Co-funded by the
Erasmus+ Programme
of the European Union

Technical Specification: Lighting Lab Equipment and Instruments

1. Illuminance Meter:

Measuring parameters: Illuminance, illuminance difference, illuminance ratio, integrated illuminance, integration time and average illuminance.

Technical requirements

S. No.	Description	Specification	Value/Range	Remarks
1	**Receptor placement**	Detachable		
2	**Receptor sensor material**	Silicon photocell		
3	**Receptor cord length**		> 1m	
4	**Measurement range**	Automatic and manual	0.01 to 2,90,000 Lux	
5	**Relative spectral response**	Percentage of CIE V(λ) for photopic vision	<6%	
6	**Cosine correction**		<3%	
7	**Linearity limit**		±2%	
8	**Operating temperature**		-10 to 40 °C	
9	**Storage temperature**		-20 to 55 °C	
10	**Temperature humidity drift**		±3%	
11	**User calibration function**	Color correction factor setting		
12	**Output**	Digital and analog		
13	**Display**	LCD with automatic backlight		
14	**Power source**	Battery and AC adaptor		

Should have port for both analog and digital output of measured data.

2. Luminance Meter:

Measuring parameters: Point illuminance measurement of light source and surface with measurement modes for instantaneous value, maximum/minimum value, luminance difference and luminance ratio.

Technical requirements

S. No.	Description	Specification	Value/Range	Remarks
1	**Optical system**	SLR viewing system		
2	**Angle of view**	With dipole adjustment	9 °	
3	**Measuring angle**		1 ° or 1/3 °	
4	**Measurement range**	Automatic and manual	0.01 to 999,900 cd/m2	
5	**Relative spectral response**	Close to CIE V(λ)		
6	**Spectral response mismatch**	mismatch index (f1')	<3%	
7	**Minimum measurement area**		<14mm	
8	**Operating temperature**		0 to 40 °C	
9	**Storage temperature**		0 to 45 °C	
10	**Accuracy**		±2%	
11	**User calibration**	Calibration channel	10	
12	**Output**	Digital and analog		
13	**Display**	LCD with automatic backlight		
14	**Power source**	Battery and AC adaptor		

Should have port for digital interface.

3. Modular Spectroradiometer system with integrating sphere, AC and DC power source and power meter:

Measuring parameters: Spectral data and calculation of luminous flux, chromaticity coordinates, CCT, CRI, luminous efficacy, radiant power, Color purity, power factor, RSPDF.

Technical requirements:

3.1 Integrating sphere and Spectroradiometer:

S. No.	Description	Specification	Value/Range	Remarks
1	**Sphere size**	Diameter	1.5m	
2	**Sphere coating**	High reflectance diffused		
3	**Sphere reflectance**	Non selective in visible range	>90%	
4	**Baffles location and coating**	Inside the sphere with high disused reflectance		
5	**Auxiliary lamp**	Mounting on lamp to allow self-absorption measurement	Halogen lamp	
6	**Luminous flux range**		50-20000lm	
7	**Luminous flux accuracy**		3%f.s.+0.001lm	
8	**Luminous flux resolution**		0.001lm	
9	**Color temperature range**		1300-25000k	
10	**Spectroradiometer entrance port of integrating sphere with cosine correction**	Cosine correction with a value of f2	<15%	
11	**Measuring wavelength range**	Visible range	380nm to 780nm	
12	**Wavelength uncertainty**		<0.5nm	
13	**Wavelength accuracy**		±0.5nm	
14	**Wavelength resolution**		0.1nm	
15	**Linearity correction**		>99.8%	

16	**Chromaticity coordinates accuracy**	Under standard illuminant	± 0.002	
17	**Chromaticity coordinate resolution**		0.0001	
18	**Bandwidth and scanning interval**		<5nm	
19	**Measurement standard**	4π measurement complying LM79		
20	**Repeatability of measurement after opening and closing the sphere**		±0.5%	
21	**Calibration**	Reference calibration standard traceable to SI. Capability of calibrating from both software and hardware end.		
22	**Built in power source**			
23	**Power source**	Constant current power source		
24	**Current supply range**		1-15000 mA	
25	**Voltage range**		0-20V	
26	**Forward and reverse voltage accuracy**		0.02V	
27	**Constant current supply accuracy**		0.02%+0.1mA	
28	**Stability drift**	Within 3 minutes	0.002	

3.2 Programmable DC power source:

Should be constant current and constant voltage power source for powering DC lamps and DC luminaires. Capability of adjusting from hardware and remotely from software of Spectroradiometer.

S. No.	Description	Parameter	Value/Range	Remarks
1	**Rated output**	Voltage/Current	**0-32V/0-6A**	
2	**Load regulation**	Voltage	≤0.01％+5mV	
		Current	≤0.01％+3mA	
3	**Power source regulation**	Voltage	≤0.01％+5mV	
		Current	≤0.01％+3mA	
4	**Set point resolution**	Voltage	1mV	
		Current	0.1mA	
5	**Backward read resolution**	Voltage	1mV	
		Current	0.1mA	
6	**Set point accuracy** **1 year (25℃±5℃)**	Voltage	≤0.04％+8mV	
		Current	≤0.1％+8mA	
7	**Backward read accuracy** **1 year (25℃±5℃)**	Voltage	≤0.04％+8mV	
		Current	≤0.1％+8mA	
8	**Ripple and noise (20HZ-20M)**	difference-mode voltage	≤4mVp-p and 1mVrms	
		difference-mode current	＜6mArms	
		Common-mode current	＜1.5uArms	
9	**Dynamic response time** **(return to 75mV)**	50%-100% load	100	
		drop 10%-90%	＜350ms	

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3.3 Programmable variable frequency AC power source:

S. No.	Description	Value/Range	Remarks
1	**Power**	1KVA	
2	**AC input**	single phase 220V±10% 50Hz±5Hz	
3	**AC output**	Downshift: 0-150V Top shift: 151-300V; resolution 0.1V	
4	**Allowance error**	±1%;	
5	**Variable frequency range**	45Hz -400Hz, resolution 0.1Hz	
6	**Fixed frequency output**	50 Hz	
7	**Frequency stability**	≤0.1%	
8	**Voltage stability**	≤1%	
9	**Distortion**	≤2%(resistive load)	
10	**Crest factor**	3:1	
11	**Source voltage effect**	≤1%	
12	**Loading effect**	≤1%	
13	**Efficiency**	≥80%	
14	**Frequency display**	4 digits LED, resolution 0.1Hz	
15	**Voltage display**	4 digits LED, resolution 0.1V	
16	**Current display**	4 digits LED, resolution 0.001A/0.1A	
17	**Power display**	4 digits LED, resolution 0.01W/0.1Kw	
18	**Power factor display**	3 digits LED, resolution 0.01	
19	**Preset function**	Preset for output voltage, output frequency, float percentage of output voltage	
20	**Shortcut function**	Common voltage, frequency conversion and output voltage float choice	
21	**Protection**	Overload and overheat protection	

3.4 AC and DC digital power meter.

Should be capable of measuring voltage, current, power and power factors of AC, DC or AC+DC. Digital communication port with data acquisition system.

S. No.	Description	Value/Range	Remarks
1	**Voltage measurement range**	0-600 V AC and DC	
2	**Voltage measurement error**	<0.4%	
3	**Current measurement range**	0.005A-10.00A AC and DC	
4	**Current measurement error**	<0.4%	
5	**Power factor measurement range**	0.000 – 1.000	
6	**Power factor measurement error**	<0.4%	

4. Portable Goniophotometer:

Goniophotometer should be portable plug and play system with weight less than 10 Kg. Measurement and power supply unit should be modular with AC and DC power source and power meter.

Measuring parameters: Luminous intensity distribution, beam angle and lumen output

Technical requirements

4.1 Goniophotometer and measurement system:

S. No.	Description	Specification	Value/Range	Remarks
1	**Average lumens error**		<10%	
2	**Intensity accuracy**		<3%	
3	**Measurement resolution**		At least 0.1 degree	
4	**Test sample rotation**	Vertical rotation range	0 to 360 degree	
5	**Test sample rotation**	Horizontal rotation range	-90 to +90 degree	

6	**LED base type support**		E27, B22, E18 and GU10	
7	**Computer interface**	Digital interface with dedicated software		
8	**Spectral range**		380 to 780 nm	
9	**Spectral resolution**		<5nm	
10	**Accuracy**	Accuracy class 1		
11	**Reference**	Standard reference lamp		
12	**Temperature sensor**	High accuracy temperature detector		

4.2 Programmable DC power source:

Should be constant current and constant voltage power source for powering DC lamps and DC luminaires. Capability of adjusting from hardware and remotely from software of goniophotometer.

S. No.	Description	Parameter	Value/Range	Remarks
1	**Rated output**	Voltage/Current	**0-32V/0-6A**	
2	**Load regulation**	Voltage	≤0.01%+5mV	
		Current	≤0.01%+3mA	
3	**Power source regulation**	Voltage	≤0.01%+5mV	
		Current	≤0.01%+3mA	
4	**Set point resolution**	Voltage	1mV	
		Current	0.1mA	
5	**Backward read resolution**	Voltage	1mV	
		Current	0.1mA	
6	**Set point accuracy** **1 year (25°C±5°C)**	Voltage	≤0.04%+8mV	
		Current	≤0.1%+8mA	
7	**Backward read accuracy**	Voltage	≤0.04%+8mV	

	1 year (25℃±5℃)	Current	≤0.1％+8mA	
8	**Ripple and noise (20HZ-20M)**	difference-mode voltage	≤4mVp-p and 1mVrms	
		difference-mode current	＜6mArms	
		Common-mode current	＜1.5uArms	
9	**Dynamic response time**	50%-100% load	100	
	(return to 75mV)	drop 10%-90%	＜350ms	

4.3 Programmable variable frequency AC power source:

S. No.	Description	Value/Range	Remarks
1	**Power**	1KVA	
2	**AC input**	single phase 220V±10% 50Hz±5Hz	
3	**AC output**	Downshift: 0-150V Top shift: 151-300V; resolution 0.1V	
4	**Allowance error**	±1%;	
5	**Variable frequency range**	45Hz -400Hz, resolution 0.1Hz	
6	**Fixed frequency output**	50 Hz	
7	**Frequency stability**	≤0.1**%**	
8	**Voltage stability**	≤1**%**	
9	**Distortion**	≤2**%**(resistive load)	
10	**Crest factor**	3:1	
11	**Source voltage effect**	≤1**%**	
12	**Loading effect**	≤1**%**	
13	**Efficiency**	≥80%	
14	**Frequency display**	4 digits LED, resolution 0.1Hz	
15	**Voltage display**	4 digits LED, resolution 0.1V	
16	**Current display**	4 digits LED, resolution 0.001A/0.1A	

17	**Power display**	4 digits LED, resolution 0.01W/0.1Kw	
18	**Power factor display**	3 digits LED, resolution 0.01	
19	**Preset function**	Preset for output voltage, output frequency, float percentage of output voltage	
20	**Shortcut function**	Common voltage, frequency conversion and output voltage float choice	
21	**Protection**	Overload and overheat protection	

4.4 AC and DC digital power meter:

Should be capable of measuring voltage, current, power and power factors of AC, DC or AC+DC. Digital communication port with data acquisition system.

S. No.	Description	Value/Range	Remarks
1	**Voltage measurement range**	0-600 V AC and DC	
2	**Voltage measurement error**	<0.4%	
3	**Current measurement range**	0.005A-10.00A AC and DC	
4	**Current measurement error**	<0.4%	
5	**Power factor measurement range**	0.000 – 1.000	
6	**Power factor measurement error**	<0.4%	