INDIAN INSTITUTE OF TECHNOLOGYKHARAGPUR
KHARAGPUR – 721302

SUB:PROCUREMENT OF EQUIPMENT

Tender Notice No.**IIT/EE/OTG/SM/EQ/2018-19/08**Date: **05.11.2018**

Indian Institute of Technology Kharagpur, an Institute of National Importance, invites sealed quotations from reputed Original Equipment Manufacturers (OEMs) or their Authorized representatives & General Suppliers for the supply of **Software and Hardware for development and validation of supervisory controller system for a plug-in Hybrid Electric Vehicle (PHEV)** for the Department of Electrical Engineering.

Interested vendors are requested to send their sealed bids under a **two cover system** as per requirement mentioned in tender document, along with the Technical Specifications & Compliance Certificate (as mentioned in **Annexure – I)**of thetender document.

Details are also mentioned in the Institute website **www.iitkgp.ac.in** [link: **Tenders**].

The proposal has to be sent in a sealed packet, containing two separate sealed envelopes (**Technical Bid** and **Price Bid**) duly superscripted with Reference Number **(Tender Notice No. IIT/EE/OTG/SM/EQ/2018-19/08 Date: 05.11.2018)**to the office of Prof. Siddhartha Mukhopadhyay,Department of Electrical Engineering, Indian Institute of Technology, Kharagpur, P.O. Kharagpur Technology, PIN: 721302 ***on or before*** **28.11.2018 at 3.00 pm.**

The **technical bids will be opened on 28.11.2018 at 4.00 pmin the Office of Prof. SiddharthaMukhopadhyay,Department of Electrical Engineering, IIT Kharagpur** in the presence of the vendors/ or their authorized representatives. Price bids will be opened (to be notified separately) only of those firms, who will be found technically qualified/short listed, after evaluation of their technical bids.

Prof. Siddhartha Mukhopadhyay
PI, CNE_OTG, IIT Kharagpur

Encl: Annexure – I & II

Copy to:

1. **Institute website**
2. **Jt. Registrar (Stores & Purchase)**
3. **CPPPortal**
4. **Chairman, Purchase Committee**
5. **Notice Board**

Procurement of Equipment

It will consist of the equipment as per the specifications given in **Annexure I.**

TERMS AND CONDITIONS

1. Technical bid should contain all relevant technical details; printed technical leaflet of models quoted and other details, which may be necessary to ensure that the offer is complete in all respects, e.g., technical specifications, etc.
2. Technical bid should also contain a Compliance Certificate duly signed by the bidder.
3. PRICE may be quoted either in INR or in foreign currency. Where tenderer intends to quote in Indian Rupees (INR), the price should be quoted “FOR IIT Kharagpur” basis. The price should be all inclusive including GST. The unit price without tax and the tax breakups should be shown separately for each item (if applicable). Prices for software components, if any, must be shown as separate line items.
4. IIT Kharagpur is registered under DSIR, Govt. of India. GST rate for scientific goods is 5% as per the Notification No. 47/2017 - Integrated Tax (Rate) dated 14th November, 2017. Necessary certificate in this regard will be issued as per requirement and on request of the successful bidder.
5. Where tenderer intends to quote in foreign currency FCA/FOB source port price by Air/Sea to be quoted. In case of comparison between FOR IIT Kharagpur (quoted in INR) and FOB/FCA price (quoted in foreign currency) 20% will be added on FOB/FCA price after conversion to INR.
6. IIT Kharagpur is eligible for exemption for payment of Customs Duties in terms of Government of India Notification No.51/96-Customs dated 23.07.96. Necessary certificate in this regard will be issued as per requirement and on request of the successful bidder.
7. Any particular items/products/components/sub-components may be procured independently from any vendor following standard purchase practices. All sub-components' pricing (1a, 1b,1c, 1d, 1e, 1f(i),1f(ii), 1g, 2,3a,3b,3c) should be mentioned separately. The bidder may submit quotation even if an item/component/sub-component or multiple components/sub-components is/are unavailable with them.
8. Payment Terms: 90% Payment shall be made after successful installation of the Equipment/Accessories duly certified by PI, CNE_OTG. Balance 10% may be released against submission of Performance Bank Guarantee to the tune of 10% of the total purchase order value. The Performance Bank Guarantee shall be issued from any Commercial Bank, which must remain valid for a period sixty days beyond the expiry of the Warranty Period. Bid security will be refunded back on submission of performance Security.

   Through Letter of Credit / Wire Transfer (after receipt of stores) for foreign principal. In case of Letter of Credit 90% payment will be made on submission of shipping documents and balance 10% payment will be made on installation, commissioning and submission of Performance Bank Guarantee for performance period. On behalf of the

Principal, Indian Agent must be able to provide Performance Bank Guarantee.

9. Warranty:OEM warranty, at least 12 months from the date of successful installation of the equipment.
10. Delivery Period:The equipment should be supplied within 8 weeks from the date of receipt of the Purchase Order.
11. Liquidated Damage: In the event of failure to deliver the stores beyond the specified date, liquidated damages @ 1% per month or part thereof in respect of the value of stores will be deducted, subject to a maximum of 5%; alternately the order will be cancelled and the undelivered stores purchased from elsewhere at the risk and expense of the vendor.
12. Tender Fee:An amount of **Rs 1,000.00** (Rupees One Thousand only) as tender fee (nonrefundable) is to be paid. The payment shall be made by Demand Draft from any Bank in favour of "Indian Institute of Technology Kharagpur", payable at "Kharagpur". Quotation will not be accepted without the Tender Fee. Tender fee should be enclosed separately in an envelope and stapled with the Technical Bid.
13. Earnest Money Deposit (EMD): An amount of 2,00,000.00 (Rupees two lakh) only (Refundable) in the form of Demand Draft drawn in favour of "Indian Institute of Technology Kharagpur", payable at Kharagpur or Bank Guarantee as per format at Annexure-II is to be submitted. E.M.D. should be enclosed separately in an envelope and stapled with the Technical Bid document superscribed with the tender no. The validity of the EMD should be 6 (six) months from the date of issue. Any bid without EMD will summarily be rejected. No interest is payable on EMD. EMD will be refunded to the unsuccessful bidder after finalization of the tender process. No interest is payable on Security Deposit. Security Deposit shall be forfeited if the selected vendor fails to execute the contract after receiving the same.

    [NOTE: IIT Kharagpur will give exemption for submission of tender fee and EMD who are registered with MSME or Central Purchase Organization or startups as recognized by DIPP as per revised rule 170 of GFR-2017 only. However proper and valid document in this regard must be submitted by the bidders in support of their claim.]
14. Bid Submission: Technical Bid and Price Bid should be submitted in two separate sealed envelopes quoting reference number on the top of the envelope. Technical bid should have a copy of the price bid with costs blanked out. Tender Fee and EMD should be enclosed with the Technical Bid documents, in separate sealed envelopes, stapled with the packet containing Technical Bid documents.
15. Acceptance of Tender:The authority of IIT, Kharagpur reserves the right to accept/reject any or the entire tender bids received without assigning any reason thereof.
16. Conditional offer will not be accepted.
17. Period of Validity: Bids shall remain valid for acceptance for a period of 120 days from the date of opening of the price bid. The benefit of downward prices (revision on account of budget/financial policy, tax revision, etc.) should be given to IIT Kharagpur by the selected OEM/vendor.
18. PastperformanceofthevendorswillbejudgedatthetimeofTechnical Evaluation.
19. The Institute does not bind itself to offer any explanation to those bidders whose

technicalbidshavenotbeenfoundacceptablebytheTechnicalEvaluation Committee of the Institute.

20. Bidders shouldenclose the following documents:
    i. Earnest Money Deposit (EMD).
    ii. Certificate of Registration/Trade License.
    iii. PAN number and GST registration number.
    iv. IT returns for the last three years.
    v. Copy of product literature technical leaflet, wherever applicable for which the prices have been quoted should invariably be enclosed.
    vi. Signed copy of the tender document, with company seal, agreeing to the terms & conditions and declaration.
21. **Alltendersareto**besubmittedorhandedovertotheofficeof **Prof. Siddhartha Mukhopadhyay, Department of Electrical Engineering,IITKharagpur.** The bids (technical and price bids) once submitted shall be the property of the Institute and shall not be returned to the vendor in future.
22. **The person/officer signing** the tender/bid documents should be delegated with an appropriate authority.
23. **Opening of Price Bids:** The Price Bid(s) of only those vendor(s) who are found technicallyqualifiedwillbeopenedandthesamewillbeopenedbeforethe technically qualified vendor(s). **The date for opening of price bids will be notified separately.**
24. Bidder or his/her authorized representative (with proper authorization letter for opening of technical bids and also for opening of price bids) may choose to be present at the time of opening of Technical Bids/Price Bids.
25. The addendum/corrigendum if any shall be published on Institute's Website and on CPP Portal.
26. The Institute at its discretion may change the quantity at any time before placing the order.
27. Copy of mandatory test reports, national testing/reliability and endurance test reports etc., certified or conducted at the manufacturing site, granted by the bureaus/quality control departments/national testing laboratories, as appropriate, should be enclosed.
28. Deviation from Specifications: It is in the interest of the tenderer to study the specifications in the tender schedule thoroughly before quoting so that, if the tenderer makes any deviations, the same are prominently brought out in the body of the tender. If you need to add any optional items to your system in order to meet our specifications, you are requested to quote for the total including the option required to suit our requirements. Otherwise, your tender will not be considered at all.
29. Guarantee: The tenderer has to declare that the goods sold to the buyer under this contract shall be of the best quality and workmanship and shall be strictly in accordance with the specifications.
30. Jurisdiction: All questions, disputes, or differences arising under, out of or in connection with the contract, if concluded, shall be subject to the exclusive jurisdiction at the place from which the acceptance of Tender is issued i.e. Jurisdiction of KOLKATA HIGH COURT. Acceptance to this effect is also necessary at the time of opening of Technical

Bid.

31. Agency Commission, if any will be paid to the Indian agents in Rupees on receipt of the equipment and after satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances.
32. **Tenderer(s), who are Indian Agents of OEMs**:
    (a) Bidders should enclose / furnish the following documents / details:
        - Port of shipment and Country of origin is to be provided for each item.
        - Purchase order to be placed on: Should be mentioned in the quotation with full address.
        - Complete address and tele links for contact persons of principals and Indian agent offices dealing with this purchase.
        - Name and full address of the OEM's Banker and their swift code.

    (b) Should furnish a clear declaration as follows: We declare that I am/we are Accredited Agents of the suppliers aboard. DGS&D enlistment certificate needs to be attached (applicable only for the Indian Agents)
33. **<u>Important</u>**
    (a) Abidsubmittedwithfalseinformationwillnotonlyberejectedbutalsothe OEM/vendor will be debarred from participation in future tendering process.
    (b) The OEMs/Vendors need to submit a certificate thattheyarenotcurrentlydebarredorblacklistedinIITKharagpurforany supplies, products or services, or at present in any national organization or educational institute/university.
    (c) In case of any dispute, the decision of the Director of this Institute shall be final and binding on the bidders.
    (d) For any query pertaining to this bid document, correspondence be addressed to:

        Prof. Siddhartha Mukhopadhyay,
        Department of Electrical Engineering
        Indian Institute of Technology, Kharagpur721302
        siddhartha.mukhopadhyay@gmail.com / patrashamit@yahoo.com

    (e) In case the due date for submitting tender **happens to be a holiday, the same will be accepted on the next working day**. The timings will however remain unchanged. **Please Note that the Institute remains closed during Saturdays & Sundays.**

Annexure I

Software and Hardware for development and validation of supervisory controller system for a plug-in Hybrid Electric Vehicle (PHEV)

For the development of a hybrid control unit which interacts with all the components of a hybrid electric vehicle the software and hardware products are required as given in Table-1. The development process will involve making a suitable hybrid control logic which will first require an offline detailed validated industry standard simulation environment (having models of various components) to develop and test the same in closed loop with various ECUs under different realistic scenarios. Once the hybrid control logic is developed using the offline simulation modelling environment its efficacy has to be tested and validated in real time. For this a suitable real time PHEV model (including the ECUs for the components such as BMS, TCU, MCU, etc) capable of running in HILs with all realistic subsystems including their respective controllers interacting through CAN interfaces is to be procured. The developed hybrid control logic as well as diagnostics functionality are to be implemented in a real controller having hardware, and software interfaces (such as device drivers, etc) with the respective components which also need to be procured. This controller may also come with its inbuilt skeleton application control logic code, IDE and firmware.

Table -1

Item Number	Requirement of products
1.	**Dynamic Real-time PHEV simulation software in MATLAB Simulink modelling (having models validated with real data) and simulation Environment comprising following components:** **a. Real time electric motor and motor controller along with thermal components simulation platform** **b. Real time Li-on Battery pack model, charger and BMS along with thermal components simulation platform** **c. Real time Transmission and its controller along with thermal components simulation platform** **d. Real time vehicle dynamics model having 6-dof and Electronic stability control** **e. Real time other accessory circuits and components in simulation platform** **f. (i) MPFI Spark Ignition engine model and control unit** **(ii) GDISpark Ignition engine model and control unit** **g. CAN network module**
2.	**Dynamic and Steady state Offline (Desktop) high fidelity industry standard validated PHEV model and simulation software environment (along with GUI/cockpit) for developing and testing, comprising of complete PHEV architecture having all components with its subsystems including all ECUs and circuits**

3.	**Supervisory controller hardware, firmware (ISO 26262 complaint, also following AUTOSAR guidelines) and software platform to support development of application control logic and diagnostics of VCU* Comprising of following components:** **a. Open ECU hardware and firmware for PHEV Supervisory Controller** **b. ECU development platform having virtual ECU**(optional: supporting Hex files to run in ECU) while supporting closed loop (ECU in loop) testing/simulations with components/plant model via CAN** **c. Open/Alterable control strategy/application software for supervisory controller of VCU of P2, P2.5, P3 HEVs (required for control/diagnostics) for supporting (at least have provision for or basic features of) various relevant functionalities**

***VCU:** Vehicle Control Unit

****Virtual ECU**: Allows integration test of simulation of an ECU for validation in desktop, without hardware prototype

1. Dynamic Real-time PHEV simulation software in MATLAB Simulink modelling (having models validated with real data) and simulation Environment comprising of following components

a. Real time electric motor and motor controller along with thermal components simulation platform

SN.	Component	Details	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
1.	**Motor**					
	Motor Type	PMSM (inner rotor/outer rotor), SRM, 3-Φ Induction Motor				
	Motor Rated Voltage	24/48V/240 V				
	Motor Rated Current	Range				
	Motor Peak Power@---rpm	44 -125 kW				
	Motor Peak Torque@---rpm	125 Nm-320 Nm				
	Motor rpm	Up to 7000 RPM				
	Coolant circuit	Air cooled, Water cooling				
2.	**MCU, Inverter, Pre-charge**					
	Microcontroller	Type of processor				
	Inverter device type	MOSFET (three phase Voltage source inverter with parallel MOSFETS)				
	Inverter Rated Voltage	***Range***				
	Inverter Rated current	***Range***				
	Maximum Switching Frequency	~30 kHz				
	Switch type	MOSFET (space vector PWM or bus-clamped				

		PWM)				
	Heat dissipation and cooling circuit	Heat sink along with liquid cooling				
	Precharge logic and circuit	Architecture and strategy				
	Operating modes	Speed and Torque				

1. b. Real time Li-on Battery pack model, charger and BMS along with thermal components simulation platform.

SN.	Component	Details	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
1.	**Battery**					
	Battery Type	Li ion, Li-FePO4, Lithium Nickel Manganese Cobalt Oxide pouch cells				
	Cell nominal voltage, peak, cut-off	3.2 V, 3.8 V, 2.5 V				
	Cell capacity	40 Ah				
	Operating temperature range	Operating temperature , storage temperature				
	Battery Rated Voltage	48V/150 V				
	Battery charging current , standard, max	Standard , Maximum, Impulse				
	Battery discharging current, constant, impulse	Standard, Maximum, Impulse				
	Battery Capacity (kWh)	8 - 100				
	BatteryPeak Power@---C	***Range***				
	Motor Peak Current@---C	***Range***				
	Battery Internal	DCR Impedance ,				

	parameters	ACR impedance				
	Battery dimensions	***Range***				
	Battery weight	***Range***				
	Battery cooling circuit	Cooling plate/ microchannel fluid cooling				
2.	**BMS**					
	SOC estimation	e.g., Extended Kalman Filter				
	SOH estimation	e.g., intrinsic relation between ohmic internal resistance and capacity				
	State of Power estimation	Functionality				
	Cell balancing	Active and Passive				
	Max C rate flag	If present				
	BMS self-test on power ON	If functionality included				
	Cell Voltage sensing					
	Cell Temp sensing	e.g., Negative Temperature Coefficient Thermistors				
	Pack current sensing	Type of sensing				
	Memory handling for storing and extracting vital parameters					
	Reporting various statuses via flags					
	Contactor operations for charging and discharging					
	Communication using CAN messages with					

	VCUand BMS					
	Charge control functionalities: i. Getting/limiting the charge into the battery (Charging) ii. Optimising the charging rate (stabilising) iii. Knowing when to stop (Terminating)	**Input ratings:** 3.5kW, 220V, 75A **Output ratings:** **DC** 48V				
	BMS Software	i) Monitoring of all key indicators coupled to control actions. (Cooling, Power disconnect, Load management) ii) Control actions or switch off in case of out of limits condition				

c. Real time Transmission and its controller along with thermal components simulation platform

SN.	Component	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
1.	**Transmission Details**				
	Fixed Gear transmission				
	Automated Manual Transmission (AMT)				
	Continuously Varying Transmission(CVT)				
	Dual Clutch Transmission(DCT)				
2.	**Clutch**				
3.	**AMT/AT Controller details**				
	AMT				
	CVT				
	DCT				
4.	**Transmission Cooling System**				
5.	**Torque Converter**				

d. Real time vehicle dynamics model with 6-dof

SN.	Component	Desired Capability	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
1.	**Tire Model**					
2.	**Road Interaction Model**	Friction, gradient				
		Road conditions under rain, dry, Road-un-metalled, asphalt concrete				
3.	**Longitudinal load model**					

4.	**Vehicle Load distribution model (4 wheels)**					
5.	**Driver Model**					
6.	**Longitudinal Dynamics Model**					
7.	**Lateral Vehicle Dynamics Model**					
8.	**Pitch, yaw, roll, x, y, z motions**					
9.	**Drive cycle following capability**					
10.	**Brake Model**	Electronic stability Control and mechanical brakes				

e. Real time other accessory circuits and components in simulation platform (Optional).

SN.	Component	Details	Functionality /feature/specs available	Validated with hardware?	Additional Specification/functionality available	Remarks
1.	**AC**					
	Power					
	Voltage					
	Temperature					
	FAN and its speed settings					
	Ambient and set temperature					
2.	**Wiper**					
	Power					
	Voltage					
3.	**Infotainment System**					
	Power					

	Voltage					
4.	**Head Light**					
	Power					
	Voltage					
5.	**Starter Motor**					
6.	**Stock Battery**					
7.	**Contactors, relays**					
8.	**Wiring Harness**					
9.	**Power Electronics circuit such as DC-DC Convertor**					
10.	**Integrated cooling circuitry for battery, motor, transmission along with heat exchange models**					

f. Real time BS VI complaint SI engine model (both MPFI and GDI) with control units

SN.	Component	Details	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
f.(i)	**For MPFI engine (plant model)**					
	(a) Air system					
	Intake Manifold and Intake Runner					
	Throttle using ETC					
	Turbocharger and intercooler with waste gate actuator					
	Air flow, temperature and pressure Sensors					
	Intake valves with air flow					
	(b)Cylinder system (MPFI)					
	Instantaneous pressure and temperature dynamics, heat loss					
	Valves : to support VVT					

	Ignition : Knock modeling with effect of ignition angle					
	Piston, Crankshaft and Camshaft dynamics, including torque and speed produced					
	Starter relay					
	(c)Fuel system (MPFI)					
	MPFI Fuel system including fuel pump with relay and injectors (MPFI)					
	Fuel pressure					
	Voltage to Fuel injector					
	Fuel flow rate					
	A/F ratio in cylinder					
	(d) Exhaust System					
	Exhaust manifold having : Dew Point Temperature, Exhaust Gas Temperature and Pressure					
	Muffler to atmosphere					
	Catalytic converter (map based) with O2 heater relay					
	Wideband Lambda Sensors upstream and downstream					
	EGR circuit with valve					
	** Should be able to simulate various operating load conditions and idling					
	**Appropriate inertia, friction etc. should be considered wherever appropriate					
	For MPFI engine (Controller Model)					
	Torque based Electronic Throttle Control					
	Variable Valve Timing and Spark Ignition Angle Control					

	EGR control					
	Turbo charging control					
	Fuel Injection Control (MPFI)					
	Electric water pump					
	Electric Thermostat					
	Thermal management using ECT					
	Upstream and downstream Lambda monitoring					
	Wide band lambda sensor					
f.(ii)	**For GDI engine**					
	Should be same as for MPFI (**f**(i) (a)-(d)), **except**:					
	GDI cylinder design					
	GDI Fuel system including fuel pumps with relay and injectors					
	A/F ratio control (upto 45:1) during part loads, medium loads and full loads					
	Homogenous and stratified Charge modes					
	Showing injection phasing instants(e.g., early and late injections)					
	High pressure fuel injector inside cylinder (piezoelectric)					
	GDI control strategy including injection angle control and A/F control					

g. CAN network module

SN.	CAN communication with VCU	Details	Functionality /feature/specs available	Validated with hardware?	Additional Specification/functionality available	Remarks
1.	MCU					
	Engine Control Unit					
	TCU					

	BMS (including charger module)					
	ESC (Electronic Stability Control)					

2. Dynamic and Steady state Offline (Desktop) high fidelity industry standard validated PHEV model and simulation software environment (along with GUI/cockpit) for developing and testing, comprising of complete PHEV architecture having all components with its subsystems including all ECUs and circuits

SN.	Component	Details	Functionality /feature/specs available	Additional Specification/functionality available	Validated with hardware?	Remarks
1.	**Vehicle Model**	To include all features of 1(d) 3D terrain environment Detailed GUI of vehicle model Traffic environment				
2.	**Transmission Model and TCU**	Various detailed transmission models with TCU corresponding to various architectures of HEV Also refer 1(c)				
3.	**Engine model and ECU**	Detailed model having inertia at relevant places, with instantaneous torque, power production, air exchanges, emissions, fuel consumption, Cylinder dynamics (Optional) mechanical losses, thermal model, throttle control, fuel control, EGR control with ECU				
4.	**Motor and Motor**	Having the				

	Controller model	components of 1(a). Instantaneous torque/power production, current, mechanical and electrical losses, thermal model of motor and MCU				
5.	**Battery, External charger and BMS**	Having the components of 1(b). Detailed model having instantaneous variations of voltage, current and temperatures (thermal model) of cells and pack, degradation of cells. BMS to be realistic/practical having various battery statuses				
6.	**Vehicle Control Unit (Supervisory Controller)**	Interfacing with driver demands, Functionalities of torque split commands to motor and engine as well as appropriate exchanges of commands to BMS and transmission, capability of incorporating complex mathematical logic for optimization of energy management function, diagnostics functionalities, handling fault statuses				

7.	**Detailed overall GUI of Cockpit**	To be able to view and command (parameter setting, tuning, etc.) all components listed 1 to 6.				
8.	**Environment**	Drive cycle simulations, road conditions, different possible scenarios				
9.	**CAN network for interface with different Controllers and different baud rates**	It should communicate with MCU, BMS, Engine Control Unit, TCU through CAN at different baud rates.				

3. Supervisory controller hardware and firmware platform to support development of application control logic and diagnostics of VCU (Detailed functional requirements)

No.	VCU Functionalities	Functionality /feature/specs available	Additional Specification/functionality available	Remarks
3.A. Open ECU hardware and firmware (following Autosar, ISO26262) for PHEV Supervisory Controller	**Hardware** required to support high end VCU functionality and required interfaces with other components (e.g. 4 CAN Network Ports/transievers compatible with J1939 to support the communication interfaces with different controllers) **Hardware specs** Proc.Rate> 150MHz Code space >2000 KB RAM space>300 KB Calibration space 64 KB Calibratable Y Reprogrammable Y Inputs >40 Outputs >40 **CAN buses** 4			

	Support for non-volatile memory storage in Flash ECU to closely adhere to IEEE-754 for floating point numbers **Firmware** features required to run the ECU: (a) Bootloader/factory test code (b) Operating system providing memory and i/o management (c) drivers which the application code and diagnostics require to operate (d) Application software platform developed in SIMULINK/C interface through APIs for interaction/control of components			
3.B. ECU development platform having virtual ECU (optional: supporting Hex files to run in ECU) while supporting closed loop (ECU in loop) testing/simulations with components/plant model via CAN, having: (i)supported cross-compiler (ii) target code generation tool (iii) rapid prototyping (iv) porting capability to real ECUs (iv) debugging support; step by step module execution (v) monitoring/interface of ECU signals (vi)Online calibration on PC with INCA (vii) GUI for controlling simulations or display (viii) Support for control software and simulation models imported/co-simulation from C/C++, Python , MATLAB/Simulink, TargetLink, SIMPACK, AMESim, GT-POWER, IGNITE (RICARDO) , etc.				
3.C. Open control strategy/application software for supervisory controller of VCU of P2, P2.5, P3 HEVs (required for control/diagnostics) to support (at least have provision for or basic features of) following functionalities:				
3.C.1 Battery Management System (BMS) Interaction				
BASIC	Functionalities related to BMS like enabling BMS and updating BMS			

	related parameter like Voltage, Current, Power, SOC and health status of BMS updated at periodic intervals. Appropriate motor torque commands as per BMS status			
1.	Initialise signal for the BMS activation			
2.	Check BMS Communication and other faults			
3.	Get battery Leak Status			
4.	Get BMS Main Contactor status			
5.	Get Bat-Pack Cur, Volt, Temperature			
6.	Get Cell Voltage Fault			
7.	Get Consumed Ah, Remaining Ah, Regenerated Ah			
8.	Get SoC, Battery Power			
9.	Get BMS Health Flag			
10.	Discharge and charge enable			
11.	Give SOC upper and lower limit			
12.	Manage the Main BMS Contactor (On/Off) (i.e. Send Command to BMS)			
13.	External charger interaction with VCU			
3.C.2 Motor Control Unit (MCU) Interaction				
BASIC	MCU initialization, Motor torque commands and de-rating based on different conditions, reading various statuses			
1.	Initialise signal for the MCU activation			
2.	Compute motor torque based on brake/gear position, throttle, regen, vehicle state (forward, reverse, stop) and torque split algorithm;			
3.	Check MCU Communication and other faults			
4.	Initiate precharge sequence			
5.	Get motor current, RPM; estimate motor power			

6.	Get DC_Curr			
7.	Get Motor Temp, IGBT Temp, coolant temp			
8.	Assign Operation Mode- (Forward, Reverse, Speed/Torque Mode)			
9.	Get Fault Status (Pre-chargeFail, MainContact, Igbtfail, OvrCurrentErr, OvrHeatErr, OvrHeatSevereErr , OvrVtgErr, OvrVtgSevereErr, NeutralPointVtg, UnderVtg UndrVtgSevereErr, LockedRotorSeverly, OvrSpeed, AuxilliaryFault , CanCommFault, AutoMalFunc, MtrOvrHeat, MtrOvrHeatSvrly))(To be discussed with MCU team to get to know the signals which could be given by MCU)			
10.	Get Motor Health and other Statuses			
11.	Check Recovery of Motor from fault			
12.	Assign torque/speed to the motor (Based on the status of the motor health, Battery and Engine status , mode of operation , the torque spilt value is assigned)			
13.	Derate/ Limit torque command based on several conditions			
14.	Initiate regenerative braking			
15.	Auxiliary motor commands and getting statuses			
3.C.3 Interaction with Engine Management System				
BASIC	EMS initialization, Engine torque commands and derating based on different conditions, reading various statuses			
1.	Handle idle control function			
2.	Initialise signal for the EMS activation			
3.	Compute engine torque based on brake/gear position, throttle and			

	torque split algorithm			
4.	Check EMS Communication and other faults			
5.	Check engine fault flag statuses			
6.	Get Fuel flow, Oxygen sensor status,Engine coolant temp, TPS, MAP sensor, RPM			
3.C.4 Interaction with TCU				
BASIC	Interaction with transmission components by control and status of clutch, gear, cooling system			
1.	Control Signals			
2.	Event Statuses			
3.C.5 VCU Generic Functionalities				
1.	Check Ignition			
2.	Get Cranking Status			
3.	Initiate other ECU's – BMS, MCU, EMS,TCU			
4.	Get parameter updates from ECU's			
5.	Get Throttle , Brake, Vehicle Speed Sensor (VSS) values			
6.	Compute overall traction torque to be assigned from Table			
7.	Check for acceleration limit, speed limit			
8.	Interaction with auxiliary unit such as getting statuses and turning ON components			
9.	Assign torque to Engine and Motor depending with appropriate derated values and torque splits			
10.	Handle Regenerative Braking			
11.	Supervisory control related computation of optimal torque split by incorporating optimized energy management strategy, handling diagnostics and perform self test			

ANNEXURE – II

MODEL BANK GUARANTEE FORMAT FOR FURNISHING EMD

Whereas .....(thereinafter called the "tenderer") has submitted their offer dated ..... for the supply of ..... (hereinafter called the "tender") against the purchaser's tender Notice No. .....

KNOW ALL MEN by these presents that WE ..... of ..... having our registered office at ..... are bound unto ..... (hereinafter called the "Purchaser") in the sum of ..... for which payment will and truly to be made to the said Purchaser, the Bank binds itself, its successors and assigns by these presents. Sealed with the Common Seal of the said Bank this ..... Day of ..... 20 .....

THE CONDITIONS OF THIS OBLIGATION ARE

(1) If the tenderer withdraws or amends, impairs or derogates from the tender in any respect within the period of validity of this tender.

(2) If the tenderer having been notified of the acceptance of his tender by the Purchaser during the period of its validity:

(a) If the tenderer fails to furnish the Performance Security for the due performance of the contract.

(b) Fails or refuses to accept/execute the contract.

WE undertake to pay the Purchaser up to the above amount upon receipt of its first written demand, without the Purchaser having to substantiate its demand, provided that in its demand the Purchaser will note that the amount claimed by it is due to it owing to the occurrence of one or both the two conditions, specifying the occurred condition or conditions.

This guarantee will remain in force up to and including 45 days after the period of tender validity and any demand in respect thereof should reach the Bank not later than the above date.

(Signature of the authorized officer of the Bank)

Name and designation of the officer

Seal, name & address of the Bank and address of the Branch