UNIVERSITY of RWANDA

OFFICE OF THE DEPUTY VICE CHANCELLOR FOR FINANCE

Kigali,...18.../04.../2019
REF: DVC-FIN/0262/2019

TO WHOM IT MAY CONCERN:

Expression of Interest No.: 002/S/CEBE/UR-SPIU/2018-2019/ADF related to the Consultancy Services to deliver the Academic Services under the East Africa's Centre of Excellence for Biomedical Engineering *and e-Health (CEBE)*

Loan N°: 2100150031998
IFB N°: 001/W/CEBE/UR-SPIU/2018-2019

18th **April 2019**

The Government of Rwanda has received financing from the African Development Bank towards the cost of Regional Centre of Excellence in Biomedical Engineering and e-Health (CEBE) Project. It is intended that part of the funds of this loan will be applied to eligible payments under the contract for the **Consultancy Services to deliver the Academic Services under the East Africa's Centre of Excellence for Biomedical Engineering and E-Health (CEBE).**

The Client now invites the interested ***Individual Consultants*** experienced and capable to express their interest in providing the following services.

I. MASTER'S DEGREE COURSES IN BIOMEDICAL ENGINEERING

Module	Total (Hrs)	Minimum Qualification of the Trainer
Biomedical Measurements Technology	100	PhD in Biomedical engineering, bioengineering, Neural Engineering with expertise in bio-medical sensors and data acquisition technology, bio-signal processing, recording and analyzes. Having minimum 3 years work experience in Biomedical measurement technology. Having a grade of Associate Professor and above is an added value.
Advanced Embedded System Design and Applications	100	PhD in Computer Science, Electronics Engineering, having minimum 3 years work experience in Advanced Embedded System Design and Applications. Having a grade of Associate Professor and above is an added value.
Biomaterial and Tissue Engineering	100	PhD in Biomedical Engineering, Bioengineering, Polymer Engineering, Material science, Having 3 year work in bio-materials, Molecular Biology, Biochemistry. Having a grade of Associate Professor and above is an added value.

Biomechanics and Biorobotics	100	PhD in Biomechanics, Bio robotics with minimum of 3 years work experience in Biomechanics, Bio robotics. Having a grade of Associate Professor and above is an added value.
Medical Imaging Systems	150	PhD degree in Biomedical Engineering, Electronics Engineering, with a minimum of 3 years work experience in medical imaging systems. Having a grade of Associate Professor and above is an added value.
Medical Image Processing	100	PhD in biomedical engineering, biophysics, electronics engineering with prior hands on experience in image processing software (matlab, python, openCV, C/C++), and minimum of 3 years' work experience in medical imaging processing. Having a grade of Associate Professor and above is an added value.
Healthcare Technology Management	140	PhD in Biomedical Engineering, Clinical Engineering, Electronics with a minimum of 3 years work experience teaching the Healthcare Technology Management. Having a grade of Associate Professor and above is an added value.
Medical Devices Development	100	PhD in Electronics Engineering, Biomedical engineering , Mechanical Engineering with a minimum of 3 years work experience in the development of medical devices. Having a grade of Associate Professor and above is an added value.
Orthopedic and Mobility Devices Engineering	100	PhD degree Biomechanical engineering. Having a minimum of 3 years work experience in design and development of orthopedic, prosthetic and other mobility related devices. Having a grade of Associate Professor and above is an added value.
BioMEMS -Design and Applications	100	PhD in Biomechanics, nanotechnology, microfluidic systems, mechanical engineering with a focus on biosensors, micro fluidic devices. Having a minimum of 3 years work experience, Having a grade of Associate Professor and above is an added value.

II. ADVANCED PROFESSIONAL TRAINING IN BIOMEDICAL ENGINEERING

Module	Period (Week)	Minimum Qualification of the Trainer
I. Healthcare Technology Management (HTM)	**2**	PhD in Biomedical engineering, Biomechanical Engineering, Bioengineering or Mechanical engineering, Electrical/Electronic engineering, with a minimum of 3 years experience in Healthcare Technology Management (HTM) ***Or*** Master's degree in Biomedical engineering, Biomechanical Engineering, Bioengineering or Mechanical engineering, Electrical/Electronic engineering with 8 years experience in Healthcare Technology Management (HTM).

II. Understand Hospital design	**2**	PhD degree in Biomedical Engineering, Environmental Design, Civil Engineering or Architecture with minimum 3 years experience in Hospital design training. ***Or*** Master's degree in Biomedical Engineering, Environmental Design, Civil Engineering or Architecture with minimum 8 years experience in Hospital design training.
III. Respiratory monitoring and cardiac equipment	4	Masters holder in Biomedical Engineering and related fields with minimum hands-on experience of 8 years in physiological signal monitoring equipment as a trainer.
IV. Laboratory equipment	4	Master's degree in biomedical laboratory sciences or related field with a minimum experience of 8 years as professional trainer in the field of medical laboratory equipment troubleshooting, maintenance and management.
V. Maternity and neonatology equipment	1	Master's degree in biomedical engineering, electrical/electronic engineering with 8 years experience as professional trainer in maternity and neonatology equipment troubleshooting, maintenance and management.
VI. Medical imaging equipment	4	PhD in medical imaging technology, biomedical engineering, medical imaging equipment with 3 years of work experience or Master's degree with 8 years experience as professional trainer in the field of medical imaging equipment troubleshooting, maintenance and management.
VII. Dental equipment	1	Master's degree in biomedical engineering with 8 years of work experience as professional trainer in the field of dental equipment troubleshooting, maintenance and management
VIII. Ophthalmology equipment	1	Master's degree in biomedical engineering with 8 years of work experience in the related as professional trainer in the field of ophthalmology equipment troubleshooting, maintenance and management.
IX. Medical gases system	3	Master's degree in Biomedical engineering or related field of engineering with 8 years experience as professional trainer in the field of medical gases system troubleshooting, maintenance and management.
X. Hemodialysis Machine	2	Master's degree in biomedical or electronic engineering, nephrology technology with 8 years experience as professional trainer in the field of hemodialysis machine troubleshooting, maintenance and management

III. ADVANCED PROFESSIONAL TRAINING IN E-HEALTH

Modules	Weeks	Minimum Qualifications of the Trainer
Telemedicine applications	2	Applicant should hold a PhD in Health Informatics, Computer Sciences, Public Health, or related field with minimum of 3 years in conducting training in Telemedicine Applications ***Or*** Master's degree in Health Informatics, Public Health, or related field with minimum of 8 years in conducting training in the allied field.

Legal framework for e-health information systems	2	Applicants should hold a research PhD in Computer sciences, certified certificate in computer security with at least 3 years work experience application in e-Health security system.
Medical Coding	2	Applicants should hold a Masters in Health Informatics, Public health with strong experience in medical coding certification.
E-Health: Software Development and Implementation (EHSDI)	22	**1. Electronic Medical Record (EMR) / Open MRS Developer and A trainer** • Senior Java (J2EE) Developer (Servlets/JSP on Oracle App Server, Apache/Tomcat) Jasper Reports, Spring, REST API (for Web Services), Hibernate, JavaScript/JQuery • Familiar with (JDBC with Oracle, MySQL, AJAX, XML, XSLT, CSS Layout) • Health Information System knowledge, HL7, ISO, CNIL Standards implementations • Deployment application on Linux (CentOS) and Windows Client/Server • Proof of Java software developed by the applicant • Strong knowledge of Open MRS, Bahmni distribution and proof of a module(s) that works • Being a Community Open MRS Senior Developer will be a strong asset • The applicant should be able to develop and integrate Open MRS modules. Education: Master's degree in Computer Science, Statistics, Public Health or related discipline. Having PhD in Computer Science, Statistics, Public Health or related discipline will be an added advantage. **2. DHIS2 Developer Specialist & Trainer** • More than 5 years of experience in the development and operations of robust Health Information Systems (preference for all five years of DHIS2 knowledge and practical experience) including specific work supporting DATIM • (Either with our JSI teams or country-level health and DHIS2 teams) to get the design of any customization or application right. Then test it in country and tweak it. Finally, leave behind local capacity to continue to customize and/or trouble shoot. • Experience developing web-based and/or mobile

		applications, web-oriented programming language (e.g. Java, Java Script, PHP), and Unix/Linux system management. • Expert in the use of database management systems (MS-Access and Visual Basic are vital, SQL language, SQL server or MySQL preferred) and in the operating environment of Microsoft. • Demonstrated ability to work effectively and harmoniously in cross-cultural settings with other project staff, host country counterparts, USAID, consultants, other donors and international organizations • Advanced degree (MPH, MS, MIS, MA, other) in computer science, informatics, public health or related fields such as health systems or health information • Experienced in applying user-centered requirements processes 3. **Senior developer in OPEN CLINIC, RAPIDSMS, IHRIS**, • Senior Java (J2EE) Developer (Servlets/JSP on Oracle App Server, Apache/Tomcat) Jasper Reports, Spring, REST API (for Web Services), Hibernate, JavaScript/JQuery • Familiar with (JDBC with Oracle, MySQL, AJAX, XML, XSLT, CSS Layout) • Health Information System knowledge, HL7, ISO, CNIL Standards implementations • Deployment application on Linux (CentOS) and Windows Client/Server • Proof of Java software developed by the applicant • Strong knowledge of Open Clinic distribution and proof of a module(s) that works • Being a Community Open Clinic Senior Developer will be a strong asset • The applicant should be able to develop and integrate Open Clinic modules. Education: Master's degree in Computer Science, Statistics, Public Health or related discipline. Having PhD in Computer Science, Statistics, Public Health or related discipline will be an added advantage.
Electronic Medical Records Use, Management & Health Information Systems	1	Applicant should hold a Master's degree in Health Informatics, Computer Sciences, Public Health, or related field with minimum of 3 years in conducting training in EMR implementation. Having PhD is an added value.

The selection will be based on the detailed Terms of Reference (available at www.ur.ac.rw) and in accordance with the Individual Consultant Selection method set out in with the policies of the Bank detailed in the *Rules and Procedures for the Use of Consultants.*

Application and Submission

Interested and suitably qualified candidates should submit their Expression of Interest including ***CVs, Credentials and Proofs of currently belonging in a Reputable University*** to the following addresses:

Attn: CEBE Project Director and CEBE Project Coordinator

E-mail: cebedirector@gmail.com,
cebeprojectcoordinator@gmail.com and
cebeprojectprocurement@gmail.com

The deadline for submission of expression of interest is set on 14/05/**2019**, at 05:00pm hours Kigali time.

Note: A consultant can apply to many modules/training but not more than 3 in all fields.

Sincerely,

Françoise Kayitare Tengera
Deputy Vice Chancellor for Finance

Terms of References for Trainers of Master's program in Biomedical Engineering

I. BACKGROUND AND JUSTIFICATION

Biomedical Engineering is one of the key areas on which the East African Community Regional Centre of Excellence in Biomedical Engineering, E-Health, Rehabilitation and Mobility Sciences (CEBE) is focusing. The CEBE aims to increase the knowledge and skills of Biomedical Engineering workforce in Rwanda and other East African countries for enhanced capacity for Healthcare Technology Systems management, which is currently quite limited. It is expected that with the built capacity, the technical personnel will be able to design, develop, repair, maintain, troubleshoot and calibrate medical equipment and evaluate healthcare equipment systems in the health facilities. The outcome of this endeavour will be an improved healthcare service delivery.

2. Overall Goal of the Master of Science in Biomedical Engineering programme

The purpose of this MSc. in Biomedical Engineering programmeis to strengthen the knowledge and skills in Rwanda and in the Region for the development and management of Medical equipment systems and applications in collaboration with different partners such as MoH and RBC.

3. **The specific objectives** of the e-health capacity building trainings are as follows:

3.1 Design teaching materials and upload them on the e-learning platform of the University of Rwanda. For any or all of the following five selected e-health short courses

- Biomedical measurements technology
- Advanced Embedded System Applications
- Biomaterials & Tissue Engineering
- Biomechanics and Biorobotics
- Medical Imaging Systems
- Medical Image Processing
- Healthcare Technology Management (HTM)
- Medical Device Development
- Orthopedic and mobility devices Engineering
- BioMEMS Design and Applications

3.2 Deliver any of the modules as mentioned above and detailed in Annex 1.

ANNEX 1: PROFESSIONAL COURSES TO BE DELIVERED

Modules and Objectives	Content	Requirements of the trainer
Biomedical measurements technology		
The aim of this module is to enable biomedical engineering students to acquire knowledge and skills on how instruments work in health facilities and recognize their limitations. Eventually, the biomedical engineering students will be able to develop an understanding of the measurement principles of medical instrumentation, including biochemical sensors, bio-potential amplifiers, bioelectrical signals (ECG, EEG), measurement of respiratory function, cardiac variables, blood pressure, blood flow as well as medical and laboratory devices.	**Unit 1: Sensor, Transducers, Electrodes and Amplifiers:** Bio-signals sensors and transducers, Bio-signals amplification, electrode for bio-signals **Unit 2: Bio-potential recording** ECG, EEG, EMG, PCG, EOG-lead system and recording methods, typical waveforms, frequency spectrum, abnormal waveforms, evoked response **Unit 3: Impendence techniques** Bipolar and tetra polar circuits, detection of physiological activities using impendence techniques, GSR., cardiac output, neural activities, respiratory activity, impedance plethysmography-resistance and capacitance type. **Unit 4: Non-Electrical parameters and respiratory measurements** Respiration, heart rate, temperature, blood pressure, O_2, CO_2 measurements, Spiro meter, BMR apparatus **Unit 5: Bio-Chemical measurements and blood cell counting** EM and ultrasonic blood flow meters indicator dilution method, Thermodilution method, Manual and Automatic Counting of RBC, WBC and Platelets-Auto analyzer, pH, pCO2,pO2, pHCO3 electrophoresis, colorimeter, spectrophotometer, flame photometer. Automated Biochemical analysis System, Chromatography **Unit 6: Virtual Instrumentation with LabVIEW** Introduction to LabVIEW, data acquisition-analysis tools and applications in the virtual instrumentation-Different application of virtual instrumentation	PhD in Biomedical engineering, bioengineering, Neural Engineering with expertise in bio-medical sensors and data acquisition technology, bio-signal processing, recording and analyzes. Having minimum 3 years work experience in Biomedical measurement technology. Having a grade of Associate Professor and above is an added value.
Advanced Embedded System Applications		
This module provides students with the advanced skills for studying the other courses of the program such as "product design and development". It forms advanced skills in embedded systems design. Those skills are essential in designing digital control units for consumer electronics, industrial automation, telecommunication systems and others. This Module includes lectures, laboratory work and an individual project.	**Unit 1: Embedded systems design** Embedded System Project Management, ESD and Co-design issues in System development Process, Design cycle in the development phase for an embedded system, Use of the target system or its emulator and In-circuit emulator, Use of software tools for development of an ES. **Unit 2**: **8051 Microcontroller** Microprocessor V/s Micro-controller, 8051 Microcontroller: General architecture; Memory organization; I/O pins, ports & circuits; Counters and Timers; Serial data input/output; Interrupts. Addressing Modes, Instruction set: Data Move Operations, Logical Operations, Arithmetic Operations, Jump and Call Subroutine, Advanced Instructions. Interfacing External Memory,	PhD in Computer Science, Electronics Engineering, having minimum 3 years work experience in Advanced Embedded System Design and Applications. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
	Keyboard and Display Devices: LED,7-segment LED display, LCD. **Unit 3: PIC MICROCONTROLLER** CPU, ALU, Data Movement, The Program Counter and Stack, Reset, Interrupts, Architecture Differences, Mid-Range instruction Set**,** Power Input and Decoupling, Reset, Watchdog Timer, System Clock/Oscillators, Configuration Registers, Sleep , Hardware and File Registers, Parallel Input Output, Interrupts, Prescaler, The OPTION Register , Mid-Range Built-In EEPROM Flash Access, TMR1 andTMR2 Serial I/0, Analog I/0, Parallel Slave Port (PSP), External Memory Connections, In-Circuit Serial Programming (ISCP). **Unit 4: Programming with PIC** Assembly Language Programming, Hex File Format, Code-Protect Features, Programming, PIC Emulators. Estimating Application Power Requirements, Reset, Interfacing to External Devices, LEDs, Switch Bounce, Matrix Keypads, LCDs, Analog I/O, Relays and Solenoids, DC and Stepper Motors, Servo Control Serial Interfaces. **Unit 5: Arm Processor Fundamentals** Registers, State and Instruction Sets, Pipeline, Memory Management, Introduction to the ARM Instruction Set	
Biomaterials & Tissue Engineering		
The module provides advanced knowledge of the relevant background science, theory, practice and materials required to fabricate permanent implants to replace tissue function, and other orthopedic and mobility devices. This course also teaches biological processes that occur during human tissue contact with artificial surfaces, how to critically read and review the literature on tissue engineering, how to anticipate biocompatibility issues with a variety of implant devices students may later encounter, current approaches directed toward the engineering of cell-based replacements for various tissue types.	**Units 1. Principles of tissue engineering** • Cell biology towards developing novel "tissue engineered" materials. • Molecular biology towards developing novel "tissue engineered" materials. • Materials science towards developing novel "tissue engineered" materials. **Unit 2: Cellular and Molecular Tissue Engineering.** • How a cell moves, reacts and maintains viability and function based on its surroundings, • how to engineer materials, tissue grafts and implants to integrate with the body, • bodily reactions and the biocompatibility of tissue engineered devices such as immune-reactivity and blood coagulation **Unit 3: Biomaterials** • Application of materials (Composites, metals, ceramics, thermoplastic materials, thermosetting materials) in the physiological environment. • Host reaction, testing and degradation of biomaterials in biological environments (e.g. blood – material interaction). • The regulatory, ethical and legal aspects of fielding biomaterials.	PhD in Biomedical Engineering, Bioengineering, Polymer Engineering, Material science, Having 3 year work in bio-materials, Molecular Biology, Biochemistry. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
Biomechanics and Biorobotics		
This module is designed to build and advance the principles of biomechanics and introduce the concept of performance analysis within a medical rehabilitation context. Utilizing biomechanics to create evidence-based intervention strategies to optimize rehabilitation. Introduction to Computer Aided Design theory and application using the software. Under this module, the methods of control of a robot and telemanipulation are studied. Computer simulations, MATLAB are used to explore biomimetic autonomous robots. This is a studio-based course with hands-on exercises with small robots and actuators.	Unit 1 Biomechanics 1. Introduction to Biomechanics. Nomenclature. 2. Kinematics 2.1 Basic concepts 2.2 Coordinates: the position of bodies; independent vs dependent coordinates; global vs relative coordinates 2.3 Modelling with 2D natural coordinates: rigid body constraints; joint constraints; relative coordinate constraints. 2.4 Modelling with 3D natural coordinates: rigid body constraints; joint constraints; relative coordinate constraints. 2.5 Human body models: human forearm. 2.6 Kinematic problems: assembly, position, velocity and acceleration problems; DOF. 3. Kinetics 4. Anthropometry 4.1 Methods and techniques. 4.2 Anatomical landmarks and ISB recommendations. 5. Practical work: motion reconstruction of a limb Unit 2: Biorobotics 1. Introduction to Mechatronic and Biomechatronic Devices: 1.1. Technological roots 1.2 Classification 1.3 Basic Terminology in Robotics 2. Mechatronic Assistive Devices for Surgery: 2.1 Computed Aided Surgery 2.2 Minimally Invasive Surgery 2.3 Robotic Devices in Surgery 2.4 Teleoperation in Surgery 3. Surgery Simulators 3.1 Education and Training 3.2 Planning 3.3 Virtual/Augmented Reality 3.4 Introduction to Haptics 4. Rehabilitation and Health Care Robotics 4.1 Bionics 4.2 Exoskeletons 5. Robot Mathematical Modelling and Control 5.1 Coordinate Frames and Homogeneous Transformation	PhD in Biomechanics, Bio robotics with minimum of 3 years work experience in Biomechanics, Bio robotics. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
	5.2 Kinematics of Manipulators 6. Practical work: robot modeling using Matlab	
Medical Imaging Systems		

Modules and Objectives	Content	Requirements of the trainer
The aim of this module is to provide the students with a solid understanding of all the major medical imaging techniques employed in modern hospitals, including x-ray imaging, computed tomography, magnetic resonance imaging, ultrasound, nuclear isotope imaging. Each technique will be presented in the context of the underlying clinical requirements. Students need to learn what physical principles are involved, and what properties of tissues the corresponding medical images show.	**Unit 1: Principles of x-rays** Production of x rays, continuous and line spectra, factors determining the x-ray emission, Efficiency of x-ray production, sources of radiation. Radiation units - detection and measurements of x-rays. **Unit 2: Interaction of radiation with matter** Effects of x-rays Instrumentation, basics of Radiation Protection in Diagnostic Radiology, radiotherapy & nuclear medicine, radiation accidents. **Unit 3: Various components of radiographic systems** X-ray generator, HT circuit & KV control Electrical circuit for X-ray unit, Filament circuit and mA control, Safety devices, X-ray tubes for various medical applications, rating charts of X-ray tubes. **Unit 4: Exposure switching and control of exposure time.** X-ray films and its processing, properties of X-ray films, intensifying & fluorescent screens, Fluoroscopy systems, Direct and indirect fluoroscopy, Image intensifier & TV chain for fluoroscopy, Basics of digital radiography & digital subtraction angiography. **Unit 5: Computed Tomography** Principles of sectional imaging, scanner configuration, data acquisition system, image formation principles, CT generations. **Unit 6: Magnetic Resonance Imaging (MRI)** Physics of MRI, MRI sequences, effects of magnetic fields. Image acquisition, Radiofrequency transmitter, RF power amplifier, design and principles of coils, MRI Fourier reconstruction, MRI instrumentation – magnets – gradient system -Functional MRI - Application of MRI **Unit 7: Ultrasound (US)** Characteristic impedance, wavelength, frequency and velocity of propagation, Absorption, beam width, resolution, generation and detection. US system-HV Pulse generator, transmitter circuit position encoder circuit, Time Gain Compensation (TGC), digital scan converter and types transducers and construction. Principles of image formation - principles of A-mode, B-mode and M-mode displays - Doppler Ultrasound and Color flow mapping- 3D and 4D ultrasound and its applications. **Unit 8: Radioisotope imaging** Law of radioactive decay, half-life period - production of radioisotopes for medical use, rectilinear scanners, linear scanners - SPECT – PET and Gamma camera. Physics of thermography imaging systems - Pyroelectric vidicon camera – clinical thermography.	PhD degree in Biomedical Engineering, Electronics Engineering, with a minimum of 3 years work experience in medical imaging systems. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
Medical Image Processing		
This module will describe the principles and role of digital image processing and analysis in medical imaging. It covers both the underlying theory and provides students with practical experience of these techniques applied to medical images using a computer image processing package such as Matlab.	**Unit 1: Image perception** MTF of the visual system - monochrome vision models - color vision model Image sampling and quantization - Two-dimensional sampling theory - Practical limits in sampling reconstruction. Image quantization - visual quantization. Image transforms - Two-dimensional orthogonal and unitary transforms - properties of unitary transforms – one dimensional Discrete Fourier Transformation (DFT), 2D DFT - cosine, sine Hadamard, Haar transforms, KLT, slant transforms. **Unit 2: Image enhancement** Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram modeling - histogram equalization - modification. Spatial operations - smoothing techniques. Magnification and interpolation. Transform operations. Applications in medical imaging. **Unit 3: Image filtering and restoration** Noise models. Inverse and Weiner filters –filtering using image transforms. Splines and interpolation. Maximum entropy restoration. Bayesian methods **Unit 4: Image analysis** Spatial feature extraction - transform features. Edge detection – boundary extraction, shape features image segmentation **Unit 5: Applications of Medical Image processing:** Fusion of PET and MRI for Hybrid Imaging: Hybrid PET Fusion System, PET/CT Systems, PET/MRI Systems, High-Resolution Fusion. Quantitative Medical Image Analysis. - Image reconstruction from projections CT reconstruction Radon transform-inverse radon transform back projection operator-convolution back projection- parallel beam geometry-Fan beam geometry. 2D image reconstruction techniques - Iteration and Fourier methods.	PhD in biomedical engineering, biophysics, electronics engineering with prior hands on experience in image processing software (matlab, python, openCV, C/C++), and minimum of 3 years' work experience in medical imaging processing. Having a grade of Associate Professor and above is an added value.
Healthcare Technology Management (HTM)		
This module provides to students the managerial skills at all levels of the organization process sound conceptual, technical, and interpersonal skills in order to carry out the required managerial functions of planning, organizing, staffing, directing, controlling and decision making. In addition, it provides advanced knowledge to ensure improved access, quality and use of medical equipment and	**Unit 1: Organization of the HTM system** Importance of HTM service, definitions (health technology, medical device, medical equipment, etc.), Regulatory and standardization of healthcare technology, developing policies of HTM, determining technical requirements for HTM, and how to choose an appropriate model for HTM, Organizational structure of HTM, relationship between health delivery systems and HTM, determine human resource required and responsibilities. **Unit 2. Medical equipment life cycle** Planning and Budgeting, Procurement and commissioning, Daily operation and safety, Evaluation of equipment and testing, Education and training,	PhD in Biomedical Engineering, Clinical Engineering, Electronics with a minimum of 3 years work experience teaching the Healthcare Technology Management. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
technologies.	Finance and personnel management, Implementation. **Unit 3: Medical equipment operation and hospital environment** Maintenance management, Operational management, Usage, maintenance and repair, hospital environment concept, hospital layout, computerized maintenance management systems. **Unit 4: Quality management systems for medical device** Medical equipment types**,** Market trend**,** Safety issues, Codes, standards and regulations of medical devices, Risk analysis techniques, calibration and testing	
Medical Device Development		
This course will examine the multidimensional aspects of medical device development and manufacturing and provide students with the entrepreneurship skills necessary to understand how devices are developed and brought to market. Students will specifically learn how to assess a device's clinical effectiveness, to evaluate its core function/technology, and to identify the appropriate path and requirements to obtain regulatory clearance/approval.	**Unit 1. Design requirements** Market Evaluation analysis, Risk management analysis **Unit 2. Design process** Design History file –in depth, Prototype development and simulation, Device documentation (intellectual properties/registration), Design control **Unit 3. Regulatory environment** Premarket administration: Manufacturing/import Business Licence, pro-manufacturing import registration, Good Manufacturing Practices (pre and post): Inspection premarket safety/post market administration **Unit 4. Medical device clinical Evaluation** Critically assess the requirements for clinical evaluations and investigations of medical devices and in-vitro diagnostic medical devices, Interpret the relevant commission, Explain how clinical evaluation forms part of the design and risk management processes and distinguish between the different methods of carrying out a clinical evaluation including their costs and benefits.	PhD in Electronics Engineering, Biomedical engineering , Mechanical Engineering with a minimum of 3 years work experience in the development of medical devices. Having a grade of Associate Professor and above is an added value.
Orthopedic and mobility devices Engineering		
A critical objective of this module is the preparation of design, development procedures and project presentations on prosthetic, orthotic and mobility devices, modelling and simulation applied to the biomechanics of musculoskeletal system and prosthetic/orthotics, and design of medical devices used in rehabilitation engineering.	**Unit 1**: **Design and development of prosthetic, orthotic and mobility devices** • Design of orthopaedic devices using softwares such as ProEngineer. • Methods for orthopaedic devices development with the use of 3D printers. • Wheelchair design • Mobility aids such as walking frames, crutches and others **Unit 2: Design and development of Orthopaedic Implants.** • Modeling techniques for the design of hip, knee, and spine implants. • Kinematics and surgical protocols, • Assemblies and FEA analysis of implants, • Analysis of the deformations, fatigue, and optimization of orthopaedic	PhD degree Biomechanical engineering. Having a minimum of 3 years work experience in design and development of orthopedic, prosthetic and other mobility related devices. Having a grade of Associate Professor and above is an added value.

Modules and Objectives	Content	Requirements of the trainer
	implants	
BioMEMS Design and Applications		
The emphasis of this module will be on applications and design of **M**icro **E**lectro-**M**echanical **S**ystems (MEMS) devices for Biomedical and related applications. MEMS fabrication techniques and processes are covered. Membranes and cantilevers used for sensing and actuation and how geometry affects their sensitivity and structural response will be studied. The course will conclude with an introduction to microfluidics and its application to biotechnology.	**Unit 1:** Introduction to MEMS (Micro Electrical Mechanical Systems) technology, Micro-fabrication **Unit2:** Mechanical Transducers: Cantilevers, membranes, spring constants, measuring deflections (Mach-Zehnder spectrometer), static, dynamic (frequency shift), stress, strain, Electrostatics, pull-in, piezoelectric (PZT) **Unit 3:** Chemical and biological transducers, ISFET (Ion Sensitive Field Effect Transistors) Microfluidics and Biotechnology, soft lithography **Unit 4:** Microflows, shear, pressure, flow rate, single and two phase flows, mixing, separation, surface tension, microdrops, Electrophoresis (DNA, proteins, cells), electro-osmotic flow, micropumps. Introduction to ANSYS, Using ANSYS for structure and fluid MEMS problems, ANSYS, Project.	PhD in Biomechanics, nanotechnology, microfluidic systems, mechanical engineering with a focus on biosensors, micro fluidic devices. Having a minimum of 3 years work experience, Having a grade of Associate Professor and above is an added value.

General Requirements

- Demonstrated experience as a lead for a minimum of three similar projects including design, develop, implement and evaluate ehealth systems.
- Strong data analysis expertise, including software and knowledge of significance testing and high level statistical analysis
- Previous experience working in Rwanda (or similar context) highly desirable
- Cultural sensitivity and strong inter-personal skills essential;
- Demonstrated facilitation and training skills required
- Management, planning, coordination, organization, and facilitation skills
- Flexibility and complete availability for the duration of the assignment
- Spoken and written fluency in English is a requirement; spoken and written French is an advantage
- Flexibility, tenacity and results-oriented approach essential for success.
- Experience of working in low resources settings

II. DESIGN OF TEACHING MATERIALS AND MODE OF COURSES DELIVERY

The training consultant will employ rigorous and varied methods of training and research to achieve this task. The mode of delivery shall ensure that there is transfer of skills to the trainees for sustainability purposes. The trainees should demonstrate the capacity to be future designers, developers, implementers, users and evaluators of e-health systems in Rwanda and the Region.

III. RESPONSIBILITIES

The consultant is expected to undertake the following tasks based on the CEBE approved objectives and content of the short courses:

1. Design teaching materials for the following short courses;

- Biomedical measurements technology
- Advanced Embedded System Applications
- Biomaterials & Tissue Engineering
- Biomechanics and Biorobotics
- Medical Imaging Systems
- Medical Image Processing
- Healthcare Technology Management (HTM)
- Medical Device Development
- Orthopedic and mobility devices Engineering
- BioMEMS Design and Applications

2. Deliver the modules mentioned above in collaboration with University of Rwanda lecturers

4. PERIOD OF PERFORMANCE

For each training, the start and the end date will be agreed upon between CEBE and the consultant. The consulting services will start from the date the contract is signed till the end of the agreed period for service provision.

5. REPORTING REQUIREMENTS

A detailed work plan with clear deliverables and milestones must be submitted within 2 weeks of the contract agreement. The consultant will be requested to report the progress and performance according to the contract. The final report for the whole assignment will be given as stipulated in the contract.

6. SKILLS TRANSFER

The consultant will be an experienced expert in e-health like in the design, development, implementation and evaluation of e-health innovations, and therefore will be required to transfer skills during the period of execution of the assigned tasks.

Terms of References for Trainers in Professional Short Courses in in e-Health

I. BACKGROUND AND JUSTIFICATION

E-health is one of the key areas on which the East African Community Regional Centre of Excellence in Biomedical Engineering, E-Health, Rehabilitation and Mobility Sciences (CEBE) is focusing. The CEBE aims to increase the knowledge and skills of e-Health workforce in Rwanda and other East African countries for improved healthcare service delivery and e-Health systems management, which is currently quite limited. As more and more health facilities acquire more equipment for diagnosis and treatment purposes, CEBE's target is to build the capacity of end users, managers, technical personnel and researchers who will design, develop, implement and evaluate e-health systems.

2. Overall Goal of the short course trainings

The purpose of this e-health capacity building trainings is to strengthen the knowledge and skills in Rwanda and in the Region for the development and management e-Health applications and systems under the national eHealth enterprise architecture.

3. **The specific objectives** of the e-health capacity building trainings are as follows:

3.1 Design teaching materials and upload them on the e-learning platform of the University of Rwanda. For any or all of the following five selected e-health short courses

a. Telemedicine applications
b. Security, privacy and legal framework of health information systems
c. Medical Coding
d. E-Health: Software Development and Implementation (EHSDI)
e. Electronic Medical Records use, Management and Health Information Systems

3.2 Deliver any or all of the five short courses as mentioned above and detailed in Annex 1.

ANNEX 1: PROFESSIONAL COURSES TO BE DELIVERED

Course and Objectives	Content	Requirements of the trainer
A. Telemedicine applications		
Objectives: On completion of the course trainees will be able to: • Identify available telehealth technologies and their appropriate uses • Explain the benefits of and barriers to implementing telehealth • Understand the business and financial aspects of telehealth • Analyse key legislative, regulatory and organizational policies that impact the use of telehealth • Identify data elements to collect to support quality improvement/quality assurance • Identify the roles and responsibilities of the telehealth coordinator • Communicate telehealth concepts to organizational members as well as to health care consumers • Identify elements of a successful telehealth encounter and quality telepresence • Develop efficient clinical telehealth workflows • Identify strategies that support effective telehealth program development • Draft organizational protocols to support telehealth • Identify strategies for measuring and communicating program successes and lessons learned • Consider language, culture and disability in using telehealth technologies	• Introduction to Telehealth • eICU and Telehealth Resources • Funding and Reimbursement • Policies that Impact Telehealth (Parts 1 and 2) • Telemental Health and Ethics • Quality, Outcomes and Data Collection • Telehealth in the Home and Remote Patient Monitoring • Starting a Chronic Diseases Telehealth Clinic and Unique Applications • Operational Considerations (Parts 1 and 2) • More Successful Uses of Telehealth; Telehealth Program Planning • Introduction to Telehealth Program Management (Parts 1 and 2) • The Advanced Telehealth Coordinator: Tying all Together	• Applicant should hold a PhD in Health Informatics, Computer Sciences, Public Health, or related field with minimum of 3 years in conducting training in Telemedicine Applications ***Or*** Master's degree in Health Informatics, Public Health, or related field with minimum of 8 years in conducting training in the allied field. • Good English communication skills • Ability to operate independently
B. Security, privacy and legal framework of health information systems		
Objectives: On completion of the course trainees will be able to: • Undertake Authentication, Authorization and Accounting (AAA) on e-health and m-health • Identity management on e-health and m-health	• Introduction to CIA in e-health and m-health • Security Models, Architecture, security on body area network, and Protocol for e-health and m-health • Access control: AAA, identity management,	• Applicants should hold a research PhD in Computer sciences, certified certificate in computer security with at least 3 years work experience application in e-Health security

Course and Objectives	Content	Requirements of the trainer
• Access control on e-health and m-health • Carry out cryptography on e-health and m-health • Detect intrusion on e-health and m-health • Design fault-tolerant e-health and m-health • Ensure security on body area network • Describe Security Models, Architecture, and Protocol for e-health and m-health • Perform security evaluation on e-health and m-health • Explain Ethics and regulations in e-health and m-health • Identify Policy regulatory requirements around medical record documentation • Interpret Policy and regulatory frameworks for information handling in health • Appraise National IT policies, strategies and programmes • Explain Policy regulatory requirements around medical record documentation • Carry out the strategy and policy implementation	cryptography techniques, IDS on e-health and m-health • Security policy on e-heath and m-health: Policy regulatory requirements around • medical record documentation, framework for information handling in health, ethics and regulation, fault tolerance, and security evaluation, confidentiality, consent form	system. • Good communication skills
C: Medical Coding		
Objectives: Upon completing the course, the trainees will be able to: • Define medical terminology and use of medical prefixes • Understand the purpose and use of ICD-10-CM, current procedural terminology(CPT), and Healthcare Common Procedure Coding System (HCPCS) coding and structure • Assign diagnosis and procedure codes from ICD-10-CM, CPT and HCPCS • Provide practical application of coding operative reports and evaluation and management services • Utilize appropriate coding, for example, in anaesthesia, cardiovascular, respiratory, musculoskeletal, surgery, radiology, pathology, and medical services • Solve CPT coding practice problems	• Medical terminology: basic principles of medical word building and medical vocabulary. • Coding conventions and guidelines: o List and explain coding conventions, o Apply general and chapter-specific coding guidelines when assigning codes to diagnoses, hospital diagnosis coding concepts, o Nomenclature and classification systems o Indicate the relationship between patient record documentation and accurate coding • International classification of disease (ICD): o An overview of the ICD and clinical modification coding classification system: ICD-9-CM, ICD-10-CM, and ICD-10-PCS coding	Applicants should hold a Masters in Health Informatics, Public health with strong experience in medical coding certification. • Experience in development of training materials and conducting hands on practice with set goals • Ability to develop and use various educational technology resources to achieve effective student learning outcome. • Strong verbal and written English communication skills • Ability to interact with people of

Course and Objectives	Content	Requirements of the trainer
• Interpret and understand medical documentation procedures, billing and auditing • Describe the reimbursement methodologies • Use computerized software to assign diagnoses and procedures	system. o Format and proper techniques for looking up diagnosis codes o Practice assigning diagnosis codes and validate coding accuracy according to the patient health record. o Structure of advanced ICD 10 PCS o Procedure-based payment systems o Importance of ethical coding and compliance. • Current procedural terminology (CPT): o Define key terms, format and content of CPT o Assign CPT procedure and service codes for outpatient care o Practical experience using CPT manuals and encoder software • Healthcare common procedure coding (HCPC): • List the HCPCS levels and their components • Assign HCPCS procedures and services codes • Identify situations in which both HCPS levels I and II are assigned • Assign claims to primary Medicare administrative contractors (MACs) or durable equipments MACs according to HCPCS level II code number • Reimbursement methodologies: • Introduction to the complete revenue cycle process • Importance of correct coding to avoid lost reimbursement • Prospective payment, managed care and other third party payers • Evaluation and Management • Explain and interpret CPT evaluation and management section guidelines, coding notes,	varied background • Aptitude in preparing and delivering lectures as well as seminars •

Course and Objectives	Content	Requirements of the trainer
	and modifiers • Select and assign codes for CPT evaluation and management levels of service for documented patient code	
D. E-Health: Software Development and Implementation (EHSDI)		
Objectives: Upon completing the course, the trainees will be able to: • Design, develop, customize, implement, and maintain electronic health records (EMR) software that are used in health care systems (e.g. OpenMRS, DHIS and their interoperability) • Assess the existing softwares to identify the bugs and fix them • Develop mobile health applications • Design the system users' manual, create a flow chart that shows the flow of information from the local level (local health care center) to the highest (national) level.	• Introduction to health informatics: principles of e-Health and HIS • Basics of Java programming: Language syntax, algorithms and object-orient programming • Web design: Building standards compliant web pages using PHP, HTML5, CSS, JavaScript and jQuery, etc. • Advanced Java Programming: Design patterns, regular expressions, multi-threading and JUnit testing, enterprise java programming, etc. Programming framework (Struts, Spring MVC, Grail on groovy) will be covered in this module • Open software for e-Health: OpenMRS, iHris, BAHMNI, DHIS, OpenHIS, OpenClinic, and OpenHospital • Interoperability of open softwares for e-Health • Mobile health applications (mHealth)	**1. <u>Electronic Medical Record (EMR) / Open MRS Developer and A trainer</u>** Senior Java (J2EE) Developer (Servlets/JSP on Oracle App Server, Apache/Tomcat) Jasper Reports, Spring, REST API (for Web Services), Hibernate, JavaScript/JQuery Familiar with (JDBC with Oracle, MySQL, AJAX, XML, XSLT, CSS Layout) Health Information System knowledge, HL7, ISO, CNIL Standards implementations Deployment application on Linux (CentOS) and Windows Client/Server Proof of Java software developed by the applicant Strong knowledge of Open MRS, Bahmni distribution and proof of a module(s) that works Being a Community Open MRS Senior Developer will be a strong asset The applicant should be able to develop and integrate Open MRS modules. Education: Master's degree in Computer Science, Statistics, Public Health or related discipline. Having PhD in Computer Science, Statistics,

Course and Objectives	Content	Requirements of the trainer
		Public Health or related discipline will be an added advantage. **2. <u>DHIS2 Developer Specialist & Trainer</u>** More than 5 years of experience in the development and operations of robust Health Information Systems (preference for all five years of DHIS2 knowledge and practical experience) including specific work supporting DATIM (Either with our JSI teams or country-level health and DHIS2 teams) to get the design of any customization or application right. Then test it in country and tweak it. Finally, leave behind local capacity to continue to customize and/or trouble shoot. Experience developing web-based and/or mobile applications, web-oriented programming language (e.g. Java, Java Script, PHP), and Unix/Linux system management. Expert in the use of database management systems (MS-Access and Visual Basic are vital, SQL language, SQL server or MySQL preferred) and in the operating environment of Microsoft. Demonstrated ability to work effectively and harmoniously in cross-cultural settings with other project staff, host country counterparts, USAID, consultants, other donors and international organizations Advanced degree (MPH, MS, MIS, MA, other) in computer science, informatics, public health or related

Course and Objectives	Content	Requirements of the trainer
		fields such as health systems or health information Experienced in applying user-centered requirements processes 3. **<u>Senior developer in OPEN CLINIC, RAPIDSMS, IHRIS</u>**, Senior Java (J2EE) Developer (Servlets/JSP on Oracle App Server, Apache/Tomcat) Jasper Reports, Spring, REST API (for Web Services), Hibernate, JavaScript/JQuery Familiar with (JDBC with Oracle, MySQL, AJAX, XML, XSLT, CSS Layout) Health Information System knowledge, HL7, ISO, CNIL Standards implementations Deployment application on Linux (CentOS) and Windows Client/Server Proof of Java software developed by the applicant Strong knowledge of Open Clinic distribution and proof of a module(s) that works Being a Community Open Clinic Senior Developer will be a strong asset The applicant should be able to develop and integrate Open Clinic modules. Good English communication skills
E. Electronic Medical Records use, Management and Health Information Systems		
Objectives: Upon completing the course, the trainees will be able to: • Describe the typical electronic health record (EMR) system, summarize the categories of data maintained on this type of system, and outline standard processes involved with entering,	• EMR introduction, applications and equipment • Introduction to EMR and benefits, EMR workflows, Entering and retrieving patient information, Performing clinical and administrative tasks and Integrated devices	• Doctorate degree in Biomedical Engineering, Biotechnology Biomedical laboratory, Biomedical sciences, or closely- related degree with 3 years' work experience. Or

Course and Objectives	Content	Requirements of the trainer
storing, manipulating, and retrieving patient information • Identify the different components of the Electronic medical record; describe the standards for maintaining electronic medical records. • Summarize the portions of the standard Privacy Rule dealing with protected health information (PHI), confidentiality, and disclosure, and describe the circumstances under which information may be released without patient consent • Navigate cloud-based EMR software systems and use them to enter new patient information, encounter notes, clinical information, decision support systems, and reporting. • Structure, design and analysis of principles of the medical record including notions of data quality, minimum data sets, architecture and general applications of the EMR • Describe the major EMR billing module and explain how to complete financial and administrative tasks. • Describe the opportunities available to trained medical records users at the health facilities, explain the typical job functions and ethical responsibilities related to this work, and contrast the roles of key players. • After ddcompleting the Electronic Health Records Management course, learners will be able to: • Describe the typical electronic health record (EMR) system, summarize the categories of data maintained on this type of system, and outline standard processes involved with entering, storing, manipulating, and retrieving patient information • Identify the different components of the Electronic medical record; describe the standards for maintaining electronic medical records. • Summarize the portions of the standard Privacy Rule dealing with protected health information (PHI), confidentiality, and disclosure, and describe the circumstances under which information may be released without patient consent • Navigate cloud-based EMR software systems and use them to	• EMR practice management • Introduction to HIS management, Streamlining patient flow, Training and support for EMR usage, editing and updating databases, monitoring and feedback, Codes and Clinical vocabularies • EMR Data Quality Assurance • Entering live data into EMR, Ensuring EMR completeness and accuracy, Assisting with charting functions, Identifying information errors, Importance of Data Quality Audits • EMR Regulatory compliance • Minimum standards for EMR functionalities, Standard privacy and Security, Guidelines and standard operating procedures for using and releasing information, Ethics in EMR • EMR and Billing • Entering coding, Billing, Diagnosis, Procedure information into an EMR, Translating diagnosis and procedures into numeric and alphanumeric codes, Generating reports, Posting payments and using bills • EMR in the context of HIV care • Professionals understand the use of EMR in HIV care; patient enrolment, patient care, scheduling, reports and clinical decision support systems.	Applicant should hold a Master's degree in Health Informatics, Computer Sciences, Public Health, or related field with minimum of 3 years in conducting training in EMR implementation. Having PhD is an added value. • Demonstrated educational and training management skills • Knowledge and ability to develop learning expectations reflecting students competency • Ability to Develop and update training materials to reflect training expectation to meet the student needs. • Extensive experience in supervision of laboratory practices and Extensive knowledge in preparing and delivering the course and program curriculum • Excellent English communication, Analytical and Interpersonal skills

Course and Objectives	Content	Requirements of the trainer
enter new patient information, encounter notes, clinical information, decision support systems, and reporting. • Structure, design and analysis of principles of the medical record including notions of data quality, minimum data sets, architecture and general applications of the EMR • Describe the major EMR billing module and explain how to complete financial and administrative tasks. • Describe the opportunities available to trained medical records users at the health facilities, explain the typical job functions and ethical responsibilities related to this work, and contrast the roles of key players.		

General Requirements

- Demonstrated experience as a lead for a minimum of three similar projects including design, develop, implement and evaluate ehealth systems.
- Strong data analysis expertise, including software and knowledge of significance testing and high level statistical analysis
- Previous experience working in Rwanda (or similar context) highly desirable
- Cultural sensitivity and strong inter-personal skills essential;
- Demonstrated facilitation and training skills required
- Management, planning, coordination, organization, and facilitation skills
- Flexibility and complete availability for the duration of the assignment
- Spoken and written fluency in English is a requirement; spoken and written French is an advantage
- Flexibility, tenacity and results-oriented approach essential for success.
- Experience of working in low resources settings

II. DESIGN OF TEACHING MATERIALS AND MODE OF COURSES DELIVERY

The training consultant will employ rigorous and varied methods of training and research to achieve this task. The mode of delivery shall ensure that there is transfer of skills to the trainees for sustainability purposes. The trainees should demonstrate the capacity to be future designers, developers, implementers, users and evaluators of e-health systems in Rwanda and the Region.

III. RESPONSIBILITIES

The consultant is expected to undertake the following tasks based on the CEBE approved objectives and content of the short courses:

1. Design teaching materials for the following short courses;
   - Telemedicine applications
   - Security, privacy and legal framework of health information systems
   - Medical Coding
   - E-Health: Software Development and Implementation (EHSDI)
   - Electronic Medical Records use, Management and Health Information Systems

2. Deliver the short courses mentioned above in collaboration with University of Rwanda lecturers

4. PERIOD OF PERFORMANCE

For each training, the start and the end date will be agreed between CEBE and the consultant. The consulting services will start from the date the contract becomes successful and will be based on the period in which a given assignment is to be delivered.

5. REPORTING REQUIREMENTS

A detailed work plan with clear deliverable and milestones must be submitted within 2 weeks of the service agreement. The consultant will be required to make a progress final reports of the performance according to the contract obligation.

6. SKILLS TRANSFER

The consultant will be an experienced expert in e-health like in the design, development, implementation and evaluation of ehealth innovations, and therefore will be required to transfer the skill to UR staff during the period of execution of the assigned task.

Terms of References for Trainers for Professional Short Courses in Biomedical Engineering

I. BACKGROUND AND JUSTIFICATION

Biomedical Engineering is one of the key areas on which the East African Community Regional Centre of Excellence in Biomedical Engineering, E-Health, Rehabilitation and Mobility Sciences (CEBE) is focusing. The CEBE aims to increase the knowledge and skills of Biomedical Engineering workforce in Rwanda and other East African countries for enhanced capacity for Healthcare Technology Systems management, which is currently quite limited. It is expected that with the built capacity, the technical personnel will be able to design, develop, repair, maintain, troubleshoot and calibrate medical equipment and evaluate healthcare equipment systems in the health facilities. The outcome of this endeavour will be an improved healthcare service delivery.

2. Overall Goal of the short course trainings

The purpose of this Biomedical Engineering capacity building trainings is to strengthen the knowledge and skills in Rwanda and in the Region for the development and management Medical equipment and applications and systems in collaboration with different partners such as MoH and RBC.

3. **The specific objectives** of the e-health capacity building trainings are as follows:

3.1 Design teaching materials and upload them on the e-learning platform of the University of Rwanda for any or all of the following five selected e-health short courses:

i. Healthcare Technology Management
ii. Hospital Design
iii. Service, Repair and Maintenance of:
iv. Respiratory, monitoring and cardiac equipment
v. Laboratory equipment
vi. Maternity and neonatology equipment
vii. Medical imaging equipment
viii. Dental equipment
ix. Ophthalmology equipment
x. Medical gases system
xi. Hemodialysis Machine

3.2 Deliver any or all of the five short courses as mentioned above and detailed in Annex 1.

ANNEX 1: PROFESSIONAL BIOMEDICAL ENGINEERING SHORT COURSES TO BE DELIVERED

Course and Objectives	Content	Requirements of the trainer
A. Healthcare Technology Management		
• Provide advanced skills in Healthcare Technology Management to health care professionals for service delivery and training others.	• Technology assessment • Medical equipment software management • Professional development • Quality management • Advanced planning and budgeting of medical equipment • Purchasing procedures, stores supply and control • Workshops management ,staff development and equipment disposal management	PhD in Biomedical engineering, Biomechanical Engineering, Bioengineering or Mechanical engineering, Electrical/Electronic engineering, with a minimum of 3 years' experience in Healthcare Technology Management (HTM) ***Or*** Master's degree in Biomedical engineering, Biomechanical Engineering, Bioengineering or Mechanical engineering, Electrical/Electronic engineering with 8 years experience in Healthcare Technology Management (HTM).
B. Hospital Design		
• Facilitate participants to acquire advanced knowledge in the Hospital design and environment.	• Hospital environment concept, • department connection and building accessibility • Electrical and mechanical ventilation • Hospital furniture infection prevention and control.	PhD degree in Biomedical Engineering, Environmental Design, Civil Engineering or Architecture with minimum 3 years experience in Hospital design training. ***Or*** Master's degree in Biomedical Engineering, Environmental Design, Civil Engineering or Architecture with minimum 8 years' experience in Hospital design training.
C: Service, Repair and Maintenance of Medical Equipment		
• Provide advanced skills and competency for biomedical engineers and technicians in management of high-tech medical equipment; • Train participants in servicing, installation, repair and maintenance of the medical equipment	1.**Respiratory, monitoring and cardiac equipment:** Patient ventilator, CPAP machines, Nebulizer, defibrillators, Patient monitor, ECG machines, EEG,EMG	Masters holder in Biomedical Engineering and related fields with minimum hands-on experience of 8 years in physiological signal monitoring equipment as a trainer.
	2.**Laboratory equipment:** Automated laboratory equipment, Biochemistry, Haematology, Parasitology equipment, Serology, Biosafety cabinets, And others	Master's degree in biomedical laboratory sciences or related field with a minimum experience of 8 years as professional trainer in the field of medical laboratory equipment troubleshooting, maintenance and management.
	3.**Maternity and neonatology equipment:** Infant incubator, Infant warmer, Phototherapy machine, CTG Machine, CPAP machine	Master's degree in biomedical engineering, electrical/electronic engineering with 8 years' experience as professional trainer in maternity and neonatology equipment troubleshooting, maintenance and management.

Course and Objectives	Content	Requirements of the trainer
	4.Medical imaging equipment: Ultrasound machine Magnetic Resonance (MRI), General x-ray and Mammography, Angiograph, PET CT, CT scanner ,Gama camera, Leaners accelerator	PhD in medical imaging technology, biomedical engineering, medical imaging equipment with 3 years of work experience or Master's degree with 8 years' experience as professional trainer in the field of medical imaging equipment troubleshooting, maintenance and management.
	5.**Dental equipment** Dental chair, Dental x-ray, Orthopantogram, Film processor	Master's degree in biomedical engineering with 8 years of work experience as professional trainer in the field of dental equipment troubleshooting, maintenance and management
	6.**Ophthalmology equipment** Slit lamp, Eye Scanner machine, Operating microscopy	Master's degree in biomedical engineering with 8 years of work experience in the related as professional trainer in the field of ophthalmology equipment troubleshooting, maintenance and management.
	7.**Medical gases system** Medical gases codes and standards, Medical gases piping system, Compressed medical gases, Medical oxygen plant, Medical gases storage , system, Oxygen concentrator, Vacuum system	Master's degree in Biomedical engineering or related field of engineering with 8 years' experience as professional trainer in the field of medical gases system troubleshooting, maintenance and management.
	8. **Hemodialysis Machine** Water treatment system, (OR) dialysis pumping system, maintenance of generator , calibration and testing of the unit	Master's degree in biomedical or electronic engineering, nephrology technology with 8 years' experience as professional trainer in the field of hemodialysis machine troubleshooting, maintenance and management

General Requirements

- Demonstrated experience as a lead person for a minimum of three similar projects including design, develop, implement and evaluate Biomedical Engineering systems.
- Strong data analysis expertise, including software and knowledge of significance testing and high level statistical analysis
- Previous experience working in Rwanda (or similar context) highly desirable
- Cultural sensitivity and strong inter-personal skills essential;

- Demonstrated facilitation and training skills required
- Management, planning, coordination, organization, and facilitation skills
- Flexibility and complete availability for the duration of the assignment
- Spoken and written fluency in English is a requirement; spoken and written French is an advantage
- Flexibility, tenacity and results-oriented approach essential for success.
- Experience of working in low resources settings

II. DESIGN OF TEACHING MATERIALS AND MODE OF COURSES DELIVERY

The training consultant will employ rigorous and varied methods of training and research to achieve this task. The mode of delivery shall ensure that there is transfer of skills to the trainees for sustainability purposes. The trainees should demonstrate the capacity to be future designers, developers, implementers, users and evaluators of e-health systems in Rwanda and the Region.

III. RESPONSIBILITIES

The consultant is expected to undertake the following tasks based on the CEBE approved objectives and content of the short courses:

1. Design teaching materials for the following short courses;

- Healthcare Technology Management
- Hospital Design
- Service, Repair and Maintenance of:
- Respiratory, monitoring and cardiac equipment
- Laboratory equipment
- Maternity and neonatology equipment
- Medical imaging equipment
- Dental equipment
- Ophthalmology equipment
- Medical gases system
- Hemodialysis Machine

2. Deliver the short courses mentioned above in collaboration with University of Rwanda lecturers

4. PERIOD OF PERFORMANCE

For each training, the start and the end date will be agreed upon between CEBE and the consultant. The consulting services will start from the date the contract is signed till the end of the agreed period for service provision.

5. REPORTING REQUIREMENTS

A detailed work plan with clear deliverables and milestones must be submitted within 2 weeks of the contract agreement. The consultant will be requested to report the progress and performance according to the contract. The final report for the whole assignment will be given as stipulated in the contract.

6. SKILLS TRANSFER

The consultant will be an experienced expert in e-health like in the design, development, implementation and evaluation of e-health innovations, and therefore will be required to transfer skills during the period of execution of the assigned tasks.