



The Federal University of Technology, Akure (FUTA)

In collaboration with

African Regional Centre for Space Science and Technology Education – English, Obafemi Awolowo Campus, Ile Ife, Nigeria

1. DEPARTMENT/CENTRE

The Departments of Physics, Meteorology and Remote Sensing and GIS, and the Centre for Space Research and Applications (CESRA), of The Federal University of Technology, Akure and the Department of Postgraduate Studies, African Regional Centre for Space Science and Technology Education – English (ARCSSTE-E), Obafemi Awolowo Campus, Ile-Ife, Nigeria (affiliated to the United Nations).

2. PROGRAMME OFFERED

Master of Technology (M.Tech.) in Space Science and Technology in the following options/specializations:

- (a) Satellite Communication Physics
- (b) Basic Space Physics
- (c) Satellite Meteorology
- (d) Remote Sensing and GIS

3. PROGRAMME PHILOSOPHY

The philosophy of the Master's degree programme in Space Science and Technology is to train highly skilled manpower in important application areas listed in the specializations above for Anglophone African countries in particular. The programme aims to build skills and capacities through sharing of knowledge, training and scientific research in areas of application of Space Science and Technology in the participating countries.

4. PROGRAMME OBJECTIVES

The objectives of the programme are to:

- (a) provide theoretical and practical training in Space Science and Technology applications in the options listed in 2 above;
- (b) produce through the best possible education, scientific research and application experience, high caliber professionals and scientific experts needed in the critical areas of Space Science and Technology applications for the Anglophone African countries;
- (c) develop the skills and knowledge of the graduates to be able to act as trainers, educators, and Space Science and Technology scientists and enthusiasts in their respective countries;
- (d) offer opportunity to graduates of the Postgraduate Diploma of ARCSSTE-E to further gain skills to develop and expand their knowledge and scientific research capability; and
- (e) maximize the opportunity of networking FUTA with relevant academic research communities and centres in African countries for research and training in Space Science and Technology applications.

5. PROGRAMME JUSTIFICATION

The international community through the Programme on Space Applications of the United Nations Office for Outer Space Affairs (UNOOSA) are in agreement that developing countries should effectively contribute to the solutions of environmental and resource management problems. Information and Communication Technology and Space Science and Technology have been identified to play pivotal roles in bringing up sustainable solutions to environmental and resource management issues. Therefore, there is an urgent need for higher level of knowledge and expertise in four prime areas of Space Science and Technology, namely; satellite communications, basic space and atmospheric science, satellite meteorology and global climate, remote sensing and geographic information system.

As a first step to achieving this, especially in Africa, two regional centres were created, namely, the African Regional Centre for Space Science and Technology Education – English (ARCSSTE-E) in Ile Ife, Nigeria for Anglophone African Countries. The second, Centre Régional Africain des Sciences et Technologies de l'Espace en Langue Française (CRASTELF), was established in Rabat, Morocco for the Francophone African countries. These centres were mandated to run postgraduate diploma and advanced degree programmes in the above mentioned prime areas of space science and technology education where the continent lacked the critical mass of professionals. For this reason, the regional centres were encouraged to have cooperative agreements with relevant universities or institutions in their region. In furtherance of this mandate, ARCSSTE-E entered into a collaborating agreement with FUTA. Since ARCSSTE-E started its postgraduate diploma programme in 2000, it has graduated 11 sets of students, many of whom are desirous of earning higher degrees in their respective options. Therefore, this new joint programme will give its graduates, the opportunity to attain the higher degree of M.Tech in their chosen options. Since the core of the students will be drawn regularly from Anglophone African Countries including Cameroon (with a mixture of French and English speaking citizens), the programme will further enhance the visibility of FUTA nationally and internationally. It will thus provide immense opportunities for FUTA to establish academic linkages with the regional and international centres, research institutes and government agencies in many of the countries where the students will come from. The programme will bring grants for purchase of equipment, research and consultancy engagements particularly from the countries sponsoring students in the programme and relevant Federal Government Agencies, including the military (whose personnel are regularly involved in the PGD programme). The programme will also improve the internally generated revenue profile of the university as the tuition fee payable by students would be at the United Nations rate.

6. ADMISSION REQUIREMENTS

Candidates must possess any of the following qualifications to be eligible for admission into the M. Tech degree programme:

- (i) Candidates with at least a Second Class (Lower Division) B.Tech./B.Sc. degree in Physics, Applied Geophysics, Meteorology, Geology, Mathematics, Physical Sciences, Engineering, Computer Science, Geography, Remote Sensing and GIS and Environmental or other science-related courses from any recognized University may be considered for admission on their own merit.
- (ii) Candidates with Postgraduate Diploma (PGD) at Upper Credit level in Physics, Applied Geophysics, Meteorology, Mathematics, Geology, Geophysics, Engineering, Remote Sensing and GIS, Environmental and other science-related courses from FUTA, or its equivalent from any other recognized institutions are eligible for admission.
- (iii) In addition to the general requirements above, candidates with at least ARCSSTE-E Postgraduate Diploma Certificate (Upper Credit) in Satellite Communication, Basic Space

Physics and Atmospheric Sciences, Satellite Meteorology and Remote Sensing and GIS are eligible for admission.

- (iv) Eligible candidates must satisfy the minimum GCE 'O' Level, WASC, SSCE, NECO or NABTEB entry requirements of credit passes or its equivalent in 5 subjects, including English Language, Mathematics, Physics and Chemistry/Geography (for Remote Sensing and GIS and Satellite Meteorology options) into the relevant degree programme in FUTA.

7. PROGRAMME DURATION

The joint M. Tech. degree programme will be full-time, and the duration shall be for a minimum period of 18 months (3 semesters) and a maximum of 24 months (4 semesters). The duration shall comprise two semesters of course work and an intensive period of research work and thesis writing based on a research proposal submitted and approved at the end of the second semester.

8. GRADUATION REQUIREMENTS

In addition to satisfying other University regulations, the student must have:

- (i) scored an average of 50% in the course work, and must also obtain a minimum grade of 50% in the M.Tech Thesis Project according to the regulations of the School of Postgraduate Studies, FUTA;
- (ii) accumulated at least 44 course units for those enrolled in Satellite Communication and Basic Space Physics options, at least 42 course units for those in Satellite Meteorology option and at least 48 course units for those enrolled in Remote Sensing and GIS option;
- (iii) successfully presented two thesis project seminars, proposal and final seminars; and
- (iv) successfully completed and defended a research thesis in an oral examination

9. COURSE OUTLINES

SATELLITE COMMUNICATION PHYSICS AND BASIC SPACE PHYSICS OPTIONS

FIRST YEAR

FIRST SEMESTER *(The same for both options)*

COURSE CODE	COURSE TITLE	L	T	P	U
SAP 801	Mathematical Physics	2	1	0	3
SAP 803	Electro-Magnetostatics Theory	2	1	0	3
SAP 805	Quantum and Statistical Theory	2	1	0	3
SAP 807	Electronic Systems Technology	2	0	3	3
SAP 809	Advanced Computational Physics	2	0	3	3
SAP 811	Physics of the Lower Atmosphere	3	0	0	3
Total					18

FIRST YEAR

SECOND SEMESTER (SATELLITE COMMUNICATION PHYSICS OPTION)

COURSE CODE	COURSE TITLE	L	T	P	U
SAP 802	Communication Systems	3	0	0	3
SAP 804	Propagation of Radiowaves in the Atmosphere	3	0	0	3
SAP 806	Antenna Systems Design and Theory	3	0	0	3
SAP 808	Satellite Communication Technology	3	0	0	3
SAP 810	Course Seminar	0	0	6	2
	Elective	3	0	0	3
Total					17

ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	U
SAP 820	Radio Frequency (RF) and Microwave systems	3	0	0	3
SAP 824	Satellite Imagery	3	0	0	3
SAP 826	Applications and Trends in Satellites Communication	3	0	0	3
SAP 828	Operational Communication satellite systems	3	0	0	3

FIRST YEAR**SECOND SEMESTER (BASIC SPACE PHYSICS OPTION)**

COURSE CODE	COURSE TITLE	L	T	P	U
SAP 810	Course Seminar	0	0	6	2
SAP 812	Basic Spacecraft Design and Launch	3	0	0	3
PHY 850	Planetary Atmospheres	3	0	0	3
PHY 852	Ionospheric Physics	3	0	0	3
PHY854	Physics of Geomagnetic Phenomena	3	0	0	3
	Elective	3	0	0	3
Total					17

ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	U
PHY 856	Space Weather	3	0	0	3
PHY 858	Satellite Imagery	3	0	0	3
SAP 826	Applications and Trends in Satellites Communication	3	0	0	3
SAP 828	Operational Communication satellite systems	3	0	0	3

SECOND YEAR**FIRST SEMESTER**

COURSE CODE	COURSE TITLE	L	T	P	U
SAP 899	Master's Thesis Research Project	0	0	36	12
Total					12

SATELLITE METEOROLOGY OPTION

FIRST YEAR

FIRST SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
SMT 801	Meteorology and Applications	2	0	0	2
SMT 803	Principles of Radar Technology	3	0	0	3
SMT 805	Tropical and Mesoscale Meteorology	3	0	0	3
SMT 807	Upper Air Meteorology and Sounding	2	0	0	2
SMT 809	Data Mining Methods in Meteorology	2	0	3	3
SMT 811	Satellite Meteorology	2	0	0	2
	Elective	3	0	0	3
Total					18

ELECTIVES

SMT 813	Dynamic Meteorology	3	0	0	3
SMT 815	Atmospheric-Ocean Dynamics	3	0	0	3

FIRST YEAR

SECOND SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
SMT 802	Application of Remote Sensing in Natural Resources Management	3	0	0	3
SMT 804	Radar in Satellite Meteorology	3	0	0	3
SMT 806	Empirical Climate Prediction Techniques	3	0	3	3
SMT 808	Global Climate Change	2	0	0	2
SMT 810	Course Seminar	0	0	6	2
SMT 812	Advanced Instrumentation in Atmospheric & Environmental Measurements	1	0	3	2
	Elective	3	0	0	3
Total					18

ELECTIVES

SMT 814	Air Pollution Dispersion and Control	3	0	0	3
SMT 816	Agricultural Meteorology	3	0	0	3
SMT 818	Climate Systems Modelling	3	0	0	3

SECOND YEAR

FIRST SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
SMT 899	Master's Thesis Research Project	0	0	36	12
Total					12

REMOTE SENSING AND GIS OPTION

FIRST YEAR

FIRST SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
RSS 801	Principles of Remote Sensing & GIS	2	1	0	3
RSS 803	Components of GIS	1	1	0	2
RSS 805	Implementation and Management of GIS	2	0	0	2
RSS 807	Integration of Remote Sensing and GIS	2	0	3	3
RSS 809	Numerical Methods and Algorithms in Remote Sensing & GIS	2	0	3	3
RSS 811	Geostatistical Analysis	2	1	0	3
RSS 813	Human Terrain Analysis	1	0	3	2
Total					18

Elective

COURSE CODE	COURSE TITLE	L	T	P	U
RSS 815	Public Health Administration and GIS Analysis	1	0	3	2

FIRST YEAR

SECOND SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
RSS 802	Advanced GIS	2	0	3	3
RSS 804	Research methodology	1	0	0	1
RSS 806	Emergency Management with Remote Sensing & GIS	2	0	3	3
RSS 808	Defense and Intelligence Applications of Remote Sensing & GIS	2	0	3	3
RSS 810	Course Seminar	0	0	6	2
RSS 812	Water Resources and Management	2	0	3	3
RSS 814	Business Applications of GIS	2	0	3	3
Total					18

Elective

COURSE CODE	COURSE TITLE	L	T	P	U
RSS 816	Environmental Applications of RS & GIS	1	0	3	2

SECOND YEAR

FIRST SEMESTER

COURSE CODE	COURSE TITLE	L	T	P	U
RSS 899	Master's Thesis Research Project	0	0	36	12
Total					12

10. COURSE SYNOPSES

SATELLITE COMMUNICATION PHYSICS AND BASIC SPACE PHYSICS OPTIONS

SAP 801 Mathematical Physics (3 units)

Techniques for the solution of Boundary value problems; Use of Green's functions; Integral Equations; Vector Spaces; Tensor Transformations; Materials; Complex Variable theory; Groups, Representations and symmetry. Complex treatment of partial differential equations; Fourier series and transforms; Special functions of mathematical physics and their applications; Beta, Gamma and Error functions; Legendre functions, Bessel's function, Dirac among others. Probability Statistics and Theory of errors; Special theory of relativity

SAP 802 Communication Systems (3 units)

An overview of communications and networking; Telecommunication standard; ISO, ITU, IEEE, FCC, ANSI, ETSI among others. Principles of information theory; Principle of modulation and coding; Microwave theory and techniques; Optical communications, Principles of networking and protocols; Spread-spectrum techniques; multiple access techniques; forward-error correction coding; Transmission media; wired and wireless communications and their applications, cabling architecture, electromagnetic interference (EMI).

SAP 803 Electro-Magnetostatics Theory (3 units)

Concept of electrostatics; Electrostatic field; Divergence and curl of electrostatics field; Work and Energy; Conductors; Concept of electric potential and its applications; Laplace equations; Method of images, separation of variables; Single and multiple boundary value problems; Concept of Magnetostatics; Lorentz force of law, Biot-savart law, Divergence and curl of B, magnetic vector potential; The electromagnetic fields energy, forces and momentum relations; Maxwell's equations'; Solutions of the wave equation; applications to radiating systems; Elements of relativistic electrodynamics; moving charges, classical electron theory, application in Non-conducting media, conductors, dispersion and guided waves.

SAP 804 Propagation of Radiowaves in the Atmosphere (3 units)

Propagation mechanisms through the troposphere; Radio services; Quantifying propagation performance; electromagnetic wave radiation; line-of-sight and transhorizon propagation; Attenuation by atmospheric gases; noise, rain attenuation, ionospheric propagations; Special problems of radio communication associated with the equatorial ionosphere; radio noise; prediction techniques; Calculation of field strength; power flux density; radiation and transmission loss, VLF, LF and MF applications and predictions; HF applications and predictions; Clear-air aspects of the troposphere; Nature of precipitation, cloud and atmospheric gases and their effects on propagation mechanics from VHF to mm waves; Terrestrial propagation path predictions; Earth-space propagation path predictions.

SAP 805 Quantum and Statistical Physics (3 units)

Quantum mechanics of one particle system; Quantum mechanics of Heisenberg; Matrix mechanics and transformation theory of quantum mechanics; Theory of angular momentum and spin; Zeeman effect; Time dependent and time independent approximation methods and applications; Scattering theory; Dirac equation, low order radiation processes, relativistic quantum mechanics; Thermal radiation and planck's postulate; multi-electron atoms and optical excitation; quantum statistics; molecules; solid-conductors and semiconductors; Lébesgue integration; Lébesgue integral; measurable functions, decomposition and derivatives of measure; HVZ theorem; Self adjournment.

SAP 806 Antenna Systems Design and Theory (3 units)

Antenna: Basis, construction and measurements; tuning, gain and radiation pattern measurement; Antenna modifications; Types and characteristics; antenna radiation, reception, currents and polarization. Propagation in free space; effective radiative power; system performance, fading and

variability, fading allowances, reliability, worst conditions, isotropic radiators and an-isotropic radiators. Antenna analysis; Monopole and dipole antenna, horn antenna, yagi antennas, parabolic dish, Microstrip, antenna arrays and phased arrays. Antenna measurements; standard –antenna method (SAM), standard-field method (SFM), secondary standard –antenna method (SSAM).

SAP 807 Electronic Systems Technology (3 units)

Discrete time signals and systems; sampling of continuous time signals Z-transform; discrete Fourier transform; computation of discrete Fourier transform; structure of discrete time systems; filter design techniques; Semiconductor diodes' transistors, special power semiconductor devices, transistor circuits and amplifiers; Power distortion; multistage amplifier feedback and bandwidth; IC devices and circuits; operational amplifiers; phase locked loops; gyrators; turned circuits; active filters; detectors; logarithmic generators; variable gain devices; Analysis of circuits for generating shaping and manipulation waveforms using elements like line transformers and IC's; switching circuits; Gates, AND, OR, NOR, NAND gates; Circuits designs; sum of products and product of sums expression; Karnaugh maps; Flip-flops; Binary; multipliers, memory devices; Micro-processors and micro computer; example of digital signal processing – based subsystems for satellite communications.

SAP 808 Satellite Communication Technology (3 units)

Space exploration; Navigation; Radio ranges; The scope and nature of scientific research using vehicles; Orbits in a central gravitational field; dynamic requirements for launching earth satellites; rockets propulsion; the tracking of space vehicles. Satellite remote sensing; classification by orbit; applications, advantages and disadvantages; Orbital dynamics; MIR; frequency bands for satellite communications; Radio frequency interference; propagation effects on satellite communication links; The upper atmosphere from ground-level observations. The study of neural atmospheric structure using space vehicles.

SAP 809 Advanced Computational Physics (3 units)

Numerical linear algebra; root finding; approximation theory; integration; ordinary differential equations; optimization techniques; initial and boundary value problems; finite element methods. Direct and indirect methods in matrix theory; optimization with constraints; analysis of numerical stability. Concept of error and statistical analysis in Physics. Solution of differential equation by means of laplace hyper function; micro function solution of Holonomic systems and stokes lines. Bifurcation for Non-linear elliptic boundary value problems computer programming.

SAP 810 Course Seminar (2 units)

A term paper on a chosen topic on application of space physics or satellite communication to solving industrial or societal problem will be presented by each student. An oral presentation of the seminar will be made to an audience consisting of the academic staff and students involved in the programme. The assessment of the write-up will be based on the contents (depth of knowledge, technical language, illustrations, etc) while the oral presentation will also be assessed accordingly.

SAP 811 Physics of the Lower Atmosphere (3 units)

Weather/meteorological parameters and their measurements; atmospheric thermodynamics; geotropic wind and atmospheric oscillation; atmospheric radiation. Solar radiation and its effect on atmosphere; solar radiation at the top of the atmosphere; attenuation of solar radiation in the atmosphere; radiative transfer; thermal effects of radiation; photochemical effects of radiation. Cloud physics and atmospheric electricity; satellite meteorology and remote sensing; applications to West Africa.

SAP 812 Basic Spacecraft Design and Launch (3 units)

Orbital dynamics and launch vehicles; Altitude measurement and control; Power generation and storage; Telemetry; Tracking; command; Attitude control system; Satellite payloads; Design

consideration; Frequency bands; Spacecraft antenna; Data management; Mechanical design and testing; Thermal design and control; material for use in space design; Navigation in space; position and direction on the earth's surface; Map and chart projections; Flight paths; Navigation and guidance; navigation instruments; Types of navigation; Rockets flight; Launching; Missiles; Sounding rockets; Stability and control; Reusable rockets; Propulsion; Effects of space travels on humans; Crew support; Work in space.

PHY 850 Planetary Atmospheres (3 units)

Basic concepts of the Earth's atmosphere; Atmospheric nomenclature; hydrostatic equations; scale height; geopotential height; chemical concepts of the atmosphere; thermodynamic considerations; elementary chemical kinetics. Composition and chemistry of middle atmosphere and thermosphere; thermal balance in the thermosphere; modeling of neutral atmosphere. Dynamics of the Earth's atmosphere; Equation of motion of neutral atmosphere; thermal wind equation; elements of planetary waves; internal gravity waves and atmospheric tides; fundamental description of atmospheric dynamics and effects of dynamics on chemical species. Atmospheres of planets and satellites; Inner and outer planets; atmospheric structure and composition of the Moon; Jupiter, Mars, Venus and Saturn and their important satellites.

PHY 852 Ionospheric physics (3 units)

Introduction to ionosphere; Photochemical processes; Chapman's theory of photoionization; Production of ionospheric layers; Loss reactions and chemistry of ionospheric regions; Morphology of the ionosphere; Ionospheric propagation and measurement techniques; Effect of ionosphere on radio wave propagation: Refraction, dispersion and polarization; Magneto-ionic theory; Critical frequency and virtual height; oblique propagation and maximum usable frequency; Ground-based techniques- ionosonde; radars; scintillations and total electron content (TEC); photometers; imagers and interferometers; ionospheric absorption; Rocket and satellite-borne techniques; Langmuir probe; electric field probe, retarding potential analysers, mass spectrometers, magnetometers, vapour release, satellite drag for neutral density. Ionospheric plasma dynamics; Basic fluid equations; Steady state ionospheric plasma motions owing to applied forces; Generation of electric fields; electric field mapping; collision frequencies; electrical conductivity; plasma diffusion; ionospheric dynamo; equatorial electrojet; ionospheric modeling; Ionospheres of other planets and satellites; Ionospheres of Mars, Venus and Jupiter.

PHY 854 Physics of Geomagnetic Phenomena (3 units)

Elements of solar physics; Structure and composition of the Sun; the Sun as a source of radiation; sunspots and solar cycles; solar flares; Magnetic field of the Earth and other planets; Models for generation of geomagnetic fields; secular variations of geomagnetic fields; local elements of geomagnetic fields; determinations of geomagnetic coordinates of stations. Transients variations of geomagnetic fields; diurnal variation of geomagnetic fields; geomagnetic pulsations; magnetic fields of other planets. Equatorial anomaly; Magnetosphere of the Earth and other planets; Solar wind and its characteristics; interplanetary magnetic field and sector structure; formation of geomagnetic cavity; magnetopause; magnetosheath and bow shock; polar cusp and magnetotail; plasma sphere and Van Allen radiation belts; Magnetosphere of other planets; Geomagnetic field modeling; Aurora and Airglow: Nightglow; dayglow; twilight glow; aurora; applications of airglow measurements for ionospheric dynamics and composition.

SAP 820 Radio Frequency (RF) and Microwave Systems (3 units)

Introduction; review of waves and transmission lines; various components and their system parameters; Couplers, Hybrids, power divider/combiners; isolators and circulators; oscillators and amplifiers; receiver system; transmitter and oscillator systems; Radar and sensor systems; wireless communication systems. Fris transmission equation; space loss; link equation and link budget; effective isotropic power

and G/T parameters; Radio/microwave links; mobile/satellite/personal communication systems; other wireless systems.

PHY 856 Space Weather (3 units)

Elements of space weather; Geomagnetic storms; sub-storms and current systems; coronal mass ejections. Modification of the Earth's magnetosphere during magnetic disturbances and its implications; effect of magnetic disturbance on high, mid, and low latitudes. Measurement techniques for solar and geomagnetic parameters; Optical techniques for solar parameters; radio techniques for solar parameters; X-ray; Space Missions. Space Weather Prediction; Modeling of Space Weather parameters.

PHY 858 Satellite Imagery (3 units)

Overview of remote sensing technology; History and evolution; Electromagnetic radiation and its interaction with matter; Spectral characteristics of crops/vegetation, soils, water etc; Remote sensing platforms, sensors and ground systems; Satellite remote sensing: classification by orbit, applications; advantages and disadvantages; type of observation; orbital dynamics; Types of satellites; Overview of Earth observation satellites; Overview of optical infrared (IR) remote sensing sun-synchronous satellites; Overview of polar platforms and meteorological satellites; High-resolution satellites; radar satellites; other missions; Imaging technology; Photogrammetry; GPS: concepts, techniques, systems and applications; GIS: concepts, principles and applications; GIS models; GIS components; inputs to GIS; GIS database design and organization; integration in GIS; querying in GIS; GIS outputs and visualization; accuracy of data in GIS; GIS integration errors.

SAP 826 Applications and Trends in Satellites Communication (3 units)

Satellite communication services; selection from satellite communication applications; VSAT networks; Meteorological data reception system; Data collection system; Disaster management using satellite communications; search and rescue system; international; regional; warning dissemination system; telemedicine; time and frequency transmission system; mobile and personal communication services; strategic satellite communication systems; satellite navigation system; satellite-based internet system; multimedia broadband satellite system.

SAP 828 Operational Communication Satellite Systems (3 units)

Overview of operational communication satellite systems; Fixed satellite service [FSS]; Mobile satellite service [MSS]; Broadcast satellite service [BSS]; Multimedia broadcast service [MBS]; Selection from operational communication satellite systems; International Telecommunication Union [ITU] and other standardization organizations; International Organization for standardization [ISO]; Asia Pacific Telecommunity [API]; European Telecommunication standards Institute [ETSI]; International regulations.

SAP 899 Master's Thesis Research Project (12 units)

This is a thesis project on a subject relevant to any of the fields of Satellite Communication, Basics Space and Atmospheric Physics. It is expected to be an original research project, which must involve independent investigations by the student and should make new and significant contributions to the understanding and knowledge of Satellite Communication, Basic Space and Atmospheric Physics. The report should be presented in form of a thesis using approved School of Postgraduate Studies format. Every candidate must present two successful seminars, proposal and final, before submission of the M. Tech thesis report for examination.

SATELLITE METEOROLOGY OPTION

SMT 801 Meteorology and Applications (2 units)

Overview of the Earth's Atmosphere, Composition of the Atmosphere, The Early Atmosphere, Vertical Structure of the Atmosphere, A Brief Look at Air Pressure and Air Density, Layers of the Atmosphere, The Radiosonde, The Ionosphere, Weather and Climate, A Satellite's View of the Weather Storms of All Sizes, A Look at a Weather Maps, Weather and Climate in Our Lives, Focus on a Special Topic: Meteorology—A Brief History, The atmosphere and profile of meteorological parameters (wind, temperature, humidity); Pressure and temperature systems, Coriolis force; Global Winds, Air Masses, and Fronts and Disturbance lines; Westerly winds and jet stream; Clouds and associated precipitation; the mean global circulations; scales of atmospheric motion; Pressure gradient, coriolis force, geostrophic and thermal winds. Momentum and conservation equations; Global energy budget and fluxes; order of magnitudes; Thermodynamic laws, phase changes; Clausius - Claperyon equations; Lapse rates and stability in both dry and moist atmospheres. Energy diagrams. General applications of meteorology in transportation, agriculture, urban and town planning, building technology and construction industries; Water resources systems; environmental pollution. Extreme weather and major weather hazards; turbulence, icing, fog, haze, storms, hurricanes and tornadoes.

SMT 802 Application of Remote Sensing in Natural Resources Management (3 units)

Environmental Data collection Processing and Utilization, Interpretation of Environmental Information; project identification in agricultural land-use, Biodiversity, waters resources; Environmental Impact Assessment for project implementation; local regional and global collation. Benefits of cooperative initiatives in Satellite application. Land-use management: Role of Climate Science-principles and programmes in Agriculture and food security, Degradation, Biodiversity, Water Resources Management, GIS and Satellite application in Biological conservation.

SMT 803 Principles of Radar Technology (3 units)

Principle of Radar, Ground-base and Space based Radar, Weather Radar, Application of Doppler Radar in Forecasting. Now casting Technology and Media Broadcasting, Future of Radar in Meteorology. General principles of Satellite Systems Satellite Radar Sensors - telemetry, AVHRR, ATSRIM, Passive microwave Radiometers; Handling airborne Thematic Mapper Data; Radar echoes and applications in Meteorology. Advanced Space borne microwave sensors in marine weather forecasting.

SMT 804 Radar in Satellite Meteorology (3 units)

The radar equation, spherical particles - limits and resolution. Doppler radar; Doppler spectrum and shift frequency, Attenuation; Use of Doppler radar for precipitation measurements - rainfall amount and intensity over an area. Interpretation of Doppler PPI displays; Measurement of turbulence, updraft velocities, size distribution and wind speed. Radar in cloud physics research, weather forecasting and mesoscale convective systems (MCS); Extent of convective clouds, cloud seeding tests; radar observations of medium and large scale systems; Clear echoes; Physical principles of earth satellite and their sensors, radiometers, limits of resolution, Spectral channels, weighting functions, analogue and digital image: Image enhancement and feature extraction, etc. Interpretation of satellite imagery (infrared and visible images) for the identification of upper-level features, wind, contour and streamline patterns, jet-streams, ridges and troughs, vertical distribution of moisture, surface weather, etc., inversion of CO₂ emission data. Effects of local influences; Uses of satellite information in weather forecasting, dust haze occurrence and movement; drought occurrence.

SMT 805 Tropical and Mesoscale Meteorology (3 units)

Structure and climatology of tropical systems, Major motion systems: ITD, ITCZ, monsoons, TEJ and AEJ; their climatology, causes and importance for tropical weather systems mesoscale systems such as shearlines, clouds typhoons and monsoons. Moist processes in the atmosphere, Air mass thunderstorms, Multi-cell thunderstorms, Supercell thunderstorms and tornadoes, Mesoscale convective systems, Tropical weather, Scales of motion, atmospheric oscillations, Tropical cyclones, Mountain weather, Internal gravity waves, Flow over mountains, Downslope windstorms, Katabatic winds, Barrier winds. Squall lines and El Nino Southern Oscillation; Dynamics and energetics of the tropical systems, structure and dynamics of easterly waves. Rainfall models. Land and sea breezes; Dust haze and fog. Upper level flows. WMO Initiative and achievements: GATE-GARP, FGGE, MONEX/WAMEX, AMMA, THORPEX. Nigeria's gains and major Thrust - the use of satellite Meteorology in Rainfall and NDVI. Major researches and results; Prospects for future.

SMT 806 Empirical Climate Prediction Techniques (3 units)

Crop failure and prediction models – the Indian experience; Coupled models in Australia, East Africa and South America; Desertification studies in West Africa; Investigation of Satellite-derived products: Derivation of wind fields and surface fluxes; Climate forecasting techniques (Seasonal, inter-annual and decadal).

SMT 807 Upper Air Meteorology and Sounding (2 units)

Basic equations; Scale height; Energy budget and radiative transfer; Atmospheric chemistry and physics; Tidal and wind oscillations; Gravity waves; Interaction with lower atmosphere; Atmospheric electricity; Radiowave propagation; Quasi-biennial Oscillation (QBO); Pressure changes in the upper atmosphere; Jet streams; Polar front jet (PFJ); association of jetstreams with active frontal systems in mid-latitude; the significant of the position of the jet stream; relation of upper air features to surface patterns. The solar system: Gravitation; the planets; the moons, comets and meteors. The sun: solar atmosphere; activity regions: sunspots, solar flares, solar wind, solar radiation and the Earth's atmosphere. Absorption, scattering and transmission of radiation. Attenuation of radiation under cloudy and cloudless condition. Heat Sources and Sinks and Their Seasonal Movement, The Climate of Central America and Adjoining North America, Surface Temperatures and Winds, Upper Air Temperatures, Upper Air Height (gpm), Upper Air Wind Field and Circulation, Rainfall over Central America and Adjoining Areas, Annual Rainfall over Mexico.

SMT 808 Global Climate Change (2 units)

Anthropogenic changes; Climate forcing agents; study of climate sensitivity using simplified climate models. Climate change detection and distribution; Impacts and vulnerability; IPCC assessment reports, regional impact studies, knowledge of past/future patterns of climate; Global Monitoring Techniques Climate Change defined Elements for assessment of roles of Science in Earth Observation; Role of Space-based platform and Trends. Current state of Climate Science; Climate extremes, warning systems and climate disaster risk management/reduction, Drought, Desertification Disasters and Risk Reduction; Ecosystem, livelihoods and Disasters – the new thrust on mitigation and Adaptation. The Earth's Changing Climate, Determining Past Climates, Climate Through the Ages, Climate During the Last 1000 Years, Possible Causes of Climatic Change, Climate Change and Feedback Mechanisms, The Greenhouse Effect on Venus, Climate Change, Plate Tectonics, and Mountain-Building, Climate Change and Variations in the Earth's Orbit, Climate Change and Atmospheric Particles, Aerosols in the Troposphere, Volcanic Eruptions and Aerosols in the Stratosphere, Nuclear Winter, Cold Summers, Climate Change and Variations in Solar Output, Carbon Dioxide, the Greenhouse Effect, and Recent Global Warming,

Oceans, Clouds, and Global Warming, Possible Consequences of Global Warming, The Ocean Conveyor Belt, and Climate change. In Perspective, The Sahel—An Example of Climatic Variability and Human Existence

SMT 809 Data Mining Methods in Meteorology (3 units)

Location and Dispersion measurement in a sample and grouped data (Mean, Mode, Median, Standard Deviation etc); Regression (Linear and Multiple) and Correlation, their use in prediction of Meteorological variables. Analysis of Variables (ANOVA) and Covariance. Test of hypothesis. Normal and Binomial Distribution. Functions of Real variables; Differential and Integration calculus and their applications; Error analysis; Interpolation and approximations; Vector analysis; Dot and vector product; Curl and divergence of vector fields; Matrices and its application in solving Meteorological problems; Decomposition of meteorological parameters into mean and turbulent parts; Tensor analysis. Significance and hypothesis testing; Covariance matrices; quadratic forms, associated sampling distributions; Optimization of quadratic forms; Principal component analysis; North et al's "Rule of Thumb"; Canonical Correlation analysis; Discriminant analysis; associated sampling distributions; Vector autoregressive Models; cross validation; power spectrum analysis; Predictability; Review of numerical methods relevant to meteorological applications; linear smoothing, least square fitting, fourier series, polynomial bases, wavelet bases, Finite differences and derivative expressions in terms of forward, backward and centred differences; implicit and semi-implicit formulations; Solution of differential equations with given boundary conditions using the FORTRAN language; Time series analysis and filtering techniques. Application of Matlab, Ferret surfer software packages in meteorological analysis. Introduction to computation using Linux operating system: advantages and disadvantages over window operating system. Modelling on Linux OS.

SMT 810 Course Seminar (2 units)

A term paper on a chosen topic on application of satellite meteorology to solving industrial or societal problem will be presented by each student. An oral presentation of the seminar will be made to an audience consisting of the academic staff and students involved in the programme. The assessment of the write-up will be based on the contents (depth of knowledge, technical language, illustrations, etc) while the oral presentation will also be assessed accordingly.

SMT 811 Satellite Meteorology (2 units)

Reviews of principles of atmospheric radiation and their implications in remote sensing systems: electromagnetic spectrum, forms of energy transfer, atmospheric emission, Stefan Boltzmann law, Planck's radiation law. Wien's displacement law, etc. Satellite orbits: elliptical and other types of orbits. Geostationary and near-polar orbits (sun-synchronous orbits). Orbital perturbations. Types of satellites. Polar Orbiters and Geostationary Satellites. Historical Background. Current trends in space collaborations, Global Experiments: Role of the UN Outer Space Affairs Division. The Earth as a Global Village, UN Agencies – WMO, UNEP, FAO etc., Satellite development, launch and application. Motion of Orbit, Earth and Sun : Motion of the Orbit, Secular Variations; Simplified Case. Applications: Period and Altitude, Strictly Polar Satellites Motion of the Earth, Motion of the Earth about the Sun, Motion of the Earth about the Polar Axis, Motion of the Orbit and Earth, Apparent Motion of the Sun Celestial Sphere and Coordinates, Hour Angle, Equation of Time, Solar Times, Historical Note on Time Scales Julian Day, Julian Date, Declination, Geosynchronicity, Calculating the Orbit, Geostationary Satellites , Drift of the Geostationary Orbit, Station keeping, Geosynchronous Satellites, with Highly Eccentric Orbit, Sun-Synchronicity, Constant of Sun-Synchronicity, Calculating the Orbit, Sun-Synchronous Satellites, Drift and Station keeping, Sun-Synchronous Satellites, with Highly Eccentric Orbit.

SMT 812 Advanced Instrumentation in Atmospheric and Environmental Measurements (2 units)

Techniques of laboratory and field research in atmospheric and environmental science; Air Quality Monitoring Systems (Air sampling devices, pollutant measurements - Ozone, CO, NO_x, Black Carbon); Routine and research measurements. Methods for calibrating different meteorological instruments. Sources of errors and error analysis. Data acquisition and methods of analysis. Basic instrumentation for surface meteorological parameters; Principles and operations of the following instruments: LIDAR (Light Detection and Ranging), RADAR (Radio Detection and Ranging), SODAR (Sound Detection and Ranging). Multi-filter radiometers. Pollutant measurements by DOAS systems. Retrieval of meteorology parameter: measurement of sea and land surface temperature, retrieval of vertical profiles of temperature and humidity, surface temperature and emissivity estimation. Snow, vegetation, rock: spectral of mixed pixels atmospheric correction for surface temperature measurement. Stratospheric chemistry and dynamics: satellite derived motion fields; image acquisition, automated registration of imagery target selection process. Height assignment of targets and quality control. Cloud in satellite image: weather and non – weather related satellite image.

SMT 813 Dynamic Meteorology (3 units)

Coordinate systems; Conservation equations for mass, momentum and energy; equation of state; scaling; generalized vertical coordinates; Primitive equations in z-coordinates, pressure coordinates and sigma coordinates, Dimensional homogeneity Scales Non-dimensional parameters. Natural coordinate system, Balanced flow, The Boussinesq approximation, The thermal wind, Departures from balance. Useful approximations: Geostrophic balance, thermal wind, barotropic and baroclinic flows. Circulation and vorticity: Bjerkins theorem, conservation of potential vorticity and applications, Relative vorticity equation. Barotropic vorticity equation, Rosby waves, Baroclinic instability: Two-level (Philips model). Dynamics of the tropical atmosphere, tropical stationary waves, Kelvin waves. Understanding the atmospheric response to sea surface temperature anomalies; clouds; convection; boundary layer; solar and terrestrial radiation. Energy balance. Heat fluxes (sensible, latent and ground heat fluxes). The carbon cycle. Physical climate interactions. Chemistry, biogeochemistry and biosphere-climate interactions, natural modes and coupled systems.

SMT 814 Air Pollution Dispersion and Control (3 units)

Mesoscale circulation; Sources of Air pollution; Effect of Air pollution; Atmospheric Systems and Pollutant transfer. Regulatory control of Air Pollution; Chemical Kinetics and atmospheric pollution dispersion; Pollutant dispersion models; Gaussian diffusion models: practical applications and their limitations, A Brief History of Air Pollution, Types and Sources of Air Pollutants, Principal Air Pollutants, Ozone in the Troposphere, Ozone in the Stratosphere, Air Pollution: Trends and Patterns, The Ozone Hole, Factors that Affect Air Pollution , the Role of the Wind, the Role of Stability and Inversions, Focus on an Observation: Smokestack Plumes, the Role of Topography. Severe Air Pollution Potential, Air Pollution and the Urban Environment, an Air Pollution Episode

SMT 815 Atmospheric-Ocean Dynamics (3 units)

Sea surface temperature (SST) Surface fluxes of momentum, heat, and water; Atmospheric response to sea surface temperature; Study of air-sea interaction mechanism of exchange and budgets; Basic observations of coupled ocean-atmosphere systems; Mean conditions at the air-sea interface, their seasonal cycle and intra-seasonal variability; Equations of motion and valid approximations for the ocean; one dimensional mixed layer theories; shallow water model; Two layer model; Mid-latitude

quasi-geostrophic motion on a sphere; Continuous stratification; Wind-driven ocean circulation, boundary layer and Ekman theory; equatorial undercurrent and oceanic waves; thermocline problem; Models of the tropical atmosphere; Hadley circulations; Gill model; Lindzen- Nigam model; ; interactions between the tropical ocean and atmosphere; Development of simple air-sea interaction model; Unstable interactions; Unstable Kelvin and Rossby waves; Theories of El Nino-Southern Oscillation (ENSO), La Nina and Southern Annular Mode (SAM); Predictability and prediction of ENSO. Electromagnet measurement: range, reflectivity factor rain rate, Z, Polarisation, frequency, mass content, entrainment and mixing. Radar versus Aircraft measurements. Tropical Rainfall Measurement Mission (TRMM) Satellite. Deep convection and anvil over West Africa, large less organised MCS over West Africa. Shallow convection over the East Atlantic Ocean. Physical interpretation of Z-R relationship in relation to ocean/atmosphere moisture exchange.

SMT 816 Agricultural Meteorology (3 units)

Agroclimatology, Agroecology zoning, Agrometeorology observation; Climate and strategic decision making in agriculture; Assessment of climate variability change and its impact on agricultural practice and production; Irrigation, mulching, frost protection, wind breaks, forest fire, drought and desertification; Soil and land cover climates; Crop atmospheric interactions; Biomass and productivity; Causes and effects of soil erosion; Crop-weather modelling for yields and growths; Climate and seasonal forecasting for agriculture; Onset, cessation, length of rainy season and length of growing season; selection of crop/seed type; Investigation of atmospheric conditions within a crop.

SMT 818 Climate Systems Modelling (3 units)

General equation of atmospheric motions with scale analysis; Barotropic and baroclinic atmospheres; Concepts of atmospheric instability; Parameterization of energy fluxes (radiation, moisture and momentum) in atmospheric models; Perturbation theory; Energetics of real atmosphere (available potential energy); Multi-level models; energy conversion and the general circulation. Approximate solutions, parameterisations and models, History of numerical weather prediction, finite – differencing equations, numerical stability, numerical forecast process. Balance mass and flow field. Data assimilation and analysis. Forecast quality: accuracy versus skill, verification scores. Non linear dynamics and chaos: predictability, Lorenz strange attractor. Ensemble forecast. Useful indicator on weather map produced by NWP. Elements of good weather briefing.

SMT 899 Master's Thesis Research Project (12 Units)

This is a thesis project on a subject related to any area of interest applicable to satellite meteorology. It is expected to be an original research project, which must involve independent investigations in any of the listed fields, and should make new and significant contributions to the understanding and knowledge of Satellite Meteorology. The report should be presented in form of a thesis using approved School of Postgraduate Studies format. Every candidate must present two successful seminars, proposal and final, before submission of the M. Tech thesis report for examination.

REMOTE SENSING AND GIS OPTION

RSS 801 Principles of Remote Sensing & Geographic Information Systems (3 units)

An overview of basic theory and practice in remote sensing; The importance of the fields of physics, geography, biology and computing science in remote sensing; Aerial photography and satellite imagery; More commonly used platforms, sensors and data collection methods, including key multispectral, hyperspectral and active (RADAR and LIDAR) systems; Visual image interpretation; digital image processing and rectification; Advanced image classification and validation; Mosaicking of Aerial Photo and Multi-spectral images; Re-sampling and Calibration; Inter-relationships between Remote sensing and Geographic Information Systems; GIS data structures, output and display; Global Positioning System survey techniques; coordinate systems; integration of remote sensing and GPS data into GIS; General applications of Remote sensing and GIS.

RSS 802 Advanced GIS (3 units)

Database handling: Presentation of spatial, numerical and table-based data; Classification of spatial and non-spatial, multi-dimensional, discrete and continuous data; Topology and Spatial relationships; Visualization and virtual reality (vis a vis the problems of human perception and variations in audience type); Interpolation, topographic modeling; Advanced Map design and Cartography; Mathematical concepts and algorithms commonly used in processing multispectral imagery; Introduction to Programming in GIS; Analysis functions; Advanced topics in spatial analysis using the raster data model and 3D environments; Modelling (vector analysis, raster analysis, interpolation, topographic and 3D modeling) and flow-charting; 3D and surface analysis, integration with vector-based analysis, spatial modelling techniques, and issues in managing raster and 3D datasets; Provision of creative solutions to planning problems using 3D analysis; Animations, interactive atlases, and data exploration tools. Automation in GIS Functionality, Introduction to WebGIS.

RSS 803 Components of GIS (2 units)

GIS Subsystems; Geo-spatial Information; GIS Software Data structures and capabilities; Database design, creation, implementation and management; Spatial referencing and Analysis; Map Projections, Datums in describing and measuring the Earth; Coordinate systems and the Geoid; Thematic mapping; Distributed database, Data standards and quality, Interoperability and Metadata; Concepts of Geo-spatial data infrastructure and Clearinghouse.

RSS 804 Research methodology (1 unit)

Basic research skills, scientific thoughts and methods required to succeed in a highly competitive world; Statistical and Geospatial techniques in research; Data collection, evaluation, analysis and interpretation; Skills in essay and report writing; Communication and presentation skills.

RSS 805 Implementation and Management of GIS (2 units)

Requirements analysis; Implementation planning and budgeting; Fitting GIS into the work processes; software and hardware procurement; Contracting for data and systems, system operation, and the basics of organization and staffing; Major organizational, institutional, and management issues involved in development and management of a GIS; Management of multi-participant projects; Education and training, cost recovery, data sharing, and legal issues.

RSS 806 Emergency Management with Remote Sensing and GIS (3 units)

Natural disasters (earthquakes, flooding, landslides, hurricanes, coastal surges, infectious diseases, etc) and their effects on the environment. Fundamentals of Search-and-Rescue operations. Establishment of pre-plans for any event (remote sensing data acquisition, two-way radio communication with Command and Control Centre, and with the National Base Station); incident mapping and analysis. Establishment of service areas and evacuation routes. Emergency Operations Center (EOC) activation (satellite imageries of event scene, internet facilities for data communication, and broadcasting services).

Effective preparation and management of emergency events using ArcGIS, Network Analyst Extension, and other software applications. Quick recovery from emergency events.

RSS 807 Integration of Remote Sensing and GIS (3 units)

Electromagnetic spectrum and sensor systems; Radiometric and geometric characteristics of remotely sensed data; Airborne and satellite platforms; Scale, Resolution, Classification strategies and sampling techniques; Data extraction from remote sensing sources (manually and digitally); Vector and raster datasets; Geographic Information in relation to the Environment; Landscape analysis; Geographic data presentation; Types of spatial data (primary and secondary); Sources of spatial data; Web-based mapping and use of Google Earth; Integration of remotely sensed data and other spatial data.

RSS 808 Intelligence and Defence Applications of Remote Sensing and GIS (3 units)

Overview of typical security and defence issues. Surveillance and Intelligence data gathering using remote sensing and GIS; Data sources; spatial analysis operations of defence-related data; Decision making process in defence operations (Crime situations, call for service, and demographic data analysis). Confidentiality, Integrity and Availability (CIA) as the core of Information Security; Principles of Information Security: Awareness, Responsibility, Response, Ethics, Democracy, Risk Assessment, Security Design and Implementation, Security Management, and Reassessment. Case studies involving a number of scenarios such as public disorder, crime policing, crime mapping and analysis concepts; Human behavioral mapping and analysis for strategic deployment purposes. Uses of GIS in law enforcement (analyzing crime series, crime trends and addressing deployment issues in relation to law enforcement); Customized tools for specific applications intelligence and defence (real-time intelligence mapping and crime control).

RSS 809 Numerical Methods and Algorithms in Remote Sensing and GIS (3 units)

Overview of Numerical Methods in image processing and GIS; Fourier transformation and Image Filtering; GIS and Remote Sensing Systems design and development: fundamentals; Principles in software development: data structures, methods, algorithms; Language description and software development: C++, VB.Net, Data structure for GIS and Remote Sensing; Vector description and storage; raster structures; Basic computational geometry; Basic algorithms in GIS; Resolution of some common geometric problems (positions, tessellation, vectorization, interpolation, buffering, line-following, adjacency and proximity); Image processing and algorithms for Remote Sensing (mathematical morphology, filters, textures, sampling, cartography, vector codification, graphic languages and image codification).

RSS 810 Course Seminar (2 units)

A term paper on a chosen topic on application of Remote Sensing and GIS to solving industrial or societal problem will be presented by each student. An oral presentation of the seminar will be made to an audience consisting of the academic staff and students involved in the programme. The assessment of the write-up will be based on the contents (depth of knowledge, technical language, illustrations, etc) while the oral presentation will also be assessed accordingly.

RSS 811 Geostatistical Analysis (3 units)

Probability and probability distribution (normal, binomial, Poisson, geometric, and negative binomial distribution); Regression, correlation and analysis of variance; Spatial - and geo-statistics in GIS analysis; Concept of transformation; Point pattern analysis, spatial autocorrelation, and interpolation using ArcGIS Spatial-Geo-statistical - and 3D-analyst, as well as time series analysis; Applications of geostatistics in earth sciences, agriculture, public health, etc.

RSS 812 Water Resources and Management (3 units)

The Hydrologic cycle; Origin of groundwater; Hydro-geological environments (aquifers, aquicludes and their properties); River courses (upper, middle and lower) and their characteristics; Surface hydrology, groundwater flow, groundwater storage and recharge; Porosity, permeability and their types.; Transmissivity, Storativity and Specific yield; Flood plains and wetlands; Water quality assessment (turbidity, temperature and pollution); Water resource problems (exploration and abstraction) and management (water use and reuse); Watershed problems and Watershed analysis; Erosion types: Coastal erosion and coastal zone management; Flooding (coastal, river and urban); Water pollution (industrial and domestic); Groundwater assessment and modelling.

RSS 813 Human Terrain Analysis (2 units)

Social scientific theories regarding the geo-spatial correlates of role and status; differences between geophysical and geo-social data; choice of spatial tools and software packages in terrain analysis; methodologies for spatial and temporal analysis with respect to group behavior; The use of ArcGIS, CASE, and CrimeState III in the production of statistically-classified, descriptive, explanatory, and predictive assessments of the location of significant social groups as may be found in micro (village) and macro (regional) settings.

RSS 814 Business Applications of GIS (3 units)

Proximity analysis, site location determination, and market delineation; Finding business through socio-economic and demographic spatial data gathering; Network structures, routes, dynamic segmentation, planning and management of transport network; Modeling techniques (shortest path, location and allocation, vehicle routing, and traffic assignment); Integration of intelligent transportation systems (ITS), GPS, GIS and transportation modelling and planning; Use of GIS transportation analysis package in transportation modelling; Telecommunication tower networks, Water supply and distribution networks, Electrical distribution networks, Navigation system development, GIS for business planning and management; Exploration of business GIS analysis and map integration; Report presentation as E- Documents. Case studies of Business GIS.

RSS 815 Public Health Administration and GIS Analysis (2 units)

Concepts and techniques of GIS in spatial patterns of epidemiology and health service supply; Disease events, incidence, diffusion, transmission, and service delivery modeling; Emerging infectious diseases, climate change, and bio-defence; Utilization of spatial database management systems, visualization and mapping software systems in public health and policy, environmental change, and the geography of health.

RSS 816 Environmental Applications of Remote Sensing and GIS (2 units)

General appraisal of Remote Sensing and GIS in the evaluation of natural resources and the environment; Generation of terrain data, natural resources data and other environmental data, structuring and implementation in GIS environment; Pollution (atmospheric, soil and water) and their manifestations on satellite imageries; Environmental modelling of the atmosphere, biosphere and earth processes (erosion and deposition).

RSS 899 Master's Thesis Research Project (12 units)

This is a thesis project on a subject related to the development or applications of Remote Sensing and/or Geo-information Systems (GIS). It is expected to be an original research project, which must involve independent investigations in any of the areas of Remote Sensing and/or GIS. It in addition should make new and significant contributions to the understanding and knowledge of Remote Sensing and/or GIS. The report should be presented in form of a thesis using approved School of Postgraduate Studies format. Every candidate must present two successful seminars, proposal and final, before submission of the M. Tech thesis report for examination.

AVAILABLE STAFF**SATELLITE COMMUNICATION PHYSICS AND BASIC SPACE PHYSICS OPTIONS**

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1	Prof. A. M. Arogunjo	FUTA	PhD (Akure), M.Sc.(Ibadan), B.Sc. (Ilorin)	Professor/HOD	Health Physics
2	Prof. (Mrs.) I.A. Fuwape	FUTA	PhD, M.Sc., B.Sc. (Ibadan)	Professor	Condensed Matter/Theoretical Physics
3	Prof. M. O. Ajewole	FUTA	PhD (Akure), M.Sc., B.Sc., (Ilorin)	Professor	Communication
4	Dr. O. S. Ajayi	FUTA	PhD (Akure), M.Sc.,B.Sc. (Ibadan)	Reader	Health Physics/Instrumentation
6	Dr. B. Adeyemi	FUTA	PhD, M.Sc., B.Sc. (Ilorin)	Reader	Lower Atmosphere
7	Dr. E. O. Ogolo	FUTA	PhD, M.Sc., B.Sc. (ED) (Ibadan)	Snr. Lecturer	Lower Atmosphere
8	Dr. S. E. Falodun	FUTA	PhD, M.Tech. (Akure), B.Sc. (Benin)	Snr. Lecturer	Communication
9	Dr. S. S. Oluyamo	FUTA	PhD, M.Sc., B.Sc. (Ibadan)	Snr. Lecturer	Condensed Matter
10	Dr. K.D. Adedayo	FUTA	PhD, M.Tech., B.Tech. (Akure)	Lecturer I	Instrumentation/ Communication
11	Dr. J. S. Ojo	FUTA	PhD, M.Tech., B.Tech. (Akure)	Lecturer I	Communication
12	Dr. A.T. Adediji	FUTA	PhD, M.Tech., (Akure) B.Sc.(ED) (Ilorin)	Lecturer I	Communication
13	Dr. T. Ewetumo	FUTA	PhD, M.Tech., B.Tech. (Akure)	Lecturer I	Instrumentation
14	Dr. E. O. Odo	FUTA	PhD (S/Africa), M.Tech.(Akure), B.Sc. (Ife)	Lecturer I	Condensed Matter
15	Dr. V. A. Akpan	FUTA	PhD (Greece), M.Tech (Akure) B.Sc. (Abraka)	Lecturer II	Instrumentation
16	Prof. I. E. Owolabi	ARCSSTE-E	B.Sc. (London), PhD. (Dunelm), C.Eng	Professor	Communication
17	Prof. T. Ibiyemi	ARCSSTE-E	B.Sc. (Ife), M.Sc., PhD (Ibadan)	Professor	Communication
18	Dr. S. A. Adeniran	ARCSSTE-E	B.Sc. M.Sc., PhD (Ife)	Senior Lecturer	Electronics
19	Dr. T. K. Yesufu	ARCSSTE-E	B. Eng. (Jos.) M.Sc., PhD (Ife)	Senior Lecturer	Communication
20	Dr. K. P. Ayodele	ARCSSTE-E	B.Sc., M.Sc., PhD (Ife)	Lecturer I	Electronics

21	Dr. O. O. Alabi	ARCSSTE-E	B.Sc., M.Sc. (Ife), PhD (USA)	Chief Scientific Officer	Satellite Communication/ Meteorology
22	Dr. E. O. Gbobaniyi	ARCSSTE-E	B.Sc., M.Sc. (Ife), PhD (South Africa)	Chief Scientific Officer	Satellite Communication/ Meteorology
23	Dr. I. Mangete	ARCSSTE-E	B.Sc. (PH), M.Sc. (London), PhD (Edinburgh)	Chief Scientific Officer	Basic Space Physics
24	Prof. A. B. Rabiou*	ARCSSTE-E/ FUTA	B.Sc. (Ilorin), M.Sc., PhD (UNN)	Professor	Basic Space Physics
25	Dr. O.R. Oladosu*	ARCSSTE-E/ FUTA	B.Sc.(Makurdi)), M.Sc., PhD (Ife)	Lecturer I	Lower Atmosphere
26	Dr R. O. Fayose	ARCSSTE-E	B.Sc. (Ife) M.Tech ., PhD (Akure)	Lecturer II	Basic Space Physics

* On leave of absence
Technical Support Staff

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1	Mr. H. I. Alamuoye	FUTA	PGD (Akure) HND (NIST, Akure)	Chief Tech	Instrumentation
2	Mr. O. Olasoji	FUTA	PGD (Akure) HND (NIST, Akure)	Ass. Chief Tech	Instrumentation
3	Mr. K. Adepoju	ARCSSTE-E	B.Sc., M.Sc. (Ife)	Technologist I	Instrumentation
4	Mr. A. Adegbite	ARCSSTE-E	B.Sc., (Ibadan), M.Sc. (Sheffield)	Technologist I	Instrumentation

SATELLITE METEOROLOGY OPTION

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1	Dr. A. A. Balogun	FUTA	PhD, M.Tech. B.Tech. (Akure)	HOD/ Reader	Boundary layer and Lower atmospheric processes; Agricultural Meteorology
2	Prof. D. O. Adefolalu	FUTA	B.Sc., M.Sc., PhD (Florida)	Professor	Climate studies and application with emphasis on the West African monsoon/climate systems, ecoclimate Remote sensing and mapping and sustainable land use management.
3	Dr. K. O. Ogunjobi	FUTA	PhD (S. Korea), M.Sc. (UNN), B.Sc. (Ilorin)	Reader	Pollution and climate studies with emphasis on atmospheric optical depth and aerosol characteristics of dust
4	Dr. E. C. Okogbue	FUTA	PhD, M. Phil., M.Sc., B.Sc. (Ife)	Senior Lecturer	Solar and atmospheric Radiation studies and application to surface energy balance and renewable energy; climate change and variability and implications on crop production
5	Prof. O.O. Jegede	ARCSSTE-E	B.Sc., M.Sc., PhD (Ife)	Professor	Atmospheric Physics

6	Dr. O. O. Alabi	ARCSSTE-E	B.Sc., M.Sc. (Ife), PhD (USA)	Chief Scientific Officer	Satellite Communication & Satellite Meteorology
7	Dr. E. O. Gbobaniyi	ARCSSTE-E	B.Sc., M.Sc. (Ife), PhD (South Africa)	Chief Scientific Officer	Satellite Communication & Satellite Meteorology

Technical Support Staff

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1	Mr. K.O. Ladipo	FUTA	PGD, B. Tech (Akure)	Ass. Chief Tech	Instrumentation
2	Mr. A. Okunlola	FUTA	B. Tech. (Akure)	Technologist I	Instrumentation
3	Mr. K. Adepoju	ARCSSTE-E	B. Sc., M.Sc. (Ife)	Technologist I	Instrumentation

REMOTE SENSING AND GIS OPTION

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1	Dr. A.Y.B. Anifowose	FUTA	PhD (Akure), M. Sc., B. Sc. (Ibadan)	HOD/Senior Lecturer	Remote Sensing/GIS and Geology
2	Prof. D. O. Adefolalu	FUTA	PhD, M.Sc., B.Sc. (Florida)	Professor	GIS, Meteorology and Climate Change Analysis
3	Prof. S. O. Akindele	FUTA	PhD, M.Sc., B.Sc (Ibadan)	Professor	Biostatistics, GIS and Natural Resources Management
4	Dr. F. O. Adekayode	FUTA	PhD (Akure), M.Sc. B. Sc. (Ife)	Snr. Lecturer	Soil Management and GIS
5	Dr. A. E. Olajuyigbe	FUTA	PhD (Akure), M.Sc. (Ibadan), PGD (Eschede), B.Sc. (Ife)	Snr. Lecturer	GIS and Urban Planning
6	Dr. B. K. Alese	FUTA	PhD, M.Tech., B.Tech. (Akure)	Snr. Lecturer	Computer Software and Database Development
7	Dr. J. O. Akinyede	ARCSSTE-E	B.Sc. (Ibadan), M.Sc. (Abu), PhD (ITC, Netherland)	Exec. Director	Remote Sensing & GIS
8	Prof. A. T. Salami	ARCSSTE-E	B.Sc., M.Sc., PhD (Ife)	Professor	Remote Sensing & GIS
9	Prof. O. O. Fadare	ARCSSTE-E	B.Sc., MCP (Ewu), PhD (Sheffield)	Professor	Urban & Regional Planning/Environment
10	Prof. A.S. Aguda	ARCSSTE-E	B.Sc.(UNN), M.Sc., PhD	Professor	Geography
11	Dr. D. Oyeshola	ARCSSTE-E	B.Sc., M.Sc. (Ife), PhD (UK)	Reader	Space Law
12	Dr. V.F. Olaleye	ARCSSTE-E	B.Sc. (Ogbomosho) PhD (Ibadan)	Snr. Lecturer	Geography
13	Dr. O.I. Babatimehin	ARCSSTE-E	B.Sc., M.Sc., PhD (Ibadan)	Snr. Lecturer	GIS
14	Dr. T.O. Odekunle	ARCSSTE-E	B.Sc., M.Sc., PhD (Ibadan)	Snr. Lecturer	Remote Sensing & GIS
15	Dr. N. O. Adeoye	ARCSSTE-E	B.Sc. (Ife), M.Sc. (Ibadan) PhD	Snr. Lecturer	Remote Sensing/GIS
16	Dr. S. Ayanlade	ARCSSTE-E	B.Sc., M.Sc. (Ife) PhD (London)	Lecturer I	Quantity Surveying
17	Dr. O.O. Orimoogunje	ARCSSTE-E	B.Sc., M.Sc., PhD (Ife)	Snr. Lecturer	Geography
18	Dr. O. Olayiwola	ARCSSTE-E	B.Sc., M.Sc., PhD (Ife)	Lecturer I	Geo-Informatics

19	Dr. M. A. Adepoju	ARCSSTE-E	B.Sc., M.Sc., PhD (UK)	Director	Remote Sensing & GIS
20	Dr. H. Shaba	ARCSSTE-E	B.Sc. (Kano), M.Tech., PhD (ABU)	Director	Remote Sensing & GIS

Technical Support Staff

S/N	Name	Institution	Qualifications	Status	Area of Specialisation
1.	Miss F.C. Akinwonmi	FUTA	PGD (Akure) HND (NIST, Akure)	Technologist II	GIS, Computer Sci.
2	Mr. D. R. Awoniran	ARCSSTE-E	B.Sc(Ado), M.Sc. (Benin)	Technologist I	Environmental RSG
3	Mr. O. E. Ebeiyamba	ARCSSTE-E	B.Sc. (UNN), M.Tech (Akure)	Technologist I	Environmental RSG