

**उत्तर पूर्वी अंतरिक्ष उपयोग केंद्र/North Eastern Space Applications Centre**

**भारत सरकार/Govt. of India, अंतरिक्ष विभाग/Dept. of Space**

**उमियम/Umiyam – 793103, मेघालय/Meghalaya**

Tel: 0364-2570140, Fax: 2570139

JRF Recruitment for NESAC

No. NESAC/RMT-JRF/11.4(VII)/2016

December 18, 2016

North Eastern Space Applications Centre (NESAC) is an autonomous body set up under the joint initiative of Department of Space (DOS) and the North Eastern Council (NEC). The main function of the Centre is to provide developmental support to the North Eastern Region (NER) of our country using space science and technology.

NESAC proposes to recruit the following positions of Junior Research Fellow (JRF) purely on temporary basis for various projects.

Post Code No.	No. of posts	Project Name	Essential Qualifications	Desirable qualification
01.	02	Aerosol Radiative Forcing over India (ARFI) & Network of Boundary Layer Experiments	M.Sc in Atmospheric Science/ Applied Physics/ Physics with NET or equivalent **. <b>OR</b> M.Tech in Atmospheric Science <b>OR</b> M.Sc in Atmospheric Science/ Applied Physics/ Physics with N-JET in Atmospheric Science ***.	Working knowledge in LINUX OS, programming in MATLAB, FORTRAN, IDL, etc
	03	Flood Early Warning Systems (FLEWS)	M.E/M.Tech in Civil Engineering/Remote Sensing/ Geology <b>OR</b> M.Sc in Remote Sensing/ Geology/ Geography/ Environmental Science with NET/ GATE or equivalent ** <b>OR</b> M.Sc in Remote Sensing/ Geology/ Geography/ Environmental Science with N-JET in RS & GIS Specialisation. ***	Working knowledge of Remote Sensing and GIS preferably in Watershed hydrology related areas.
03	01	River Atlas		
	04	Preparation of Forest Working Plan inputs for the Arunachal Pradesh	M.Sc in Botany/Forestry/Geography/ Applied Geography/Ecology/Remote Sensing and GIS/Geoinformatics with NET/Gate or equivalent ** <b>OR</b> M.Tech in Remote Sensing and GIS/ Geoinformatics <b>OR</b> M.Sc in Botany/Forestry/Geography/ Applied Geography/Ecology/Remote Sensing and GIS/Geoinformatics with N-JET in RS & GIS Specialisation ***.	Working knowledge of Remote Sensing and GIS in the field of forestry/ecosystem/ biodiversity, etc.
	01	Preparation of Forest Working Plan inputs for the Mizoram		
	01	IGBP-NCP-VCP Phase II for Meghalaya		
	01	NRC LULC-250K		

04.	01	Empowering Panchayati Raj Institution Spatially (EPRIS)/ SIS-DP	M.Sc in Regional Planning/Planning/Remote Sensing and GIS/Geoinformatics / Environmental Science/ Geography with NET/Gate or equivalent ** <b>OR</b> M.Sc in Regional Planning/ Planning/Remote Sensing and GIS/ Geoinformatics/Environmental Science/ Geography with N-JET in RS & GIS Specialisation***.	Experience in use of RS & GIS
05.	02	Applications of RS & GIS for Sericulture Development-Phase II	M. Sc. in Agriculture / Sericulture / Geography / RS and GIS /Geoinformatics with NET or equivalent **. <b>OR</b> M. Tech in Remote Sensing/ Geoinformatics. <b>OR</b> M. Sc. in Agriculture / Sericulture / Geography / RS and GIS /Geoinformatics with N-JET in RS & GIS Specialization. ***	Experience in use of RS & GIS

**\*\* NET/NET Equivalent qualifications:**

- i. CSIR-UGC National Eligibility Test including NET-Lecturership
- ii. Graduate Aptitude Test in Engineering (GATE) conducted by MHRD
- iii. Joint Admission Test (JAM) conducted by MHRD
- iv. Biotechnology Eligibility Test & Test conducted in Bio-informatics by Bio-informatics National Consortium
- v. Joint Entrance Screening Test (JEST), Joint Graduate Entrance Examination for Biology & Interdisciplinary Life Sciences (JGEEBILS) conducted by Department of Atomic Energy.
- vi. All India Competitive Examination (AICE) conducted by the Indian Council of Agricultural Research.

- Note:**
1. CSIR-UGC NET or equivalent /M.Tech qualified candidates are directly eligible to apply
  2. Others (i.e. not having CSIR-UGC NET/M.Tech qualified) need to qualify N-JET to be short listed for interview
  3. Selection will be purely based on interview performance.

**\*\*\* N-JET (NESAC JRF Eligibility Test):** N-JET is an aptitude test for taking up research in the area of either Remote Sensing (RS) and Geographic Information System (GIS) or in the area of Atmospheric Science. The N-JET written test shall be conducted and results will be declared before the interview for the advertised JRFs. Candidates having M. Sc. degree and not qualified NET/GATE or equivalent examination in their respective fields, may also apply for the advertised positions. Those candidates need to apply and qualify the N-JET in either RS & GIS (Candidates from RS & GIS/Botany/Ecology/Forestry/ Environmental Science/Agriculture/Geology/Geography/Applied Geography/ Geoinformatics/Regional Planning or equivalent stream are eligible to apply) or in Atmospheric Science (Candidates from Physics/Atmospheric Science/Applied Physics or equivalent stream are eligible to apply) to become eligible for the JRF posts. For details about N-JET please refer to ANNEXURE - I.

All the above posts are purely on contractual basis and co-terminus with the project without any provision for regularization. The contract is for a period of 1 (one) year and can be extendable depending upon the project requirements and assessment of their work. The Director reserves the right to cancel/postpone the interview/written test without any reason thereof. He also reserves the right to terminate the contract, even before completion of the project for which no appeal thereof shall be made. Canvassing in any form will disqualify the candidates. Candidates who do not fulfill eligibility condition will not be considered for the interview.

Note: 1) Number of positions indicated above are provisional and may vary depending on the actual requirement.

- 2) ME/M.Tech or its equivalent degree should be in first class with an aggregate minimum of 60% or CGPA/CPI grading of 6.5 on a 10 scale or equivalent. BE/B.Tech/M.Sc degree should be in first class with an aggregate minimum of 65% (average of all semesters) or CGPA/CPI grading of 6.84 on a 10 scale or equivalent. Rounding-off marks is not allowed.

### **Age Limit:**

Maximum Age 28 years as on **16.01.2017** (closing date of receipt of applications) but relaxable by 5 years in case of SC/ST and 3 years in case of OBC candidates. Persons with Disabilities are eligible for age relaxation as per Government of India orders. Age relaxation as per Government of India orders are applicable to Ex-Servicemen, Persons with Disabilities (PWD).

### **Emoluments & Other benefits:**

**Fellowship amount: `25,000/-. In addition HRA and medical benefits will be allowed as per rules.**

In addition to the above mentioned fellowship amount, HRA at the prescribed rates in force at the place of posting will be paid and Medical benefits for self only will be allowed as per extant rules. The fellowship amount shall be taken as Basic pay for this purpose.

JRFs are eligible only for casual leave. Maternity leave as per Govt. of India instructions would be available to all female JRFs. Apart from this, the candidates selected will not be entitled to any benefits or concessions admissible to regular employees.

### **How to apply:**

The application form will be hosted in the NESAC web-site [www.nesac.gov.in](http://www.nesac.gov.in). Last date for submission of On-line Application Forms is **16.01.2017** and closing time will be 16.00 Hrs. **Candidates need to apply through online mode only.** Those who are working in Central Govt./State Govt. or its autonomous bodies/PSU/Corporation are required to send the NOC within two weeks of the last date of online application.

### **Selection Process:**

The qualification prescribed is the minimum requirement and possession of the same does not automatically make the candidates eligible to be called for interview. A duly constituted Screening Committee shall screen the applications received for the posts

based on the given eligibility criteria and may fix criteria as it may consider necessary for shortlisting the candidates for interview. In case candidate is claiming equivalent specialization, he/she has to obtain certificate from his/her institute/university stating that the specialization is equivalent to the one asked in the advertisement for the post applied for. Final decision on this will be taken by the Screening Committee. The screened-in/shortlisted candidates will be called for interview before the Selection Committee. Communication shall be sent only to the screened-in/shortlisted candidates. NESAC will not entertain any correspondence on the issue of short-listing of candidates. **The call letters for the interview to the short-listed candidates will be sent only by e-mail.** No communication shall be made to the candidates who are not short-listed/Screened in.

**General Conditions:**

- Only passed candidates are eligible to apply. Students awaiting for final result need not to apply.
- Applications will be through online mode only and all further communications will be made to the applicants through e-mail/NESAC website only. Therefore, the applicants are advised to check their e-mail and visit the NESAC website from time to time. NESAC will not take responsibility for non-receipt of intimation regarding call letter/any communication due to technical reasons or whatsoever to the candidates
- The selected candidates shall be posted at NESAC, Umiam.
- Candidates called for interview will have to produce all relevant original documents in proof of details furnished in the application along with a set of self-attested photocopies. Candidates who are already employed under Central/State Government, Public Sector Undertakings or Autonomous Bodies will also have to produce the 'No Objection Certificate', in original, at the time of interview. In case the candidate fails to produce any of the above documents or if any information furnished in the application is found to be wrong or false, the candidate will not be interviewed.
- Junior Research Fellows will be engaged initially for ONE YEAR and is extendable for further periods based on assessment of their work and requirement of project. The maximum period of engagement of Junior Research Fellow shall not exceed FIVE years. The fellowship will not confer any claim or right for regular appointment in any of ISRO/DOS Centres. The JRFs are purely on temporary basis for a maximum period of one year or the period of the Project whichever is earlier.
- The selected JRFs are encouraged to register for Ph.D from recognized universities and take up relevant research topic benefitting the individual and NESAC. However they have to work extra time to complete the Ph.D research. No leave is possible for Ph.D work.
- NESAC/DOS reserves the right not to fill all or any of the fellowships, if it so decides.
- Canvassing in any form will result in disqualification.
- No interim correspondence will be entertained.
- 16.01.2017 will be cut-off date for all purposes like age, qualification, etc.
- The prescribed experience should be after acquiring the essential qualification.

- Only Indian Nationals need to apply.
- Government strives to have a workforce which reflects gender balance and women candidates are encouraged to apply.

It is for the candidate to ensure that he / she fulfills the eligibility criteria and complies with the requirements and adheres to the instructions contained in this advertisement as well as in the application form. Candidates are, therefore, urged to carefully read the advertisement and complete the application form and submit the same as per instructions given in this regard.

<b>IMPORTANT</b>
<b>OPENING DATE FOR SUBMISSION OF ONLINE RECRUITMENT APPLICATION THROUGH NESAC WEBSITE IS ON 22.12.2016</b>
<b>CLOSING DATE FOR SUBMISSION OF ONLINE RECRUITMENT APPLICATION THROUGH NESAC WEBSITE IS 14.00 HRS ON 16.01.2017</b>
<b>DATE FOR DETERMINING THE ELIGIBILITY OF ALL CANDIDATES IN EVERY RESPECT SHALL BE THE PRESCRIBED CLOSING DATE FOR SUBMISISON OF ONLINE RECRUITMENT APPLICATION. THE APPLICANTS ARE ADVISED TO FILL IN ALL THEIR PARTICULARS IN THE ONLINE RECRUITMENT APPLICATION CAREFULLY.</b>
<b>DATE FOR THE INTERVIEW ON WHICH THE SHORTLISTED CANDIDATES ARE REQUIRED TO BRING THE PRINTOUT OF HIS/HER ONLINE APPLICATION ALONGWITH OTHER DOCUMENTS AT NESAC SHALL BE INTIMATED SEPARATELY.</b>
<b>CANDIDATE SHOULD UPLOAD THE MERGED DEGREE AND MARKSHEETS IN ONE PDF FILE FOR ONE PARTICULAR QUALIFICATION e.g. FOR B.TECH, DEGREE &amp; MARKSHEETS OF ALL THE SEMESTERS SHOULD BE MERGED AND UPLOADED AND SIMILARLY FOR OTHERS ALSO.</b>

**NESAC JRF Eligibility Test (N-JET)**

North Eastern Space Applications Centre (NESAC) is an autonomous body set up under the joint initiative of Department of Space (DOS) and the North Eastern Council (NEC). The main function of the Centre is to provide developmental support to the North Eastern Region (NER) of our country using space science and technology. From time to time, NESAC had been recruiting Junior Research Fellows (JRFs) under several national and state level projects in various stream.

**About N-JET:** N-JET is an aptitude test for taking up research in the area of either Remote Sensing (RS) and Geographic Information System (GIS) or in the area of Atmospheric Science. The test is open to all candidates having M. Sc. degree and not qualified NET/GATE or equivalent examination in their respective fields to become eligible for applying for JRF positions at NESAC. Students with B.Tech / BE are not eligible to appear for N-JET. N-JET is merely qualifying in nature and selection to the post of JRFs will be purely based on performance in the interview.

Those candidates willing to apply for N-JET (NESAC JRF Eligibility Test) shall apply only through our website: [www.nesac.gov.in](http://www.nesac.gov.in)

**Eligibility Criteria**

Minimum education qualification for N-JET is passing Master in Science degree in first class in the respective disciplines for which candidate is willing to apply.

**For RS & GIS Specialisation:**

M.Sc with 65% in RS & GIS/Botany/Ecology/Forestry/Environmental Science/Agriculture (any stream)/Geology/Geography/Applied Geography/Geoinformatics/Regional Planning and equivalent.

**For Atmospheric Science Specialisation:**

M.Sc with 65% in Physics/Atmospheric Science/Applied Physics and equivalent.

**Scheme of examination:**

- 1) The exam will be conducted through offline mode and will consist of 100 objective type MCQs (Multiple Choice Questions) of one mark each thus maximum marks as 100, with no negative marking and the duration of the exam shall be of 02 hours. Detailed Syllabus is given in **ANNEXURE II**.
- 2) The cut off marks for qualifying the written test shall be of 50 marks.
- 3) The tests will be conducted in two (02) broad disciplines i.e Atmospheric Sciences & RS&GIS. RS&GIS is further divided into 06 specializations as follows:

**Break up of 100 marks in N-JET question paper:**

**3.1 For Candidates appearing for RS&GIS specialization**

Part A - I	RS&GIS (Common)	25 marks	75 marks
Part A - II	RS&GIS (Specialized) OR Life Sciences (Botany/Ecology) OR Forestry/Environmental Sciences OR Agriculture OR Geology OR Geography/Applied Geography	50 marks	
Part B	General and Research Aptitude	25 marks	
<b>TOTAL</b>		<b>100 marks</b>	

**3.2 For Candidates appearing for Atmospheric Science specialization**

Part A	Atmospheric Sciences	75 Marks
Part B	General & Research Aptitude	25 marks
<b>TOTAL</b>		<b>100 marks</b>

**Validity of the Score:**

The Score of the Test will be valid for the period of 03 (three) year from the date of declaration of the results and the qualified candidates can apply for the post of JRF at NESAC which will be advertised for recruitment during that period with the above score card. Any candidate who do not wish to apply for JRF presently, may also appear for N-JET.

**How to apply**

The application form will be hosted in the NESAC website [www.nesac.gov.in](http://www.nesac.gov.in). Last date for submission of On-line Application Forms is 02.01.2017 and closing time will be 16.00 Hrs. **Candidates need to apply through online mode only** at our website: [www.nesac.gov.in](http://www.nesac.gov.in).

**Centre for the Test:** Will be intimated later

**General Conditions:**

1. Only those who have completed their master degree are eligible to apply. Students awaiting for final result need not to apply.
2. Candidates need to upload their documents while applying through online mode.
3. Candidate should upload the merged degree and marksheets in one PDF file for one particular qualification e.g. for M.Sc degree & marksheets of all the semesters should be merged and uploaded

:1:

**Syllabus for N-JET (NESAC JRF Eligibility Test):****I. AGRICULTURE****1. Agronomy**

Principle of crop ecology; Ecosystem concept and productivity; physiological limits of crop yield and variability in relation to ecological optima; crop adaptation; Agro-ecological and agro climatic region of India; Geographical distribution of crops; Physiological stress in crops; Remote sensing: Spectral indices and their application in agriculture. Concept of organic farming & farming system approach.

Principles and methods of fertilizer application; Integrated nutrient management and bio-fertilizers ;

**2. Entomology**

Concept, Components and Principles of Integrated Pest Management (IPM). Host Plant Resistance, Agronomic Manipulations, mechanical and physical methods, Chemical methods, biocontrol agents utilization, and behavior control strategy etc. IPM strategies for field and horticultural crops. Concept of damage determination. System approach, Agro ecosystem and cropping system vs. IPM. Constraints and Strategies of IPM implementation.

Silkworm species, their systematic position and salient features. Rearing techniques of mulberry, muga, eri and tasar silkworms. Nutritional requirements of silkworms. Sericulture: rearing house and appliances, silkworm breeds, seed production and its economics. Enemies and diseases of silkworms and their management. Sericulture organizations in India.

**3. Plant Pathology**

Concepts in Epidemiology. Development of disease in plant population. Monocyclic and polycyclic pathogens. Role of environment and meteorological factors in the development of plant disease epidemics. Survey, surveillance (including through remote sensing), and prediction and forecasting of diseases. Epidemic analysis and prediction models. Crop loss assessment: critical and multiple point models.

**4. Plant Physiology**

Abiotic Stresses affecting plant productivity. Drought characteristic features, water potential in the soil- plant-ari continuum. Development of water deficits, energy balance concept, transpiration and it's regulation. Physiological process affected by drought. Drought resistance mechanisms. Water use efficiency as a drought resistance trait. Yield and mineral nutrition- concept of nutrient use efficiency, mineral nutrition under adverse soil situations-drought, salinity, acidity etc.

Likely changes in climate in future and its impact of crop and ecosystems. The green house gases and global warming, CO<sub>2</sub> as an important green house gas. Effect of elevated CO<sub>2</sub> on plant growth and development. Methane as a greenhouse gas.

**5. Fruit Science**

Commercial varieties of regional, national and international importance. Agri Export Zones (AEZ) Tropical and Dry Land Fruit Production Crops: Mango and Banana, Citrus and Papaya, Guava, Sapota Jackfruit, and Pineapple. Subtropical and temperate fruit



production: Apple, Pear, Grapes, Plums, Peach, Ltichi, Kiwi fruit, Strawberry. Prospect of horticulture in North East.

## **6. Agricultural Meteorology**

Role of meteorological parameters on growth and yield of crops; incidence and development of crop pests and disease. Micrometeorology of crops , Light interception by crop canopies as influenced by leaf area index, leaf arrangement and leaf transmissibility, radiation use- efficiency. Hydrological cycle; concept of water balance, concepts of evaporation. Crop weather models; crop growth simulation models for yield assessment. Weather forecasting and agro-advisories; crop yield forecasts; Meteorological satellites for weather forecasts.

## **7. Soil Science**

Concept of land, soil and soil science. Soil forming processes and factors. soil survey- types, techniques.

Soil erosion by water- types, effects, mechanics. Runoff- methods of measurement, factors and management, runoff farming. Soil conservation measures.

Cause of land degradation; Management of soil physical properties for prevention/ restoration of land degradation.

Soil fertility evaluation – Soil testing, plant and tissue tests and biological methods; Fertility status of major soil groups of India.

Pollution: types, causes, methods of measurement, standard and management.

## **8. Agricultural Statistics**

Frequency distribution, mean, mode and median. Standard deviation, normal, binomial and Poisson's distribution, Sampling methods and standard errors. Correlation and regression: Partial and multiple, tests of Significance; t, F, Chi-square. Design of experiments. Use of software packages like SPSS, SAS, etc. for the test and designs of experiments for analysis. Concept of probability sampling. Simple random sampling. Stratified sampling, allocations in sample to strata, choice of strata, construction of strata boundaries and collapsing of strata.

\*\*\*\*\*

## **II Atmospheric Science**

### **1. Mathematical Physics**

Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions. Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions, Taylor & Laurent series, poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Green's function. Partial differential equations. Elements of computational techniques, root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge Kutta method. Finite difference methods. Measures of central tendency and dispersion, moments, least squares method. Regression equation, coefficients of correlation, partial and multiple correlations and their applications.

### **2. Classical Mechanics**

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics moment of inertia tensor. Non-inertial frames and pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion, small oscillations, normal modes. Lorentz transformations, relativistic kinematics and mass-energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance, Hamilton-Jacobi theory.

### **3. Thermodynamics**

Laws of thermodynamics and their consequences. Equation of state, Law of conservation of energy, specific heats of a gas, Adiabatic process in the atmosphere, Standard and Dry adiabatic lapse rate, Equilibrium states, Potential temperature, Equation of state of dry air, Poisson's equation for dry air, Alternative forms of the energy equation, Entropy, Enthalpy. Adiabatic expansion of air. Maxwell relations, chemical potential, phase equilibrium, Phase space, micro and macro-states. Free energy and its connection with thermodynamic quantities. First and second order phase transitions. Diffusion equation, Brownian motion, Introduction to non-equilibrium processes.

The spectrum of Radiation, Quantitative description of Radiation, Blackbody Radiation, The Planck Function, Wien's displacement Law, The Stefan-Boltzmann Law, Radiative properties of Non Black Materials, Kirchhoff's Law, Radiative equilibrium, The Greenhouse Effect, Atmospheric Window, Albedo, Physics of Scattering, Absorption, Emission by Air molecules, gas and particles. Radiative Transfer in Planetary Atmosphere, Beers Law, Reflection and Absorption by a layer of the Atmosphere. Radiative transfer in a plane parallel atmosphere, Radiative forcing, Radiative Balance at the top of the Atmosphere, the role of radiation in climate.

### **4. Electronics and Electromagnetism**

Semiconductor devices, device structure, device characteristics, frequency dependence and applications. Opto-electronic devices. Operational amplifiers and their applications. Digital techniques and applications. A/D and D/A converters. Transducers. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media;

boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors, polarization, Fresnel's law, interference, coherence, and diffraction.

## **5. Fundamentals of Atmospheric Sciences**

Elementary concepts of weather and climate, Earth-Sun relationship, structure and composition of the atmosphere. Atmospheric pressure, temperature and their variation with height, wind, relative humidity, solar and terrestrial radiation, clouds, different forms of precipitation. Basic ideas of general circulation, ecliptic and equatorial plane, rotation of the earth, seasons. Solar radiation, terrestrial radiation, heat, energy and water balance, evaporation and evapotranspiration. Radiation climatology of the earth's atmosphere, geographical and seasonal distribution of incoming solar radiation, outgoing radiation, net radiation, terrestrial heat balance. Structure, evolution and properties of atmospheric boundary layer. Convective, neutral and stable boundary layers. Surface boundary layer characteristics. Eddy transport of heat, moisture and momentum, Mixing length theory. Boundary layer turbulence.

Inertial and Non Inertial frames, Pressure Gradient Forces, Gravitational Force, Friction or Viscous Force, Centrifugal Force, Coriolis force, Momentum Equations, Cartesian Coordinate System, Spherical–Polar coordinate system. Geostrophic Wind, Gradient Wind, Thermal wind, Vertical motion. Transformation of momentum & continuity equations. Circulation & Vorticity, Atmospheric waves and Instabilities.

Monsoon and its variability, Teleconnections of India summer monsoon with southern oscillation, El-Nino, La Nina, Indian Ocean dipole mode. Physics and life cycle of Tropical Cyclones and Thunderstorm, CAPE, CINE, Favorable conditions for severe thunderstorms, stability indices.

## **6. Fundamentals of Climate**

Roles of various components of the Earth System in determining climate. Feedback processes in climate system, Environmental change concepts. Over view of Climate and Climate Change, Physics of the Greenhouse Effect and Global Radiation Budget, Greenhouse Effect of Trace Gases, Aerosols, Clouds, Radiation interactions, Atmospheric Pollution and Visibility, Urban heat island effect and Urban Climate change, Anthropogenic forcing of climate change, Hydrological cycle, Carbon cycle.

## **7. Surface based Remote Sensing observations and Satellite Meteorology**

Working principle and applications of LIDARS, SODARS, Weather RADARS, Doppler radar, Microwave radiometer. Conventional measurements of pressure, temperature, humidity, wind, precipitation, visibility, clouds, soil temperature and moisture. Scattering by rain and ice crystals. Minimum detectable power, receiver noise, radar equations for different targets. Satellite orbits and attitude, principles of satellite motion, Kepler's laws, orbital elements, Types of orbits, Satellite derived products and their applications. Meteorological satellites, radiometers and their applications.

## **8. Computer Programming and Numerical Analysis**

FORTRAN fundamentals: integer constant, floating point constant, variables, arithmetic operator, relational operator, FORTRAN arithmetic and expression, input/output and format statements, declaration and initialization, branching and looping, Arithmetic IF, Logical IF, Unconditional GO TO, Computed GO TO, DO statement, Nesting of DO Loops,

Dimension Statement, arrays, multi-dimensional arrays, functions, sub-programs and subroutines.

\*\*\*\*\*

### III FORESTRY & ENVIRONMENTAL SCIENCE

1. Forest policy and laws- National Forest Policies, Indian Forest Act 1927, Wildlife Protection Act 1972, Forest Conservation Act 1980 and penalties for forest offences.
2. Forest mensuration – Measurement of trees, volume estimations, crop measurements, sample plots.
3. Forest survey – Chain survey, angles and bearing, plane table survey, maps and map reading.
4. Forest protection – Forest fire, protection against injuries by plants and animals.
5. Forest Ecology – Forest types of India and distribution, forest regeneration, diversity indices, biomass and productivity.
6. General Silviculture – Locality factors of trees and forests, successions.
7. Silviculture of trees – Silviculture of prominent Indian trees, soil working and plant spacing.
8. Silviculture systems – Clearfelling, uniform, shelterwood and selection system.
9. Forest Working Plan – Preliminary Working Plan and main working plan.
10. Minor Forest Products – Minor forest produce and non-wood forest products.
11. Wood anatomy – Physical and mechanical properties of wood, defects in timber and wood preservation.
12. Forest pathology and entomology – Plant diseases, major insect pests and economic entomology.
13. Forest economics – economics of timber production and forest lands.
14. Forest management – growing stock, rotation and regulation of yield.
15. Social forestry – important social forest tree species, community forestry, JFM and economic benefits.
16. Wildlife management – Conservation of Important wildlife of India, National Parks and Wildlife Sanctuaries in India.
17. Tribology – Tribals and forests, livelihoods and tribal administration
18. Agroforestry – Benefits of agroforestry, agroforestry systems and classifications.
19. Statistics – Frequency distribution, mean, median mode, experimental design, test of significance, correlation and regression
20. Forest hydrology and Watershed Management – Soil & water conservation, hydrological cycle and forest hydrology, land capability

	classification, soil loss, watershed morphometry, land use planning.
21. Environmental chemistry-	Atmospheric chemistry, water chemistry, soil chemistry.
22. Environmental biology-	Community ecology, microbiology, biotechnology, biochemistry.
23. Earth Science-	Atmospheric and earth surface processes, meteorology and climatology.
24. Statistics-	Frequency distribution, mean, median mode, sampling design, test of significance, correlation and regression.
25. Environmental pollution-	Different types of pollution and measures to control.
26. Ecosystem dynamics-	Ecosystem functions, energetics, population dynamics, biodiversity and conservation.
27. Environmental hazards-	Environmental hazards, risk and vulnerability and strategies for their mitigation.
28. Environmental monitoring-	Physico-chemical and biological methods for water and soil analysis.
29. Environmental health-	Environmental quality, exposure and human health.
30. Eco-toxicology-	Toxicants in the environment, sources, transport routes and interaction with human.
31. Hydrology&Watershed management-	Hydrological cycle, precipitation and abstraction, runoff, stream flow and erosion, hydrological forecasting and watershed management.
32. Environment and Energy-	Energy requirement, use pattern, energy sources their problems and prospects and environmental implications.
33. Environmental Impact Assessment-	EIA methodologies and socio-economic Impact analysis.
34. Environmental Laws-	Environmental law in India and environmental movement.
35. Environmental management-	Ecosystem analysis, modelling, monitoring and planning, eco-restoration and ecotourism.

## IV GEOGRAPHY

1. *Geomorphology* – Fundamental concepts in geomorphology, Geomorphic processes - weathering, mass movement, erosion and transportation, and Fluvial Geomorphology
2. *Climatology* - Nature and Scope of Climatology, Atmospheric pressure and winds, Classification of climates: Empirical and generic with reference to North East India
3. *Biogeography*: Concepts of Biogeography, Bio-geographical Zones Classification with special reference to North East India
4. *Human Geography*: Introduction to basic concepts in human geography, Introduction to concepts in population and settlement geography,
5. *Urban and Rural Geography*: Terminology, concepts, urban and Rural geography; Scope and approaches, Process of urbanization and Urban Planning
6. *Economic Geography*: Nature and Approaches to the study of economic geography, Model of economic development, Economic growth and development, transport in regional analysis;, Characteristics of trade.
7. *Cartography*: Co-ordinate systems, Map Projections, Concept of map scale & map representation.
8. *Introduction to Remote Sensing (RS) and Geographical Information System (GIS)*: Principles of RS, Introduction to GIS, Spatial Analysis

\*\*\*\*\*

## V GEOLOGY

### 1. Physical Geology

- a. Origin, age and structure of the earth
- b. Atmosphere, hydrosphere, lithosphere & their constituents. Process of weathering & Mass wasting
- d. Geological Agents - Volcanoes, Earthquakes, Geosynclines and Mountains
- e. Plate Tectonics - Recent advances, pros and cons. Dynamic evolution of continental and oceanic crust. Principal tectonics features of the earth. Nature and types of Plate Margins, Geometry and Mechanism of Plate Motion. Tectonics of Pre-cambrian Orogenic Belts of India.
- f. Isostasy- Concept and theories; Evidence of continental-drift, Sea-Floor Spreading

### 2. Geomorphology

- a. Basic concepts of Geomorphology & Typical Landforms and their evolution. An elementary idea about morphogenesis and morphography; Morphometric analysis; Morphochronology.
- b. Geomorphic features formed/produced by various agents (erosion & Depositional) - Fluvial, Wind, Glacier, action of underground water. Origin of lakes & features relating to ocean & seas.
- c. Application of Geomorphology in Mineral Prospecting, Civil Engineering, Hydrogeology and Environmental studies.

### 3. Structural Geology

- a. Mechanical principles, properties of rocks and their controlling factors. Theory of rock failure. Concept of stress and strain; Two-dimensional strain and stress analyses; Types of strain ellipses and ellipsoids their properties and geological significance. Methods of strain measurements in naturally deformed rocks.
- b. Fold - mechanics of folding and buckling. Fold development and distribution of strains in folds. Parts of fold and its description. Flexure fold; flexural slip folds, flexural flow folds, passive folds.
- c. Fault- Causes and dynamics of faulting. Strike-slip faults, Normal faults, Thrust, Overthrust fault.
- d. Joint - description, morphology, genetic and geometric classification.
- e. Terminology of foliation. Classification and genesis of axial plane foliation, crenulation foliation, bedding foliation (transposition foliation) fracture cleavage (spaced cleavage). Significance of foliation in geology. Description of lineations in deformed rocks, their origin and significance.
- f. Unconformity, determination of order of superposition. Miscellaneous structures

### 4. Crystallography & Mineralogy

- a. Elements of crystal-forms and Symmetry
- b. Crystallographic laws, systems, classes, habits, twinning, Liquid Crystals.
- c. Mineralogy – physical & optical properties of Minerals
- d. Study of common rock forming minerals- silicate, olivine, pyroxenes, amphiboles, feldspars, quartz, mica, chlorites, garnets, carbonates etc.

:2:



## **5. Petrology**

- a. Introduction, composition & constituents of magma, Magma: Its physics, nature, factors affecting magma and evolution. Petrology and melting of mantle. Generation of magmas in different tectonic environments. Differentiation and assimilation.
- b. Igneous Petrology - origin, classification (IUGS), structure & texture, common igneous rocks. Petrogenesis of the following igneous rock types: Ultramafic (Peridotite and Picrite, Komatiite), Basalts, Andesites, Granites, Syenite, Carbonatite, Anorthosite
- c. Sedimentary Petrology - origin, classification, structure (Genesis and Stratigraphic Significance) & texture, common sedimentary rocks. Fundamentals of fluids laminar & turbulent flow. Reynold's number, Froude number, velocity profiles and bed roughness. Interpretation of Depositional Environments.
- d. Metamorphic Petrology – processes of metamorphism, diffusion, nucleation; Metamorphic facies (low, medium, high & very high), classification, structure & texture, common metamorphic rocks

## **6. Economic & Mining Geology**

- a. Terminologies, formation process, geochemistry of ore deposits, modern concepts of ore genesis; ore deposits & plate tectonics.
- b. Origin, mode of occurrence, distribution & economic uses of the following minerals
  - Gold, Iron, Copper, Manganese, Chromium, Aluminum, Lead, Zinc, Mica, Gypsum, Magnesite, Kyanite, Diamond, Coal, Petroleum, etc.
- c. Application of rock mechanics in mining. Different mining methods. Mining hazards-mine inundation, fire and rock burst, safety measures.

## **7. Stratigraphy & Paleontology**

- a. Basic principles & elements of stratigraphy, chronological subdivisions Lithostratigraphy, Codes units, correlation and contacts. Biostratigraphy- units, biogeographical acme zone provinces, controlling factors, zonation and their time significance
- b. Indian Stratigraphy –Pre-Cambrian, Palaeozoic, Gondwana, Mesozoic, Mesozoic, Cenozoic stratigraphy
- c. Introduction to Paleontology, Modes of Preservation permineralization, replacement, carbonization, recrystallization, and the production of molds and casts. Environmental Indicators, Vertebrate & Invertebrate Paleontology, Use of Fossil Assemblages in Determining Age. Stratigraphy of North East India.

## **8. Remote Sensing in Geology and Geomorphology**

- a. Spectral Characteristics of solar radiation. RS Satellite characteristics-orbits and swaths. Sensors used in remote sensing.
- b. Applications of Remote Sensing techniques in geological investigations-Mapping lithology, lineaments and minerals based on recognition elements (photographic and geotechnical elements). Convergence of evidence
- c. Interpretation of topography and tectonic features and evaluation of ground water potential.

- d. RS in geohazard studies and monitoring (landslides, floods, droughts, cyclones, earthquakes). Examples and case studies from India.
- e. Characteristics of various landforms in satellite images. Terrain evaluation for selection of dam, reservoir, industrial sites.

## **9. Hydrogeology**

- a. Hydrologic cycle and its components.
- b. Ground water origin, types, importance, occurrence, renewable and non-renewable ground water resources.
- c. Hydrologic properties of rocks; Hydraulic properties of aquifer and aquitard and their controlling factors. Darcy's law
- d. Water table contour maps, hydrostratigraphic units of India. Artificial recharge of ground water, rain water harvesting. Water balance methods, water level fluctuations: causative factors and their measurement, Problem of over exploitation. Ground water legislation.
- e. Various surface & subsurface geophysical & geological methods of groundwater exploration.

## **10. Environmental & Engineering Geology**

- a. Spectrum of environmental geology, global changes in the Earth system and climate. Anthropogenic impacts on the atmosphere, local impacts changing the landscape, role of geology in understanding atmospheric changes
- b. Global warming in present atmosphere due to indiscrete exploitation of fossil fuel, volcanic eruptions and deforestation. Global climatic changes, causes impacts, assessment. Examples and case studies. Climate change impacts on water resources and agriculture.
- c. Role of engineering geology in civil construction and mining industry, various stages of engineering geological investigation for civil engineering projects.
- d. Engineering properties of rocks, rock discontinuities, features of active faults. RQD, engineering classification of rock mass.
- e. Study of properties of common rocks with reference to their utility in engineering projects. Evaluation of dams and reservoir sites, tunnel alignments and transportation routes
- f. Improvements of properties of rock mass: grouting, gutting, rock bolting, cable anchorage.
- g. Engineering properties of soil, textural classification, stress distribution of soil with reference to foundation.

\*\*\*\*\*

## VI LIFE SCIENCES (Botany & Ecology)

Basic understanding of:

1. Microbiology – Bacteria, Virus & Bacteriophage, Microorganism and environment.
2. Biochemistry – Amino acids, proteins, carbohydrate & lipid
3. Cell Biology – Basic cell structure & function
4. Genetics – DNA, RNA & Chromosome – structure and function
5. Animal Physiology – tissues, Cardio-vascular systems, Respiratory system, Excretory system, Digestive system, reproductive process
6. Plant Physiology - Water relations in plants, Photosynthesis, Respiration, Phytochrome and photomorphogenesis.
7. Developmental Biology - Cell differentiation and development
8. Ecology and Bio-diversity
9. Biostatistics - elementary idea of Statistics in Biology
10. Plant & Animal Cell Culture

\*\*\*\*\*

**:1:**

## **VII REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM**

### **1: Fundamentals of Information Technology and GIS**

1.1 Introduction to Information systems and IT

1.2 Basic of Data Arrangement and access, file Environment, DBMS, Logical Data model, Data Warehouses, Meta Data and Global Databases, Spatial Databases available

for natural resources and Terrain.

1.3 Information System, Data, knowledge, and Decision support.

1.4 DSS, Data visualization Technologies, knowledge Management and Organizational knowledge Bases, Data mining.

### **2: Fundamentals of Remote Sensing and Image Interpretation**

2.1 Remote Sensing – history & development, definition, concept and principles

2.2 Energy Resources, radiation principles, EM Radiation and EM Spectrum

2.3 Platforms/Sensors – Types and their characteristics

2.4 Satellites and their characteristics – Geo-stationary and sun-synchronous

2.5 Earth Resources Satellites -LANDSAT, SPOT, IRS, IKONOS satellite series

2.6 Optical mechanical scanners – MSS, TM, LISS, WiFS, PAN

2.7 Concept of Resolution – Spatial, Spectral, Temporal, Radiometric

2.8 Basic concept and principles of Thermal, microwave and hyperspectral sensing

2.9 Basic principles, types, steps and elements of image interpretation

2.10 Techniques of visual interpretation and interpretation keys

2.11 Multidate, multispectral and multidisciplinary concepts

2.12 Instruments for visual interpretation

2.13 Remote Sensing Data Products and their procurement

2.14 Ground Truth Collection – Spectral Signatures

### **3: Aerial Photography and Photogrammetry**

3.1 Introduction to aerial photography – Basic information and specifications of aerial photographs

3.2 Aerial cameras – Types and their characteristics

3.3 Introduction to digital photogrammetry- Orthophotos and digital orthophotography

3.4 Principles of stereo photogrammetry

3.5 Model deformation and rectification

3.6 Simple plotting Instruments – simple and stereoplotters

3.7 Aerial triangulation, control and mapping

### **4: Cartography and Global Positioning System**

4.1 Digital cartography - elements of digital cartography Relation between digital cartography, RS & GIS

4.2 Map Projection – concept and classification

4.3 Azimuthal, cylindrical , conical and rectangular projection system

4.4 Choice of map projection – Satellite image and map projection

4.5 Thematic maps and base maps

4.6 Map digitization and Map Compilation

4.7 Introduction to Global Positioning System (GPS) – Fundamental concepts

4.8 GPS system elements and signals

:2:

4.9 GPS measurements and accuracy of GPS

4.10 Classification of GPS receivers

## **5: DIGITAL IMAGE PROCESSING**

5.1 Introduction to digital image processing- Concept of digital image, steps in DIP

5.3 Digitization of photographic image, converting digital image to visual form image

5.4 Digital image data formats, Image data storage and retrieval

5.5 Radiometric correction of remotely sensed data

5.6 Geometric correction of remotely sensed data

5.7 Image registration – definition principle and procedure

5.8 Image enhancement Techniques - an overview

5.9 Pattern recognition and image classification, Unsupervised classification – advantage, disadvantage and limitations

5.10 Supervised classification - training site selection, Classifiers used in supervised classification – Minimum distance to mean, Parallelepiped, maximum likelihood

5.11 Classification accuracy assessment

## **6 : GEOGRAPHICAL INFORMATION SYSTEMS**

6.1 Introduction to GIS – definitions, concept and history of developments in the field of information systems

6.3 Hardware and software requirements for GIS

6.4 Coordinate System and Projections in GIS – Conic, cylindrical and planner

6.5 Data structure and formats

6.6 Spatial data models – Raster and Vector

6.7 Data base design - editing and topology creation in GIS, Linkage between spatial and non spatial data

6.8 Spatial data analysis – significance and type, Attribute Query, spatial query

6.9 Integration of RS and GIS data

6.10 Data analysis and modeling in GIS– types of GIS modeling

6.11 Decision support systems

6.12 Overview of image processing & GIS Packages – ARC GIS, ERDAS, MAP INFO, ILWIS,

GEOMEDIA, IDRISI, QGIS

6.13 Recent Trends in GIS –Virtual 3D GIS, OLAP, Internet GIS, Open GIS

## **7 : THERMAL AND MICROWAVE REMOTE SENSING**

7.1 Thermal radiation principles, thermal process and properties

7.2 Characteristics of thermal IR images and Factors affecting thermal images

7.3 Interaction of thermal radiation with terrain elements

7.4 Introduction to microwave remote sensing – Concept and principle, backscattering, cross

section Wavelength, incidence angle, aspect angle.

7.5 Interactions between radar and surface materials - complex dielectric properties, roughness polarization

7.6 Passive microwave sensors & Active microwave sensors

7.7 Radar image interpretation

7.8 Applications of microwave remote sensing

## VIII SYLLABUS OF GENERAL & RESEARCH APTITUDE

1. Current events of national and international importance and current developments in Science & Technology
2. English grammar and comprehension
3. Logical reasoning and analytical ability
4. General mental ability
5. Research : Meaning, Characteristics and Types; Steps of Research, Methods of Research, Research Ethics, Paper, Articles, Workshop, Seminar, Conference and Symposium, Thesis Writing : Its characteristics and format.

\*\*\*\*\*