African Regional Centre for Space Science & Technology Education – English [ARCSSTEE-E]
Obafemi Awolowo University, Ile-Ife, NIGERIA
- Capacity Building Programmes
www.arcsstee.org.ng

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International Training Workshop on Global Navigation Satellite System [GNSS]
Obafemi Awolowo University, Ile-Ife, NIGERIA, 8-13 August, 2016
ARCSSTEE Capacity Building Programmes

United Nations General Assembly Resolutions

• 37/90 of 10th December 1982 – UNISPACE ’82

‘That the United Nations Office for Outer Space Affairs (UNOOSA), through its Programme on Space Applications should focus its attention, interalia, on building of indigenous capacities for the development and utilization of Space Science and Technology, particularly at the local level’

• 45/72 of 11 December, 1990 – UN-COPUOS

‘That the UN should lead, with the active support of its specialized agencies and other international organisations, an international effort to establish Centres for Space Science and Technology Education at the regional level in existing national/regional educational institutions in the developing countries’

African Centres: ARCSSTE-E (Anglophone - NIGERIA) ; CRASTE-LF – (Francophone – MOROCCO)

• India (inaugurated in 1995)
• Morocco (inaugurated in 1998)
• Nigeria (inaugurated in 1998)
• Mexico and Brazil (inaugurated in 2003)
• Jordan (inaugurated on 29 May 2012)
• China (inaugurated 2014)
ARCSSTE-E
- Established 15 September 1998

ARCSSTE-E has operated under the administration of NASRDA since the inception of NASRDA on May 5, 1999.
ARCSSTE-E also serves as NASRDA’s Centre for Space Science and Technology Education (CSSTE)
• Development of skills and knowledge of university educators, research application scientists through rigorous theory and research works, applications, field exercises, and Pilot-Projects in aspects of Space Science and Technology, especially in five principal areas:

- Remote Sensing & GIS
- Basic Space & Atmospheric Science (BSAS)
- Satellite Communications
- Satellite Meteorology
- GNSS (Commenced 2014)

• To Establish academic relationships with space-related institutions, as well as regional and international cooperation in space science and technology programmes e.g. participation in FP7 (Horizon 2020) programme of the EU and similar ones in USA & Canada, etc.

• To establish space education outreach programmes for the dissemination of the value of space science & technology to pupils/students and teachers at primary, secondary, and tertiary institutions, policy and decision makers and the general public.
Focus of the Individual and Institutional Capacity Building Programmes

- Post Graduate
  - PGD (9 months)
  - MTech in collaboration with Federal University of Technology, Akure (18 months)

- Space Education Outreach

- Space Research & Development

PGD Programme:

**International Participants** are offered full scholarship covering:

- Tuition Fee
- Hostel Accommodation, Monthly Stipend, Course & Projects Materials
- Medical Services (Obafemi Awolowo University)
- Travel Tickets (UNOOSA)

- *** Programme Curriculum developed by UNOOSA***
ARCSSTEE Capacity Building Programmes

ARCSSTEE-E
- PGD Programme Participation

Botswana *
Cameroon *
Egypt
Ethiopia *
Eritrea
Ghana *
Kenya *
Lesotho
Liberia *
Mauritius
Malawi *
Mozambique
Nigeria *
Namibia *
Somalia
Swaziland
Sudan *
South Africa *
Sierra Leone *
Tanzania *
The Gambia *
Uganda *
Zambia *
Zimbabwe *

* 17 Countries have participated in the PGD programmes to date
### Distribution of PGD Participants by Country (2001-2015)

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Curricula for all the PGD courses - developed by UN-OOSA

Graduation Ceremony
Annual Distribution of PGD Participants (2001 - 2013)

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<td>2013</td>
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ARCSSTEE Capacity Building Programmes

Distribution of PGD Participants by Course Options (2001 - 2013)

- Satellite Meteorology: 3% (7)
- Satellite Communication: 24% (76)
- Basic Space Science: 5% (17)
- Remote Sensing & GIS: 68% (206)
### Distribution of RS/GIS Participants by Gender (2006 - 2013)

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ARCSSTE Capacity Building Programmes

- PGD Programme Field Trip & Excursions
### Impact of Human Capacity Building (PGD Projects) on Development

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<th>2007</th>
<th>2008</th>
<th>2009</th>
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### ARCSSTEE Capacity Building Programmes

**Applications of some SATCOM projects carried out by course participants**

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Typical Examples of Participant’s Research Projects

ARCSSTEE Capacity Building Programmes

Agricultural Drought Severity Assessment Using Land Surface Temperature and NDVI In Nakuru, Kenya

NAKURU REGION; KENYA

NAKURU REGION; KENYA

NAKURU REGION; KENYA
(2) Geospatial Analysis of Land Use Dynamics in Ganta City, Northeast Liberia

ARCSSTEE Capacity Building Programmes

Civil War 1989-2003

Legend
- Blue: Rivers
- Red: Roads
- Light Blue: WTB: Water Bodies
- Brown: BSR: Bare Soil/Rocks
- Orange: SAS: Settlement/Artificial Surfa
- Green: VGT: Vegetation
- Light Green: FLF: Farm Land

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<th>Year</th>
<th>Bare Soil/Rocks</th>
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A 10x10x10 prototype Cubesat (EregbuSAT) was developed by a student in Satellite Communication option of the PGD program.

EregbuSAT is designed to simulate communication (send and receive data) between a satellite and its Ground Station (GS).

When completed, this device will provide an opportunity for future students in the Satellite communication option of ARCSSTE-E PGD program to develop the capacity to build and operate a prototype Satellite.

The development of EregbuSAT has being well reported in the website (http://www.uk.amsat.org/?p=12387) of AMSAT-UK, a voluntary organization that supports the design and building of equipment for Amateur Radio Satellite.
ARCSSTE-E Regional Biennial Conference, initiated in 2010 is designed as a forum for Alumni of the PGD program of ARCSSTE-E to showcase how they have been able to successfully apply space science and technology for the socio-economic development of their home countries.
Space Education Outreach Program

- Workshops for Primary, Secondary & Tertiary Institutions
  - Introduction to Robotics
  - Science Exhibition
  - Science Quiz Competition
  - Essay Competition
  - Debate
  - Space Club Activities
  - Space Holiday Camp
  - Workshop for Teachers

- Public Awareness
  - World Space Week
  - Carnival (Distribution of information & educational materials in local languages through local groups and organizations)

- Space Education Outreach Foundation

- Space Science Curriculum & Content Development

- Talbott Initiative for Girls in Science (TIGS)

- Mass Media Educational Activities
  - Television/Radio/Internet

- Seminar for Stake Holders

Affiliated to
United Nations Office for Outer Space Affairs

- Space Education Outreach Programme
**Zero-Gravity Instrument Project (ZGIP)**

**Human Space Technology Initiative (HSTI)**

Zero-Gravity Instrument Project (ZGIP) promotes space education and research in microgravity.

The United Nations Office for Outer Space Affairs launched the ZGIP on 1 February 2013, and distributed the microgravity simulation instruments to qualified schools, universities, research centres and institutes.

**CLINOSTAT**: A one-axis clinostat was selected for distribution because of the ease of use and potential scientific benefits.

**ARCSSSTE-E** received, on a competitive basis, one of the 20 Clinostats distributed in 2013.

**During this project, the students learn:**

- How to collect scientific data in a laboratory environment
- Analyze the data with specialized software
- Obtain results
- Interpret and present the result of their study in a standard format to the scientific community.
The Founder/CEO of SLOOH addressing the participants during the ‘Twinkle Twinkle Little Star’ Workshop - 2015
ARCSSTEE Capacity Building Programmes

Training Workshop for Teachers
MTech. (Space Science & Technology Applications)

PROGRAMME DURATION
* Full-Time Joint MTech. Degree programme  * Duration: Min: 18 months (3 semesters)  
Max: 24 months (4 semesters). Two semesters of course work and an intensive period of research work and thesis writing.

GRADUATION REQUIREMENTS
Average Score Course Work: 50%  
* Mtech. Thesis Project : 50%

Options:  
- Satellite Communication and Basic Space Physics  
- Satellite Meteorology  
- Remote Sensing and GIS
ARCSSTEE Capacity Building Programmes

MTech. (Space Science & Technology Applications)

African Regional Centre for Space Science and Technology Education - ENGLISH, O.A.U Campus, Ile-Ife

Collaboration

18 months

For More Information:
http://www.arcsstee.org.ng/index.php/post-graduate/125-futa-masters

Commenced: 2013 with 18 Students
2014: 15 Students
2015: 20 Students
ARCSSTE-E’s permanent site under development
NIGERIA’s EO Space Infrastructure Supporting ARCSSTEE Activities

NigeriaSat-1

NigeriaSat-2

NigeriaSat-x
CORS in NIGERIA; Source: Dodo et al. 2011
<table>
<thead>
<tr>
<th>Course code</th>
<th>Title</th>
<th>Overview</th>
<th>Dates</th>
<th>Duration</th>
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<tbody>
<tr>
<td>GNS 701</td>
<td>Fundamentals of GNSS</td>
<td>Introduction to GNSS; Reference systems; Satellite orbits; Basic techniques of communication</td>
<td>Jan 20 – Feb 7</td>
<td>3 weeks</td>
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<tr>
<td>GNS 702</td>
<td>Position determination techniques</td>
<td>GNSS measurements; Position determination techniques; Satellite constellation and DoP</td>
<td>Feb 10 – Feb 28</td>
<td>3 weeks</td>
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<tr>
<td>GNS 703</td>
<td>Augmentation systems</td>
<td>Errors in GNSS measurement; Error effects; Error mitigation techniques; Augmentation systems</td>
<td>Mar 3 – Mar 28</td>
<td>4 weeks</td>
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<tr>
<td>GNS 704</td>
<td>Sensors and Embedded systems</td>
<td>Sensors; Transducers; Embedded systems</td>
<td>Mar 31 – Apr 25</td>
<td>4 weeks</td>
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<tr>
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<td>Duration</td>
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<tr>
<td>GNS 705</td>
<td>GNSS Receivers</td>
<td>Receiver architectures; Navigation algorithm</td>
<td>Apr 28 – May 16</td>
<td>3 weeks</td>
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<tr>
<td>GNS 706</td>
<td>GNSS/Integrated Navigation</td>
<td>INS; INS error dynamics; GNSS/INS integration</td>
<td>May 19 – Jun 13</td>
<td>4 weeks</td>
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<td>GNS 707</td>
<td>GNSS Applications</td>
<td>Geospatial databases; Communication, Navigation &amp; Surveillance; Remote Sensing of the atmosphere; LBS</td>
<td>Jun 16 – Jul 11</td>
<td>4 weeks</td>
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<tr>
<td>GNS 708</td>
<td>Space weather and GNSS</td>
<td>Space weather effects; scintillations; GNSS-based monitoring of ionosphere; correction models</td>
<td>Jul 14 – Jul 25</td>
<td>2 weeks</td>
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<tr>
<td>GNS 799</td>
<td>Laboratory experiments; field visits; project work</td>
<td></td>
<td>July - Sept</td>
<td>12 weeks</td>
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Inadequate Funding
- Member States involvement in Funding the Institution
- Non-Completion of Permanent Site
  - A modern library facilities
  - Improved ICT facilities
  - Inadequate Training Rooms with facilities

Establishment of **Ground Receiving Station** facilities for teaching and research

Collaboration for the establishment of E-Learning

Collaboration for Staff Internship and Secondment/Exchange of teaching staff with other Centres and relevant institutions

Collaboration in research and support for teaching facilities
Recommendations

- Inventory of EO related Capacity Building Institutions in Africa

- Review of UN-Regional Centres Curriculum & adoption as foundation course at EO Capacity Building Institutions

- Regional ‘themes’ for student and research projects that will use EO data using best practice methodology developed through the RR & D. Grants may be instituted as incentives

- Establishment of CB network (National & Regional)
  - Define Minimum Facilities to Establish UN regional Centres
    - Dedicated Office in a conducive environment
    - Personnel – capacity, number, etc.
    - Annual dedicated funds for running the office
    - Effective participation in International R & D work programmes and responding to calls for participation

- Linkages with Regional Organisations e.g. AARSE, UNECA, etc.

- Regional Institutions to collaborate in the delivery of E-Education
Conclusions

- The applications of SS&T to socio-economic development within the African region are gaining wide acceptance with the emergence of more countries pursuing the development of one form of SS&T programme or the other, depending on the individual country’s level of investments.

- There is a clear evidence of the impact of the UN-assisted capacity building programme which has already produced appreciable number of trained personnel as revealed in ARCSSTE-E’s programme implementation and its achievements since its inception in November, 1998.

- New strategies for capacity building at the formal and informal levels of education to train a sizeable number of experts to ensure meeting up the SDGs 2030. Those to be trained will include representatives of space industry, governmental and non-governmental organizations.
ARCSSTEE Capacity Building Programmes

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