AMMAN ARAB UNIVERSITY جامعة عمان العربية

Wind Energy Lab. Tender

Item #	Required specifications	Quantity
1.	**Apparatus name: Wind Energy Unit/ Edibon, EEEC or equivalent.** **وحدة قياس طاقة الرياح.**	1
	Objective: • Study of the conversion of kinetic wind energy into electrical energy. • Study of the power generated by the aerogenerator depending on the wind speed. • Determination of the typical parameters of the aerogenerator (short circuit current, open-circuit voltage, maximum power). • Determination of the I-V curve. • Study of voltage, current and power in function of different loads. • Study of the influence of the load variation on the aerogenerator. • Determination of the maximum power output of the aerogenerator. • Study of the power generated by the aerogenerator depending on the incident angle of the air. • Study of the characteristic curve of the rotor. **Technical specifications as below:** • Tunnel: Stainless steel tunnel of **200 x 50 x 50cm approx.**, includes transparent windows. • Movable apparatus. • Power Supply **230V .50Hz.** • Max flow rate: **10650 m^3/h approx.**	

- Max. Power: **1.5KW.**

Aerogenerator:

- Diameter: **510mm approx.** Starting air speed: **2.0m/s approx.**
- Max. Power output: **60W.**
- Voltage: **12V. Max.**
- Charging current: **5A.**
- Blades Material nylon reinforced with fiberglass.
- Number of Blades: **6 Min.**
- Number of different shape (design) of Blades: **3 Min.**
- The blades can be adjusted in a **360º range.**
- The blades can be removable and it's possible to set different blade configurations.).
- Low friction alternator.
- Change the angle of every blade, as each one embeds its own calibrated protractor.

DC Load Regulator.

- Metallic box with diagram in the front panel.
- Two lamps of **12V.**
- DC motor: voltage: **24V**, power: **5W.**
- Rheostat of **500W.**
- Two manual switches.
- Four position load selector.

Sensors:

- Temperature sensor.
- Air speed Sensor **(0.20 – 13m/s.) approx.**
- DC voltage and current sensor.
- Force sensor to measure the mechanical torque **(0 – 600g.) approx.**
- Force sensor to measure the thrust force **(0 – 3000g) approx.**

SCADA SYSTEM:

- Control Interface Box.
- National Instruments Data Acquisition Board.
- Software for Computer Control Data Acquisition, Data Management.

	• Desktop computer core **I7**, and laser printer with two ink cartridge to be supplied with the unit.	
2.	**Apparatus name: High Speed Camera/ Photron, Mini AX100 or equivalent.** **كاميرا لتصوير الاجسم عالية السرعة.**	**1**
	Objective: • High-speed imaging system delivering superior image quality and sensitivity in a compact, lightweight and rugged camera design. Providing 1 Megapixel image resolution (1024x1024 pixels) at frame rates up to 4,000fps and to 540,000fps at reduced resolution. 1µs global shutter independent of frame rate. **Technical specifications as below:** • Megapixel CMOS Image Sensor: **1024 x 1024 pixels at 4,000fps.** • Pixel Size: **≥20µm x 20µm.** • Sensor includes micro-lenses. • Full sensor compatible with both full format (FX) and APS-C (DX) format lenses without vignetting. • Maximum Frame Rate: **540,000fps.** • Class Leading Light Sensitivity: **ISO 50,000 monochrome.** • Global Electronic Shutter: **1ms to 1µs independent of frame rate.** • Inter Frame Time (for PIV): **1.71µs.** • Internal Recording Memory: **16GB (expandable to 32GB).** • Dynamic Range (ADC): **12-bit monochrome.** • Camera Control Interface: **High-speed Gigabit Ethernet.** • Programmable outputs for synchronization of external hardware such as lasers for PIV. • Built in delay generator to permit division of camera frequency by a factor of 2 for PIV (frame-straddling) applications. • Compact and Lightweight. • Operational shock: **≥100G, 10ms, 6-axis.** • Saved image formats: BMP, TIFF, JPEG, PNG, RAW, MRAW, AVI, MOV.	

	• Camera control software supports the following features: • Focus assistant. • Lens distortion calibration. • Keystone correction. • Linear calibration. • Measurement tools to include: Distance, angle, velocity, and diameter. • Manual tracking. • Image overlay: Live/Saved, Saved/Saved. • Layout save. • Cycle view. • Extensive image annotation options. • Automatic report generation for MS Word, Excel and Powerpoint.	
3.	**<u>Apparatus name: Continuous Green Light Laser/ Shanghai Dream Lasers Technology, DPSS 532nm 3000mW green laser SDL-532-3000T or equivalent.</u>** **<u>ليزر الضوء الأخضر المستمر بقدرة 3000mW.</u>**	**1**
	<u>Objective:</u> • Visualizing the flow by Mie scattering technique. **<u>Technical specifications as below:</u>** • Output Power @ **25 ℃ 2000~3000mW.** • Wavelength **532nm.** • Operation Mode **CW, near TEM00.** • Beam height from base plate (mm) **45mm.** • Linear Polarization **>100:1.** • Beam Diameter at the aperture **~3. 0mm.** • Beam Divergence (**1/e2** , Full Angle) **<2.0mrad.** • Power Stability after warm-up **<1%, <3%, <5%** (over 2/4/8 hours) Warm-up time < 10 min. • Input Voltage **90-264VAC, 50/60Hz.**	

	• Operating Temperature **10℃～35℃.** • Power adjustable and current display option.	
4.	**<u>Apparatus name: Subsonic Open Loop Wind Tunnel/ Edibon, TA50/250 or equivalent.</u>** **نفق لجريان الرياح بدورة مفتوحة دون سرعة الصوت.**	**1**
	<u>Objective:</u> • Aerodynamic studies. **<u>Technical specifications as below:</u>** • Movable apparatus with frame made of Aluminum Industrial Profile **4x4 cm** cross section with **1 m approx.** height from the floor level. • Tunnel made of Acrylic **1 cm** thickness, length, width, and height such as **183 x 50 x 50 cm approx.**, includes movable windows from top sides along the test section **1 m length approx.** • Max. Cross air speed **20 m/s.** • Max. Non-uniformity of cross flow **0.8%** along the test section. • Max. Turbulence intensities of flow **0.8%** along the test section. • Tractable Pitot –tube with Max. Outside diameter of **3 mm.** In addition to High-precision electronic differential **pressure transducer** connected with **FFT** and **data acquisition system** and **LabVIEW/ Arduino.** • Air speed Sensor (Hot-wire anemometer made of Tungsten or Platinum wire with diameter and length of **5 µm** and **1.5 mm**, respectively. probe for the sensor about **0.5 m** length and Max. diameter of **3 mm.** Fixing tool (welding wool) in case the wire was broken, and extra wires (about **1m** length). • A stepping-motor-controlled three-dimensional traversing mechanism with accuracy of **10 µm** to accurately position the probes within the test section.	
5.	**<u>Apparatus name: Wind velocity sensor and data logger/ ACD machine control, FDB-MK IV or equivalent.</u>** **<u>حساس لقياس وتخزين قراءات سرعة الرياح واتجاهها.</u>**	**1**

	Objective: • To measure the wind speed. • To determine the wind direction. **Technical specifications as below:** • Wind Velocity Sensor : Three Cup Assembly with Infrared Sensor. • Range: 5 to 200 km/ hr. (Least Count 0.1km/ hr). • Wind Direction Sensor: Wind Vane with Analogue output. • Sampling time will be selectable (1 sec, 5 min, 10 min, 30 min). • Range : 0 to 360 from North (Least Count 1). • Operating Voltage : 100 To 240 V AC 24 V DC. • Compatible software for readings.	