राष्ट्रीय प्रौद्योगिकीसंस्थान, उत्तराखण्ड

NATIONAL INSTITUTE OF TECHNOLOGY, UTTARAKHAND

Ref.No.:NITUK/TEQIP-III/Procurement/2019/17/(XXVI)/ Date: 18.06.2019

ORDER TO BE PLACED UNDER PROPRIETARY CERTIFICATE

National Institute of Technology, Uttarakhand is going to place order for following software under proprietary article basis. Objection(s) if any, in this regard are called upon at **teqipthird@nituk.ac.in** from party/organization latest by the 9thJuly, 2019 before 05:00 PM.

In case of no objection received from any firm/agency on or before the above mentioned date and time, then order will be placed as under:

S. No.	Item	Party (Proprietary)	Sole Authorized Distributor in Indiaauthorized to quote/sale/supply the item on behalf of OEM to the Institute doing the procurement or the jurisdiction of area covered	Qty.	Specifications
1.	Ball & Beam Servo Experiment	Quanser Consulting Inc., 119 Spy Court, Markham, Ontario Canada	Edutech India Pvt. Ltd. Crystal Lawn, No 20 Haddows Road, Chennai – 600006, India	01 (One)	enclosed

Sd/-

Coordinator (TEQIP-III)

Encl:

1. Copy of Specification
2. Copy of OEM certificate(s)

Specifications

S. No.	Item Description	Specifications
1.	Ball & Beam Servo Experiment	a) Modular Servo Plant : The servo plant shall be ideally suited to introduce fundamental control concepts and theories on an easy-to-use and intuitive platform. • The plant should consist of a DC motor in an anodized solid aluminum frame. • The motor should be equipped with a gearbox that drives external gears. • The servo plant shall be equipped with a potentiometer to measure the output/ angular load. • The architecture should be flexible to accommodate attachment of different experimental modules to perform different experiments that can be interchangeably run using the same servo motor. • Rigid geared system with direct drive motor (not belt-driven mechanism) to actuate load with minimal controller lag. • High quality internal gear-box and re-configurable output gears for achieving different combinations of gear ratios b) Ball and Beam Module: The Ball & Beam module should consists of a steel rod in parallel with a nickel-chromium wire-wound resistor forming the track on which a metal ball is free to roll. • The position of the ball should obtainable by measuring the voltage at the steel rod. When the ball rolls along the track. • There should a potentiometer like set up on the track, which as a wiper resulting in the measurement of the position of the ball. • When coupled to the servo plant, the DC motor should be able to drive the beam such that the motor angle controls the tilt angle of the beam. • Technical Specifications of the Ball-beam Module : i. Base Dimensions : not more than 50 cm x 25 cm ii. Mass of the module : Not more than 0.65 Kg iii. Beam length : between 40-45 cm iv. Lever arm length : between 10-13 cm v. Support arm length : between 15-18 cm

		vi. Ball diameter : 2.5 + 0.1 cm vii. Ball mass Not more than 65 grams viii. Beam sensor bias power : z 12 V ix. Beam sensor measurement range : 1 5 V c) Data Acquisition Card : The Experiment setup should include a Data Acquisition card with the following specifications : • Multiple OS compatibility and Interrupt support USB for the encoder index pulses. • Number of I/O shall be : 8 ADCs„ 8 DACs , • 8 encoder inputs with 4X quadrature position and 1X quadrature velocities • 8 PWM , • 8 dgtaNnput • DAQ maximum pulse output frequency of 49.766 lHHz. DAQ maximum encoder frequency • 99.5 NHz in quadrature mode. d) Curriculum : Curriculum must include modeling, position control, speed control and Ball & Beam. Student workbook, teacher workbook and lab setup guide must be provided in electronic format on CD. • Modeling the electro-mechanical plant of a servo DC motor and load shaft, actuator dynamics • Open-loop and closed-loop analysis • Frequency response analysis • First order system identification using the bump test • Model validation • Closed-loop transfer function • Using high pass filter instead of direct derivative and implications • PID control design based on time domain transient and steady state specifications (response time, steady state error, percentage overshoot) • System response to various input types such as square, ramp, sine wave, etc. • Actuator saturation • Integral action • Actuator dynamics and modeling

		• Transfer function representation of the system • Cascade control design and tuning • Stability analysis • Lead-Lag compensation design, parameter tuning and Bode plots • Sensor noise e) Other requirements : • The setup should be compatible with MATLAB and SIMULINK. • The design should be modular with easily-interchangeable parts. • Open architecture design. • Windows Single user license for Real-time Control, as Rapid Control and Prototyping Software • On board sensors should include high resolution encoder, potentiometer and on-board tachometer for directly measuring the output shaft' s angular speed. • System should include remote ball sensor which allows for a master-slave configuration (tele-operation) to control ball position. • All the components should be compatible with one another.

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May 9, 2019

PROPRIETARY ITEM CERTIFICATE

Quanser is the world leader in education and research-based systems for real-time control design and implementation, providing control challenges for all levels of university education and research.

We confirm that the Quanser's solutions are proprietary Control lab systems, incorporating combination of specialized hardware and control software. We are the sole Manufacturers of this system in the world. **M/s. Quanser Consulting Inc., 119 Spy Court, Markham, Ontario, CANADA L3R 5H6:**

- **Quanser Aero**
- **QBot 2e ground robot**
- **SRV02 with Ball and Beam**

We also confirm that M/s. **Edutech India Pvt Ltd** 20, 1st Street, Haddows Road, Chennai - 600006, India, is authorized to sell all our products and is our distributor in India.

Please contact the undersigned for any queries on this subject.

Sincerely,

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