Tempus Project University of Kragujevac
WBCVMnet
WBC Virtual Manufacturing Network
Fostering an Integration of the Knowledge Triangle

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European Commission
TEMPUS

Name	Electronic medical devices
Code	CTC-KG-08
ECTS	4
Location	CTC Kragujevac, University of Kragujevac, Faculty of Mechanical Engineering, Sestre Janjić 6, 34000 Kragujevac, Serbia
Trainer/s	Prof. Dr Goran Stojanović (CV is in addendum)
Purpose	The basic parts of the majority of medical devices are printed circuit boards, microcontrollers, etc. and because of that they can be naturally called electronic medical devices. In many clinical centers in Serbia is pronounced the lack of technical and engineering staff for handling, control, maintenance and support to the modern medical devices. Participants of this training will obtain practical knowladge to design and manufacture simple ECG or pulsoximeter, etc, and will be able to understand work of other medical devices such as Rengen, CT scanner, magnetic resonance imaging, etc., as well as to know their elementary parts. This will give the opportunity to them to open SME for production or maintenance of the medical devices and also they will be able to find job in clinical centers participating some other courses in this field.
Recommended entry level	7th level of professional qualification, electrical engineering, mechanical engineering, medicine
Special requirements	Basic knowledge in electronics (amplifiers, filters, speakerphones, microphones, etc.)
Duration	40 hours
General objectives	Trainees should be able to: • Design electrical circuits of pre-amplifiers and amplifiers for application in electronic medical devices • Understand basic parts of devices for application in electrocardiography (ECG), electromyography (EMG) and electroencephalography (EEG), etc. • Manufacture simple electronic medical devices based on microcontrollers as well as to test their operation • Perform connection and communication of developed devices, such as ECG or pulsoximeter, with PC • Understand operation and basic blocks of diagnostic medical devices (Roentgen, Scanner, Magnetic resonance imaging) • Design and manufacture simple microelectronic sensors or converters for application in medicine (blood pressure sensor, ocular pressure sensor, body temperature sensor, etc.)
Topics	**1.** Preamplifiers and amplifiers for application in electronic medical devices **2.** Electromyography (method of detection and recording muscle action potentials) **3.** Electrocardiography **4.** Electroencephalography (recording brain action potentials) **5.** Electrosurgical instruments - electrocautery **6.** Stimulator of heart rhythm (pace maker) and defibrillator **7.** Application of miniature implanted sensors in medicine **8.** Roentgen devices **9.** Axial tomography (CT scanner) and Magnetic resonance imaging **10.** Application of nanotechnology in modern medicine
Specific learning outcomes in topics	**Topic 1: Preamplifiers and amplifiers for application in electronic medical devices** — **Number of hours** — **4** Trainees should be able to: • Design of instrumental amplifier as input block of most medical devices • Recognize basic pre-amplifiers and amplifiers chips for application in ECG, EMG or EEG • Apply filters for noise elimination (or reduction) in electro-medical devices • Connect electrodes (usually placed on the body) with preamplifiers **Topic 2: Electromyography (method of detection and recording muscle action potentials)** — **Number of hours** — **2** Trainees should be able to: • Describe basic EMG device blocks

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	• Understand importance of measuring EMG in contemporary medicine, sports, etc.		
	Topic 3: Electrocardiography	**Number of hours**	**6**
	Trainees should be able to: • Understand electrocardiographic leads (bipolar, unipolar, precordial) • Design and manufacture a simple one-channel ECG device based on microcontroller MSP430 (Texas Instruments) • Interpret recorded ECG signal and explain elementary disorders in ECG signal, their origins and possible consequences		
	Topic 4: Electroencephalography (recording brain action potentials)	**Number of hours**	**4**
	Trainees should be able to: • Understand block diagram of EEG device • Understand standard way of placing electrodes during the recording of EEG • Describe the role of Hollter monitoring, Brain mapping, Poligraph		
	Topic 5: Electrosurgical instruments - electrocautery	**Number of hours**	**2**
	Trainees should be able to: • Understand the operation principles of electrocautery instruments • Understand differences and effects of Monopolar technique, Bipolar technique and coagulation • Understand the potential risks during the application of electrocautery instruments		
	Topic 6: Stimulator of heart rhythm (pace maker) and defibrillator	**Number of hours**	**4**
	Trainees should be able to: • Understand different types of pace makers and the places of their placing, type of electrodes, etc. • Manufacture one simple pace maker and test them in laboratory conditions • Understand the concept of defibrillator operation • Learn to use automatic external defibrillators which are obligatory in public places such as airports, train stations, water pools, etc.		
	Topic 7: Application of miniature implanted sensors in medicine	**Number of hours**	**4**
	Trainees should be able to: • Design and manufacture of pressure sensor for measuring blood pressure or pressure in the eye • Understand working principles of neural electronic interface as well as to fabricate them		
	Topic 8: Roentgen devices	**Number of hours**	**4**
	Trainees should be able to: • Understand of work of one Roentgen devices and their basic parts • Describe types of the Roentgen tubes (X-ray tubes) and their cooling principles • Understand application areas of Roentgen devices in medical diagnostics		
	Topic 9: Axial tomography (CT scanner) and Magnetic resonance imaging	**Number of hours**	**6**
	Trainees should be able to: • Understand of the work of CT scanner (CT - computerized tomography) and to interpret recorded image • Understand all parts of the magnetic resonance imaging (MRI) device (main superconductive magnet, gradient magnets, RF transmit/receive coils) • Compare images of CT scanner, MRI device and PET scanner		
	Topic 10: Application of nanotechnology in modern medicine	**Number of hours**	**4**
	Trainees should be able to: • Understand concept of destroying cancer tissue using magnetic and gold nano-particles • Understand drug delivery concept • Apply modern software tool (such as COMSOL) for modelling and simulation of thermo-amputation cancer tissue (software simulation of the removal liver cancer cells)		
Portfolio	Trainer evaluates level of success in overcoming the training of each student, through		

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assessment	assessments laboratory exercises and testing. **Rating exercise:** Lab exercise trainer defined on the basis of which can be implemented to assess the degree of learning outcomes. **Examination:** Test is defined by trainer on basis of examination which can assess the cognitive skills and their application. For this purpose it is necessary to respond to a range of questions. Answers to questions are provided in writing and orally, in a conversation with trainer evaluator. **Evaluation:** Meet 50 - 64% Successful 65 - 79% Excellent 80 - 100% **Performance criteria and the percentage of representation of these techniques in the evaluation module will be given later.**