MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER

पाठ्यक्रम

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF SCIENCE

M.Sc. Remote Sensing & Geo-Informatics
M.Sc. (Semester I & II)
(w.e.f. 2015-16)
M.Sc. (Semester III & IV)
(w.e.f. 2016-17)

महर्षि दयानन्द सरस्वती विश्वविद्यालय, अजमेर

NOTICE

1. Change in Statutes/Ordinances/Rules/ Regulations Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

सूचना

1. समय-समय पर संशोधन या पुन: निर्माण कर परिनियमों/ अध्यादेशों/नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

MAHARSHI DAYANAND SARASWATI UNIVERSITY, AJMER
SYLLABUS
Scheme of Examination and courses of study

M.Sc. Remote Sensing and Geo-informatics (Semester I)-2015
M.Sc. Remote Sensing and Geo-informatics (Semester II)-2015
M.Sc. Remote Sensing and Geo-informatics (Semester III)-2016
M.Sc. Remote Sensing and Geo-informatics (Semester IV)-2016

1. Candidates for admission to the Master of Science Remote Sensing and Geo-informatics degree shall be required to have passed the Bachelor of Science, Bachelor of Computer Application, engineering or M.A./M.Sc in Geography. Candidate should have stereoscopic normal vision. Candidates having a minimum of 55% marks at graduate/postgraduate level will be eligible for the course and admission will be taken on the merit basis.

2. Students of reserved category will be given relaxation in percentage as per university rules.

3. The duration of the course is four semesters in two academic years covering two semesters in each year. The course work of the M.Sc. degree in Remote Sensing and Geo-informatics shall be in accordance with the scheme of examinations and syllabus prescribed.

4. The minimum attendance required by a candidate will be as per university rules.

5. A candidate for a pass at each of semester Examination and shall be required to obtain :
   a. at least 36% marks in the aggregate of the papers prescribed for the examination and
   b. at least 36% marks in the practical(s).

6. Wherever prescribed at the examination, provided that a candidate fails to secure at least 25% marks in each individual paper at the examination he/she shall be deemed to have failed at the examination notwithstanding having obtained the minimum percentage of marks required in the aggregate for the examination.

7. No division will be awarded at the first three semester examination. Division shall be awarded at the end of the second year after four semesters of examination and combined marks obtained at the each semester examination will be taken together as noted below :

First Division : 60% of aggregate or above marks taken together.
Second Division : 48% of aggregate or above marks taken together.

All the rest will be declared to have passed the examination.

8. Educational tours for M. Sc. Students (at least once in two semesters) will be organized to important places related to Remote Sensing and Geo-informatics interest within or out side the state under the supervision of faculty member/s of the department as per the requirement of the syllabus. The expenses will be borne by the participating students. However. the university will provide Train/ Bus concession as per necessity and University rules. Traveling expenses of the teacher/s will be borne by the university as per rules of TA/DA.

SCHEME OF EXAMINATION

Paper	Nomenclature	Max. Marks
M.Sc. Semester I		
Paper I	Basics of Remote Sensing	50
Paper II	Principles of GIS	50
Paper III	Principles of GPS and Digital Cartography	50
Paper IV	Geodesy, Surveying and Projections	50
PRACTICAL		**100**
	Experimental work	60
	Practical record & scientific material preparation	20
	Viva voce (Based on Experiments)	20
	Total	300
M.Sc. Semester II		
Paper V	Thermal and Microwave Remote Sensing	50
Paper VI	Digital Image Processing	50
Paper VII	Indian Space Programme	50
Paper VIII	Photogrammetry	50
PRACTICAL		**100**
	Experimental work	60
	Practical record & Seminar	20
	Viva voce (Based on Experiments)	20
	Total	300

M.Sc. Semester III		
Paper IX	Space Technology and Climate Change	50
Paper X	Spatial analysis and trends in GIS	50
Paper XI	Applied Statistics and basics of computing	50
Paper XII	Applications of Remote Sensing and Geo-informatics	50
PRACTICAL		**100**
	Experimental work	60
	Practical record & scientific material preparation	20
	Viva voce (Based on Experiments)	20
	Total	300

M.Sc. Semester IV

Dissertation based on Project work	**150**
Project presentation and Viva Voce	**150**
Total	300

Total of M.Sc. All Semesters	1200

1. Practical Examination would be conducted by Board of Examiners consisting of one internal and one external Examiner.

2. Dissertation work will be carried out by the candidate from the institute/company/NGO related to Remote Sensing and Geo-informatics to be selected by candidate however recommendation letter will be issued by the HOD. The duration of the project will be of one semester of the M.Sc. The dissertation will be submitted in the department under the supervision of subject expert and one faculty member of department. Evaluation of Dissertation work will be done by the internal and external examiner at the time of practical examination of IV Semester. The remuneration to external and internal examiner will be paid as per university rules for evaluating project work of each candidate.

Semester I

Paper I : Basics of Remote Sensing

Section A
Data acquisition: Sources of energy, propagation through the atmosphere, Atmospheric windows and scattering, electromagnetic spectrum, Radiation Laws, interaction of radiation with matter, spectral signature, resolution- spatial , temporal, spectral, radiometric. Sensing systems- air borne and space borne platforms, Active and passive sensors.

Section B
Principles of earth observation satellite - platforms and orbits, Remote Sensing sensors, Multi-spectral scanning principle, Thermal Scanners, Microwave sensing. Land observation satellites, Characteristics of real and ideal remote sensing system, advantages of remote sensing. Energy recording technology.

Section C
Visual data processing and analysis: Types of data products, Fundamental of image interpretation, Elements of image interpretation –tone, texture size, shape, shadow, pattern, location, association. Visual interpretation – interpretation techniques – detection, recognition and identification. Ground truth, aids of image interpretation.

Paper II: Principles of GIS

Section A
Overview –GIS definition and Terminology, H/W and S/W requirements for GIS, Components of GIS and GIS work flow, Theoretical framework for GIS. Data models and structure, Data acquisition procedure. GIS hardware-Raster and Vector formats, GIS queries, GIS software

Section B
Conceptual modeling of spatial and non spatial data, database creation, editing and topology, Data quality estimation: sources of errors and calculation. Raster and Vector data models conversion method, image storage formats.

Concepts and need of integration, Data base management system, GIS

data file management, Storage of GIS data, and Object based data models, data base models. Types of data structure, raster and vector formats, advantage and disadvantage of various data structure and data formats

Section C
Overview spatial data analysis overlay operations, Buffers, interpolation methods. Vector based analytical technique; Raster based analytical technique, Network analysis concepts and models, Terrain characteristics analysis. Method of spatial analysis, GIS and Remote Sensing data integration, digital elevation modal (DEM).

Paper III : Principles of GPS and Digital Cartography

Section A
Introduction of global positioning system, Satellite Constellation, GPS signals and data, Geopositioning basic concepts, Components of GPS: control segment, space segment and user segment, GPS positioning types: absolute positioning and relative positioning, GPS and differential GPS, GPS accuracy. Error corrections.

Section B
Number of satellites, multipath, ionosphere, troposphere, satellite geometry, satellite signals and its strength, distance from the reference receiver, radio frequency (RF) interference, Loss of radio transmission from base. Selection of reference station, reference station equipment: GPS receiver, GPS antennae, Radio and its types, radio antennae and cables.

Applications of GPS. Navigation, IRNSS System, Surveying and mapping Remote Sensing and GIS.

Section C
Categories of maps, Cartographic objects and databases, Data measurement , cartographic design, colour and pattern, map lattering , map compilation, map scale, Generelisation, symbolization, dot, isarithm and Choropleth mapping, 3D multivariate and dynamic mapping, map production.

Paper IV: Geodesy, Surveying and Projections

Section A
Basic concept of geodesy, datum/ Ellipsoid/ Geoid . Coordinate Systems, Geographical referencing system, Maps, Map types, Scale factors, Scale types, symbol, symbol types ,cartographic generalization, map numbering, Indian Grid system, Historical Evaluation.

Section B
Map Projections; Properties of map to be considered for choosing a map projection, Map Projection types - conical , cylindrical , plannar. Aspects of Projection- normal, Transverse, and oblique. View point of projection- Gnomonic, orthogonal , stereomorhic. Commonly used map projections and their comparison- Polyconic ,Lamberts, conical , orthomorhic, (conformal) and UTM Projections.

Section C
Visualization of geospatial Data: Design and Geometric aspects, Database management systems , spatial data representation. Raster and vector data, Basics of Surveying ,Coordinates of points , establishment of control points, coordinate extension, Azimuth angles, Survey equipments.

Practical
Laboratory Experiments

1. **Visual Image interpretation**

   Visual analysis of satellite data and their area calculation using dot grid and planimeter.

2. **Geographical Information System (GIS) using ARC GIS Editing & topology building, spatial and non-spatial data Integration (Linking of tables and joining tables)**

3. **Mapping and Surveying using GPS and DGPS**

4. **Soil analysis & Mapping**

Semester -II

Paper V: Thermal and Microwave Remote Sensing

Section A
Thermal imagery and Energy Exchange Theory, Thermal Imagery and Atmosphere System, Factors Affecting Thermal Imagery, Environmental Factors affecting Thermal Image, Qualitative and Quantitative Image Interpretation.

Section B
Active and passive microwave systems, Backscattering, Cross-section, Wavelength, Incidence angle, Aspect angle, Polarization, Complex die-electric properties, Surface roughness, sub-surface roughness, volume Scattering.

Section C
Radar: Radar Geometry, Resolutions in Radar, Errors in Radar image, Radar image and mosaics, SLAR and SAR System, Radar imagery merged with other imagery. Applications of Microwave and Thermal Remote Sensing.

Paper VI: Digital Image Processing

Section A
Concepts of digital image and its characteristics: Spectral, Spatial Radiometric and Temporal resolution. Visual vs. Digital methods, Image data storage and retrieval storage formats. Image displays B & W and FCC. System design considerations: Hardware and software requirements.

Sources of image degradation, Image restoration and Noise abatement – Radiometric and Geometric correction techniques. Interpolation methods – linear and non linear transformation for geometric corrections,

Section B
Display forms, Look-up Tables (LUT), Enhancement techniques: Contrast stretching: Linear and non-linear methods, Filtering techniques: Image smoothing, Edge enhancement and Edge Detection, Gradient filters,

Directional and non-directional filtering. Multi-band enhancement techniques: Principal Component Analysis, Band ratio, Types of Vegetation indices, Resolution merge techniques.

Section C

Concept of Pattern Recognition, Multi-spectral pattern recognition, Spectral discrimination, Characteristic curves, Signature bank, Parametric and non-Parametric classifiers, Unsupervised classification methods, Supervised classification techniques, Change detection techniques. Limitations of standard classifiers. Elementary concept of Artificial Neural Networks and Fuzzy sets.

Paper VII: Indian Space Programme

Section A

Indian Space Programme towards National Development -Indian Space endeavors, approach, primary objectives & its thrust areas, history of the Indian Space Programme & its major events.

Section B

Indian Space Programme-Stages of evolution, Indian Space Research Organization (ISRO), evolution of Indian Remote Sensing IRS programme, and coverage cycle, evolution of Indian Remote Sensing application programme, Space Applications Centre, National Remote Sensing Centre, Regional centres of space Department.

Indian Remote Sensing Application Missions- Natural Resources Management System, Earth Observation System, Space Applications, INSAT Applications, Space Transportation

Section C

Characteristics of Indian Remote Sensing Satellites - IRS Series of Satellites, sensors & its specification. Characteristics of communication satellites- INSAT series of satellites. launch vehicles of satellite - launch facilities, space programme-IRS- P4 mission, IRS- P5 mission, Radarsat-2 mission, IRS P6 mission, Gsat International mission of Remote Sensing satellites, remote sensing satellite imaging systems, forthcoming Indian and foreign Remote Sensing satellites, & future plans.

Paper VIII: Photogrammetry

Section A

Introduction: Historical development, definition of Photogrammetric terms, types of photographs. Relief and Tilt displacement. Fundamental concepts of Aerial photography and flight planning.

Stereovision: overlaps required for stereovision, binocular vision, accommodation and convergence, stereoscopic viewing, principle of stereoscopy, pocket and mirror stereoscopes.

Section B

Parallax: measurement of absolute and differential parallax; parallax bar and wedge, measurement of height, principle of floating marks, contouring from stereometric height, measurement of slopes/dips. Stereoscopic exaggeration; model deformation, elements of exterior and interior orientation.

Aerial mosaics: uncontrolled, semi-controlled and controlled mosaics, comparison with maps. Orthophotographs.

Section C

Terrestrial photogrammetry: Principle and applications; merits and demerits; comparison of aerial vs. terrestrial photographs.

Aero-triangulation: Radial line methods, graphical, mechanical and analytical methods, scaling, GCP and rectification.

Digital photogrammetry: Principles of EDM instruments. Methods of Digital Photogrammetry.

Coordinate System: Airborne components. Degrees of freedom. Image coordinate; object coordinates. Coordinate transformation.

Practical
Laboratory Experiments

1. Digital Mapping

1. Base map preparation.
2. Designing of a Map.
3. Selection of Geographical co-ordinates.
4. Scanning of a map
5. Symbolization of map

6. Updating of maps
7. Analysis of topographical maps.
8. Digitization of maps.

2. Digital Image Processing

1. Display of B/W and FCC image on ERDAS image processing softwares.
   Geometric correction and mosaicking of image
   Single band enhancement techniques.

2. Radiometric enhancement
   Linear stretching
   Non-Linear Stretching

3. Edge enhancement
   Low pass filters
   High pass filters
   Multi-band enhancement techniques

4. Principal component analysis for multi-band data
5. Band ratio and NDVI
6. Pattern recognition
7. Unsupervised classification
8. Supervised classification
9. Map Composition
10. Output preparation

3. Photogrammetry & Photo-interpretation

3 D Vision test using pocket stereoscope.
Scale and dimension, Measurements using single photograph.
Annotation of aerial photographs. Drawing of flight line.
Height measurement of an object using stereomodel.
Slope determination.
Contouring using stereomodel.
Interpretation of single aerial photograph and comparision with a stereopair, Interpretation of aerial photographs for the mapping of Geomorphology. Land use/land cover and Transport network.

Semester III

Paper IX - Climate change and Space Technology

Section A

Composition, mass and structure of the atmosphere, Distinction between weather and climate, Heat balance of the earth: Vertical and horizontal distribution of temperature, green house effect, Temperature zones: Tropical, temperate and high latitude weather systems, Meteorological observations, Oceanography- physical attributes: temperature, salinity, structure, mixing, waves, internal waves, tides, Water currents, Influence on monsoon, Ocean atmospheric interaction-EL Nino, southern oscillation (ENSO) and La Nina, Climatic zones of India. Climatic Classification of Koppen and Thornthwaite, Theory of climatic changes, Regional and hemispherical models, Evidences Possible causes, global warming, Indian climates and its controls, Monsoon, Western disturbances, Jet streams.

Section- B

The Greenhouse Gases, Role of Carbon Dioxide, Role of Methane, and Major Uncertainties: Co_2 Emissions: Human Emissions of Co_2, Co_2 status in atmosphere, Carbon in the Ground, Earth's Carbon Reservoirs, Biogeochemistry, Carbon Cycling: Chemical Processes in the Atmosphere: Carbon Pollutants, Sulfur Pollutants, Nitrogen Pollutants, Atmospheric Photochemical Oxidants, Air Toxics.
Water Pollution – sources and types: Water Pollution: Sources of water and its quality, Definition and sources of water pollution.

Micro climate, Global climate, Impact of climate change on the glacier health, Glacier as environmental thermometer, Glacier fluctuations- an indication of climatic variations, climate change in response to the ice melt and global sea level rise.

Section C

Different type of satellite images viz. Visible, IR and Microwave, Image enhancement techniques, Weather satellite data - from polar orbiting and geostationary satellites, Radar observation of precipitation, Principle and uses of Radar in cloud physics. Characteristic features of satellite and uses of Radar in cloud physics. Characteristic features of satellite imageries: Cloud features associated with jet stream, Western disturbances and tropical cyclones. Glacier inventory: Types of glaciers, Zones of glaciers, Glacier movement, Identification and mapping of Glacial features by traditional and remote sensing methods, field investigations,

Glacier volume estimation, Glacier retreat and deformation, Glacial landforms, Glacier compositions and structures, Shapes and dimensions, Glacial erosion, Landscape evolution under glaciers, Remote sensing systems for pollution studies.

Paper X: Spatial analysis and trends in GIS

Section A
Statistical analysis, Measurement, Proximity analysis, (buffering), overlay analysis, classification, Network analysis, multicriteria analysis, nearest neighbour analysis, thiessen polygons, surface mapping, interpolation techniques (including TIN),

Section B
Digital Elevation model (DEM), Terrain reclassification-slope, aspect, angle of incidence etc. visibility analysis, Semi variogram and kringing, regression and corelation analysis, gravity modeling, change detection, spatial and non-spatial query

Section C
HTML, Web GIS, 3D GIS, and Object oriented GIS, Mobile GIS, Location based services, Knowledge based GIS, Spatial data warehousing, spatial data mining GIS design and implementation. GIS and integration of other types of data, Application of Remote Sensing based GIS

Paper XI : Applied Statistics and basics of computing

Section A
Review of Frequency distribution, Measures of location, central tendency, Dispersion, Skewness, Kurtosis, Variance, correlation, Co-Variance Regression analysis,

Random and discrete variables – probability density and distribution function. Standard distributions-Binomial poisson, Normal and Bi-Variate normal distributions Sampling distribution of statistics – standard error – 't', 'f' chi-square and 'Z' Distribution, Interval estimation for population means, standard deviation, difference means, point estimation, maximum likelihood and least square estimation.

Section B
Small samples, Tests concerning proportions, Chi-square test, goodness of fit test and test of independence. Design of Experiment: Introduction to Randomised block design, Latin square and Factorial design, Analysis of variance.

Conventional computers, Programming languages, Data Structure, Stage of language development, Arithmetic and logical operators and their concepts.
Basic Computer Organization, Central Processing unit. Number System: Binary, decimal, hexadecimal and octal systems, conversion from one system to the other, Binary Arithmetic: Addition, subtraction and multiplication, Character codes (ASCII, EBCDIC)

Section C
C fundamentals, data types, variables, constants, operators, expressions, assignment statement, control statements, arrays, functions, pointers, strings, structures union and enumerated data type, C preprocessor, files. C-programming applications: sorting (Bubble sort, selection sort), searching (binary search, linear search).
Visual basic concept/fundamentals: form and other GUI objects. Designing applications, variables and constants, program using decision statements and loops, build menus, arrays, active X control, single document interface and multiple document interface, object linking and embedding, database connectivity.

Paper XII : Applications of Remote Sensing and Geo-informatics

Section A
Agriculture: Vegetation types, Spectral Properties of vegetation, Crop yield and acreage estimation.
Soil classification, Land capability, Land degradation and erosion, Water-logging, Salinity, Desertification,

Forestry: Forest types and forest Classification and wild life management.

Human Settlement Analysis: Settlement types and patterns, Urban Master Plan/New town development plan, Urban landuse classification, Urban change detection and urban sprawl. Utility mapping. Existing transportation network, Landuse pattern and traffic system, Shortest rout planning,

Section B
Resources Management : Concepts and definitions, Resource classification systems, Resources Inventories, Resources Identification, Resource survey, Problem identification, Thematic mapping, Resource area measurement, Resource monitoring. Resource conservation and

planning for development. Sustainable Development and Decision Support System.

Disaster Management issues and fundamentals- Disaster management fundamentals, elements of hazard mapping, risk analysis, Damage assessment, loss analysis- hazard mitigation. Disaster Mitigation planning and strategies for implementation, Role of Geo informatics in disaster mitigation measures.

Section C
Hydrology & Water Resources: Basic Concepts, Hydrologic Cycle, Hydrological parameters,

Surface & Ground-water exploration- Surface water, Classification of streams and rivers, Drainage basin and Catchment, Ground-water regimes Geophysical techniques for Ground-water prospecting. Application of remote sensing for the hydro-geomorphological and ground water exploration.

Watershed management- Watershed definition and scope, Watershed classification and coding, watershed modeling, Evaluation of hydrologic parameters, Watershed management

Water Resource Evaluation- Estimation of Soil Moisture, Evaporation, Snow cover mapping. Run-off and discharge , Water Conservation Projects, Site Location for river valley projects, Dam site (Storage and diversion projects) selection

Practical
Laboratory Experiments

1. **Exercises based on Programming**

2. **Exercises based on ARC GIS and Software prepared by ISRO for combined image processing and GIS.**

M.Sc. Semester IV

Dissertation based on Project work
Project presentation and Viva Voce

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