P. Kudesia, Educational Publishers, Meerut, Uttar Pradesh.
05. Our Environment and Green Revolution: M. P. Mishra, S. Chand & Co. Ltd. New Delhi.(2000)

06. Environmental Concerns and Strategies: T. N. Khoshoo.

07. Environmental Management in India: R. K. Sapru.

08. Forests in India: V. P. Agrawal, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi (1968).

D) Solid Waste Management

Unit I: Solid waste pollution **20 hrs**

Introduction of solid waste, Sources and characteristics; Composition, Types of solid wastes: Residential wastes, Commercial wastes, Industrial wastes. Hazardous waste Types, characteristics and health impacts. Biomedical waste, e-waste: classification, methods of handling and disposal. Fly ash: sources, composition and utilization. Plastic waste: sources, consequences and management. Solid waste collection and transportation, container systems - hauled and stationary, layout of collection routes, transfer stations. Solid waste dumping site leads to leachate pollution, Surface water pollution, Groundwater water pollution

Unit II: Solid waste management and Control techniques, **20 hrs**

Solid waste processing and recovery– Recycling, recovery of materials for recycling and direct manufacture of solid waste products. Electrical energy generation from solid waste (Fuel pellets, Refuse derived fuels), composting and Vermicomposting, biomethanation of solid waste. Disposal of solid wastes – sanitary land filling and its management, incineration of solid waste. Hog feeding, open dumping, Pyrolysis, incineration, Controlled tipping, Pulverization, Hammer mills, rotating drum machines. '4R' principles of solid waste, solid waste pollution scenario in India.

Unit III: Solid waste legislation/Rules: **20 hrs**

The Solid Waste Management Rules, 2016, Hazardous waste management: Treatment Methods – neutralization, oxidation reduction etc, Hazardous waste management Act 1989, The Plastic Waste Management Rules, 2016, The e-waste (Management) Rules 2016, The Construction and Demolition Waste Management Rules, 2016; The Bio-Medical Waste Management Rules, 2016. Solid waste management case studies, current issues in solid waste management.

REFERENCES:

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01. **Soil and Noise Pollution :** B. K. Sharma, H. Kaur, Goel Publishing House, Meerut, 1994

02. **Solid waste pollution :** Dr. Aradhana Salpekar, Jnanada Prakashan, New Delhi, 2008

03. **Principals of soil science :** M. M. Rai

04. **Soil pollution & Soil organisms :** P. C. Mishra

05. **Environmental Chemistry :** B. K. Sharma

06. **Environmental Science :** S. C. santra, New Central Book Agency, Kolkata, 2005

07. **Environmental Pollution Control Engineering,** C. S. Rao, New age International, Mumbai, 2003

08. **Fundamentals of Soil Science :** Henry D. Foth, John Wiley & Sons, New York, 1984

09. **Environmental Engineering :** Davis & Cornwell, McGraw – Hill Publications, New York, 1998
10. **Environmental Science Principles and Practices :** R. C. Das, D. K. Behra, Printice Hall, New Delhi, 2008

E) Environmental Hazards & Toxicology

Scope and Distribution of Toxic substances, Hazardous waste problems in India, Toxic substances, Routes of Exposure: Inhalation, Eye absorption, Ingestion. Responses to Toxin Exposure, Duration, Dose response Relationship. Chemical carcinogenesis, Natural detoxification Routes, Saturated Aliphatic and Aromatic Hydrocarbons. (10)

Organic Chemicals in Soil and Environment. Water Solubility, Soil Adsorbents, Plant uptake, Inorganic Chemicals in Soil and Environment. Metal toxicity- Metals in bio-sorption- Air, Water, Soil, Plants, Animals, Microorganisms etc. (10)

Pesticide Toxicity– Introduction, Growth Regulation, Organo-chlorines, DDT, Heterocyclic Compounds, Organophosphates, Pesticides and Environment. Pesticides and Human health, Acute Poisoning, Chronic Poisoning. Eco-toxicology, Accumulation of Toxicants in Organisms, Toxic Residues, Residual Analytical Methods. (10)

Factors affecting toxicity, Evaluation of toxicity, Bioassays, Xenobiotics, Absorption and distribution of toxicants, Excretion of toxicants, Bio-magnification, Chemical safety evaluation of toxicants, Environmental hazards and environmental risk assessment, Categories of bio-medical waste. (10)

References:

01. Water Toxicology: V. V. Metelev, A. I. Kanaev, N. G. Dzasokhova, Amerind Pub. Co. Pvt, Ltd, New Delhi (1971).
02. Water Pollution and Toxicology: S. K. Shukla & P. R. Srivastava,, Commonwealth Publisher,
03. Industrial Toxicology: Raymond D Harbison, A Times Mirror Co, 5th Ed, New Delhi (2006).
04. Environmental Science : S.C. Santra, New Central Book Agency, Kolkata (2001).
05. Environmental Pollution Health & Toxicology : S V S Rana, Narosa Publishing House, New Delhi (2006).
06. Toxicology : P D Sharma, Rastogi & Company, Meerut (1995).

07. Principles of Environmental Toxicology : Ian Shaw & John Chadwick, Taylor & Francis, Padstow UK, (1998).
08. A textbook of Environmental Studies : G R Chatwal & Harish Sharma, Himalaya Publication House, (New Delhi) (2004).

F) Water Pollution & Control Methods

Precipitation & Types, Rainfall measurement, Surface sources, Rivers, Lakes, Streams, Ponds, Storage reservoir. Ground water quality, Natural contaminants, domestic wastewater, Industrial & commercial sources, Agriculture wastewater & problems. (10)

Physical characteristics of wastewater, Chemical characteristics of wastewater, Biological characteristics of wastewater and analysis, Phytoplankton, Zooplankton, Bacteriological water analysis: Coli forms, MPN (Most Probable Number), Presumptive, Confirmatory, Completed, Water Quality Standards, Hydrological and Global Water Cycle. (10)

Importance and need for Freshwater management, Eutrophication, Effects, Prevention of Eutrophication, Remedial measures. Water Treatment Methods: Necessity of treatment, Sedimentation, Coagulation, Filtration, Disinfection, Chlorination. (10)

Water Softening Methods, Purpose, Temporary & Permanent hardness removal, Lime soda process, Zeolite process, Demineralization process; Colour, odour and taste removal, Fluoridation; Defluoridation; Water Act 1974; Water conservation. (10)

References:

01. Industrial Chemistry: B. N. Chakrabarty, Oxford and IBH Pubn Co., New Delhi, 1998
02. Environmental Science: S. C. Santra, New Central Book Agency, Kolkata, 2005
03. Industrial Chemistry: B. K. Sharma, Goel Publishing House, Meerut, 1994
04. Industrial Hygiene: Dr. G. R. Kakri, Everest Publishing House, Pune, 1987
05. Reutilization of Industrial Effluents & Wastes : R. K. Baslara, A. K. Shrivastava, Pragati Prakashan, Meerut, 2008
06. Waste Water Treatment: S. P. Mahajan
07. Water Supply and Sanitary Engineering: S. C. Rangwala, R. C. Rangwala (Charotar Publishing House Anand)

08. Water and Waste Water Technology: Mark J. Hammer, Mark J. Hammer Jr. (Prentice Hall of India Pvt. Ltd., New Delhi).

G)Instrumental Techniques in Environmental Sciences

Sample preparation, Preservation and Processing, Separation, Sampling techniques, Precipitation, Fractional crystallization, Fractional distillation, Solvent extraction. Barometer, Temperature measurement: Turbidity measurement: Principle, Operation, Measurement of rain by Rain gauges & its types. (10)

Principles, Methods and applications of Thin Layer Chromatography (TLC): working and applications; Column chromatography: working and applications; Gas chromatography (GC): working and applications; High performance liquid chromatography (HPLC) Ion exchange chromatography: working and applications. (10)

Principle and working Ultra Violet (UV) Spectrophotometer: working and applications; Nuclear Magnetic Resonance (NMR): working and applications; Atomic Absorption Spectrophotometer (AAS): working, applications and its importance; Flame Photometer: working and applications; Fluoride meter: utility and significance; Conductivity meter: Working and applications; pH meter: working and applications. (10)

Theory and applications of High Volume Air Sampler, Respirable Dust Sampler (RDS) measurement and its scope, Suspended Particulate Matter Sampler (SPM) analytical significance, Particulate Matter (PM), its measurement and practical application, Human health. (10)

References:

01. Instrumental Methods of Analysis: Willard Merit and Dean (CBS Publication, New Delhi)
02. Instrumental Methods of Chemical Analysis: B. K. Sharma, Goel Pub. House, Meerut (1996).
03. Standard Methods for the Examination of Water and Waste Water: (APHA, AWWA & WPCF) 1985.
04. Instrumental Methods and chemical Analysis: H. Kaur, Pragati Prakashan, Merrut (2009).
05. Instrumental Methods of chemical Analysis: Chatwal and Anand (Himalaya Pub. House, New Delhi) 1994.
06. Instrumental Analysis: Gurdeep Chatwal (Himalaya Publishing House, New Delhi), 2000
07. Instrumental Methods: V. B. Borade (Nirali Prakashan, Mumbai)

08. Instrumental Analysis for science and Technology: W. Ferren (Agrobios India, Jodhpur)

H)Geographical Information Technologies

Introduction and fundamental concept of remote sensing; Interaction of EMR with earth surface features, Principles of Remote Sensing, Process of Remote Sensing, Active and Passive Remote Sensing, Indian Remote Sensing Programme, Types of Satellites- Sun-synchronous and Geostationary Satellites, Resolution- Spatial, Spectral, Radiometric, Temporal (10)

GIS: Introduction to GIS, Definition, History of GIS, Scope and Importance of GIS, Components of GIS, Hardware and Software components, Data models in GIS - Raster data model, Vector data model, basic entities of GIS: line, point and polygon, Geodatabase, Map Projection, Types and Need of projection system, Spatial and non spatial data, data editing in GIS, General processes involved in image processing, Georeferencing, mosaic, subset, Point interpolation techniques: Krigging, IDW, Introduction and Methods of Interpolation, Data analysis, network analysis, DEM and DTM, Thematic maps. concept of layer, digitizing, Data Base Management System: Concept, types of DBMS, Hierarchical, Network and relational data models, advantages and disadvantages (15)

GPS: Global Positioning Systems, History and developments in GPS, Trilateration process, types of GPS, GPS Surveys, Mapping and layout, Applications of GPS technology (07)

Applications of Geographical Information Technologies: Role in formulation of project report, Agricultural applications, Forest Applications, Land use Land Cover mapping, Natural hazards identification, Management of natural resources, Snow and glaciers studies, Coastal zone management, Marine fisheries (08)

Text Books and Reference Books:-

Laurini, Robert and Derek Thompson (1992). Fundamentals of Spatial Information Systems. Academic Pr., London

Thanappan Subash (2011). Geographical Information System, Lambert Academic Publishing.

Ahmed, E. L. Rabbany (2002): Introduction to Global Positioning Systems, Artech House, Boston

Anji Reddy, M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication, Hyderabad

Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York

Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London

Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York

Demers, M. N. (2000): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi
Drury, S. A. (2001): Image Interpretation in Geology, Blackwell, Oxford
Heywood, I., Cornelisus, S., Carver, S. (2011): An Introduction to Geographical Information Systems, Pearson Education, New Delhi
Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey
Joseph, G. (2004): Fundamentals of Remote Sensing, Universities Press, Hyderabad, India
Korte, G. B. (2001): The GIS Book, Onward Press, Bangalore
Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2008): Remote Sensing and Image Interpretation, John Wiley & Sons, New Delhi
Lo, C. P., Yeung, A. W. (2002): Concepts Techniques of Geographical Information Systems, Prentice-Hall of India, New Delhi
Longley, P. A., Goodchild, M. F., Maguire, D. J., Rhind, D. W. (2002): Geographical Information Systems and Science, John Wiley & Sons, Chichester

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