

SECTION - C

TECHNICAL SPECIFICATIONS OF STORES AND DRAWINGS.

Supply of NIR spectroscopic system

The complete system contains two major parts:

1.0.5 meter Spectrometer

2. NIR sensitive InGaAs detector

Computer controlled Spectrometer with one Front Entrance Slit, One front exit port with Adaptor flange for InGaAS detector and side exit slit using beam diverter mirror, and an interchangeable triple grating turret with three gratings in NIR range.

Parts/paramters/configuration/items	Value/range/quantity/design
Part 1. Specification for spectrometer	
Focal length of the spectrometer	500 to 550 mm
Optical Design	Imaging, Czerny -Turner with Aspheric mirror
Aperture ratio	F / 6.4 to F /6.8
Exit Focal plane size	
Height	≥ 14 mm
Width	≥ 26 mm
Entrance and exit Slit/port location	One Entrance slit at front end One Exit slit at side end with flipping mirror and One Exit port in front end for InGaAs detector
Slit width	Adjustable; from 10 μm to 3 mm, motorized and computer controlled
Optimum wavelength range	500 nm to 2100 nm (based on grating selection)
Coatings	All mirrors, gratings and optical components should have appropriate coating (e.g. Silver coating) for achieving reflectivity efficiency > 96 % in VIS and NIR range (supported by corresponding data sheet).
Grating Turret	Interchangeable Triple grating turret to accommodate 3 gratings
Grating Selection in turret	Computer controlled using software
Gratings : 3 numbers of gratings required	1.) Ruled Grating, 300 grooves/mm blazed at 1600 nm, 2.) Ruled Grating, 600 grooves/mm blazed at 1000 nm, 3.) Ruled Grating, 1200 grooves/mm blazed at 750 nm
Stepper Motor scanning drive system	Required with AC, 220-240 Volts, 50 Hz power supply
Grating Change repeatability	≤ 0.02 nm
Scanning Drive step size	0.002 nm /step
Wavelength reproducibility	≤ 0.004 nm (in both scan directions)
Wavelength accuracy	≤ 0.04 nm
Astigmatism Correction	Should be done using suitable Toroidal Mirror
Linear dispersion measured using discrete spectral line; e.g 546.1 nm, 912 nm, 1013 nm, and 1529 nm (based on grating selection).	≤ 6.7 nm/mm with 300 grooves/mm grating ≤ 3.3 nm/mm with 600 grooves/mm grating ≤ 1.6 nm/mm with 1200groove/mm grating
CCD resolution with 20 μm entrance slit using discrete spectral line; e.g 546.1 nm, 912 nm, 1013 nm, and 1529 nm,	≤ 0.28 nm with 300 grooves/mm grating ≤ 0.15 nm with 600 grooves/mm grating ≤ 0.07 nm with 1200groove/mm grating

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(depending upon grating selection).	
Computer interface	USB
Control software	Full control software with all applicable licenses (if any).
Cables and accessories	All connection and communication cables/cards.
<u>Part 2: Detector specification</u>	Details requirements
Type	NIR sensitive cooled InGaAs detector
Sensor format	1024 × 1
Pixel Size	25 μm × 500 μm (width × height)
Spectral sensitivity range	800 nm to 1700 nm
Typical read Noise	For High sensitivity mode (high gain): ≤ 500e- For High dynamic range (low gain): ≤ 5500e-
Typical dark noise	≤ 10 K e-/pixel/s with maximum cooling of detector and looking at room temperature target (~ 25°C) in the high sensitivity (high gain) mode.
Minimum Exposure time	≤ 50 μs
Peak Quantum efficiency	≥ 85 % (supported by data sheet)
Gain factor	High gain: ≤ 90 e-/count Low gain: ≤ 2500e-/count
Scan Rate	500 KHz and 2 MHz
Spectral frame rate	≥ 450 frame/second
Digitization	16 bit
Blemish specification	≤ 1% defects
Triggering option	External hardware trigger (preferably TTL)
Detector Cooling Temperature	≤ -90 ° C
Interface	USB/ Gig E interface
Essential data acquisition and control software to acquire and plot data.	Should be Included /provided
Interface	USB/ Gig E interface
Accessories to make smooth operation of detector coupled with Spectrometer	1. Intensity / wavelength calibration lamp with software 2. Suitable optics for fiber coupling at entrance Slit: Coupling optics at entrance slit for the optimized light coupling to the spectrometer by best possible matching of f number of spectrometer and 1 mm diameter and 0.22 NA optical fiber

Acceptance Test:

The final acceptance of the product will be given after the following two tests:

1. Pre-dispatch test at factory site by the vendor. (Pre-dispatch test by IPR personnel at factory (vendor) site is not required).
2. Final acceptance test at IPR.

Part I: Pre-dispatch test at factory site by the vendor:

Vendor will carry out the below mentioned tests of the integrated spectrometer system after coupling the InGaAs detector with the spectrometer at its exit focal plane. The vendor will send a detailed test report to IPR before the dispatch of the equipment. The test report will be evaluated by IPR and if found satisfactory, IPR will send the dispatch clearance certificate. The integrated spectrometer system should be tested for the following parameters and indices:

1. Physical dimension and mechanical movements:
 - i) Confirm the physical dimensions of gratings/mirrors/housings.
 - ii) Provide the actual Focal length of the spectrometer after integration.
 - iii) Provide engineering and section drawings of the final assembled system.
 - iv) Confirm the movements/controls of grating and turret rotation, slit variation (maximum and minimum openings) through computer interface.

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2. Recording of Spectra:
 - i) Using a standard Hg spectral lamp (if required, use any other source to cover wavelength range of interest) record the single/multiple spectrum/spectra over several wavelength windows (atleast two) using all three gratings separately and provide the plots/graphs of intensity versus wavelength. Please use entrance slit width ~ 20 μ m for the above test.
3. Wavelength Accuracy and reproducibility:
 - i) Test for the wavelength accuracy and reproducibility using all three gratings separately.
 - ii) Provide spectral line plots/graphs of the above test.
4. Dispersion and spectral resolution:
 - i) Test the spectrometer using all three gratings separately for its dispersion in terms of both nm/mm and nm/pixel in at least two well separated wavelength window for each grating.
 - ii) Test the spectrometer using all three gratings separately for its spectral resolution in terms of FWHM in at least two wavelength window for each grating using spectral lines at 546.1 nm and/or 912 nm, and/or 1013 nm depending on the upon system response.
 - iii) Tabulate the results for three different gratings and provide the table.
 - iv) Provide spectral line plots/graphs for both dispersion and spectral resolution tests for all three gratings separately.
5. Dark current measurement:
 - i) Dark current should be measured in both high gain (high sensitivity) and low gain (high dynamic range) modes, with the detector coupled with the spectrometer and at minimum attainable cooling temperature of the detector.
 - ii) Provide graphs/plots of Dark counts in the situation mentioned above for all the three gratings.
6. Read noise measurement:
 - i) Read noise of the detector should be measured in both high gain (high sensitivity) and low gain (high dynamic range) mode.
7. External trigger mode and frame rate:
 - i) Confirm the operation of the system in external trigger mode.
 - ii) Acquire images at the quoted frame rate and provide graphs/plots in support.

Part II: Acceptance Test at IPR

Upon the arrival of spectrometer at IPR, installation, testing and demonstration of its performance should be carried out either by the principal or by their Indian representative. During the tests at IPR, the vendor (principal/Indian representative) should carry out all the tests carried out during the pre-dispatch test (mentioned in the part 1 of this document). The acceptance will be subjected to the successful reproduction of the test results obtained during the pre-dispatch test by the vendor at their factory site.

COMPLIANCE STATEMENT

The complete system contains two major parts:

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- 2. NIR sensitive InGaAs detector**

Computer controlled Spectrometer with one Front Entrance Slit, One front exit port with Adaptor flange for InGaAs detector and side exit slit using beam diverter mirror, and an interchangeable triple grating turret with three gratings in NIR range.

Parts/Parameters/configuration/items	Value/range/quantity/design Requirement of IPR	Specification offered by Vendor
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Coatings	All mirrors, gratings and optical components should have appropriate coating (e.g. Silver coating) for achieving reflectivity efficiency > 96 % in VIS and NIR range (supported by corresponding data sheet)	
Grating Turret	Interchangeable Triple grating turret to accommodate 3 gratings	
Grating Selection in turret	Computer controlled using software	
Gratings : 3 numbers of gratings required	1.) Ruled Grating, 300 grooves/mm blazed at 1600 nm, 2.) Ruled Grating, 600 grooves/mm blazed at 1000 nm, 3.) Ruled Grating, 1200 grooves/mm blazed at 750 nm	
Stepper Motor scanning	Required with AC, 220-240 Volts, 50 Hz	

drive system	power supply	
Grating repeatability	Change ≤ 0.02 nm	
Scanning Drive step size	0.002 nm /step	
Wavelength reproducibility	≤ 0.004 nm (in both scan directions)	
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Astigmatism Correction	Should be done using suitable Toroidal Mirror	
Linear dispersion measured using discrete spectral line; e.g , 546.1 nm, 912 nm, 1013 nm, and 1529 nm (based on grating selection).	≤ 6.7 nm/mm with 300 grooves/mm grating ≤ 3.3 nm/mm with 600 grooves/mm grating ≤ 1.6 nm/mm with 1200groove/mm grating	
CCD resolution with 20 μ m entrance slit using discrete spectral line; e.g., 546.1 nm, 912 nm, 1013 nm, and 1529 nm, (depending upon grating selection).	≤ 0.28 nm with 300 grooves/mm grating ≤ 0.15 nm with 600 grooves/mm grating ≤ 0.07 nm with 1200groove/mm grating	
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Typical dark noise	≤ 10 K e-/pixel/s with maximum cooling of detector and looking at room temperature target ($\sim 25^\circ\text{C}$) in the high sensitivity (high gain) mode.	
Minimum Exposure time	≤ 50 μ s	
Peak Quantum efficiency	≥ 85 % (supported by data sheet)	
Gain factor	High gain: ≤ 90 e-/count Low gain: $\leq 2500e^-$ /count	
Scan Rate	500 KHz and 2 MHz	
Spectral frame rate	≥ 450 frame/second	

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Digitization	16 bit	
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Triggering option	External hardware trigger (preferably TTL)	
Detector Cooling Temperature	≤ -90 ° C	
Interface	USB/ Gig E interface	
Essential data acquisition and control software to acquire and plot data.	Should be Included / provided	
Part 3: Accessories	Details requirements	
Accessories to make smooth operation of detector coupled with Spectrometer	<ol style="list-style-type: none"> 1. Intensity / wavelength calibration lamp with software 2. Suitable optics for fiber coupling at entrance Slit: Coupling optics at entrance slit for the optimized light coupling to the spectrometer by best possible matching of f number of spectrometer and 1 mm diameter and 0.22 NA optical fiber 	
Any Other relevant Information		

Authorized Signatory

Official Seal

Date :-