राष्ट्रीयप्रौधोगिकी संस्थान, वारंगल

NATIONAL INSTITUTE OF TECHNOLOGY, WARANGAL, TELANGANA-506 004.

(An Institute of National Importance, Ministry of Education, Govt. of India)

SUPPLY, INSTALLATION & COMMISSIONING OF "ANSYS ACADEMIC MULTIPHYSICS CAMPUS LICENSE WITH ONE YEAR TECS"

Tender Ref. No. : NITW/PS-29/Ansys Software/2024-25/

राष्ट्रीयप्रौधोगिकी संस्थान, वारंगल
NATIONAL INSTITUTE OF TECHNOLOGY, WARANGAL, TELANGANA-506 004.
(An Institute of National Importance, Ministry of Education, Govt. of India)
NITW
Email: dr_ps@nitw.ac.in **Ph. No.: 0870 246 2910 / 2917 / 2918**

Tender No.: NITW/PS-2/Thermal Probe/2024-25/ Date: 05-04-2024

NOTICE INVITING TENDER

Single Tender Enquiry

To
M/s. Entuple Technologies Pvt Ltd
122 Optima, 1st Floor, Puttappa Industrial Estate,
Mahadevapura, Bengaluru,
Karnataka - 560048

Email: kavitha.m@entuple.com , Mobile No. +91 9886084445.
CPP Login ID: rajkumar@entuple.com
Bidding Through CPP Portal https://eprocure.gov.in/eprocure/app

Dear Sir/Madam,

The National Institute of Technology, Warangal intends to hire the Services specified below and invite online quotations in Single part tender in accordance with the terms and conditions detailed in the bid document.

S. No.	Name of the Item	Quantity	Validity of the bid	Delivery Period	Warranty / Subscription period
1.	Supply, Installation and Commissioning of "ANSYS ACADEMIC MULTIPHYSICS CAMPUS LICENSE with 1 YEAR TECS" • ANSYS Academic Teaching Mechanical Bundle - Aqwa, Structural & Mechanical 50 Tasks • ANSYS Academic Teaching CFD Bundle - CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery 50 Tasks • ANSYS Academic Teaching HFSS Bundle 50 Tasks	**01 No.**	**90 Days**	**30 days**	**One year with TECS**

	• ANSYS Academic Teaching EM Bundle - EM, Maxwell 50 Tasks • Ansys Learning HUB - ALH - Annual Subscription – 30 Nos • ANSYS academic Research Mechanical Bundle - Aqwa, Structural, Autodyn, Additive & Mechanical 10 Tasks • Ansys Academic Research CFD Bundle – CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery 10 Tasks • ANSYS Academic Research HFSS 10 Tasks • ANSYS Academic Research EM 10 Tasks • Ansys Academic Research Mech + CFD Bundle - Aqwa, Structural, Autodyn, Additive & Mechanical , CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery , ROCKY 10 Tasks • ANSYS Academic Research Lumerical Bundle – Annual Lease 05 Tasks • ANSYS Academic Research Optics Bundle – Annual Lease 05 Tasks **(**Detailed Technical specifications as per Section-3 enclosed**)**				
	Bid Security / EMD	Bid Security declaration as per **Annexure-3**			
	Performance Security	**5% of the contract value** valid till 60 days beyond the completion of warranty/Subscription period			

Offline bids including hard copy in any form will not be accepted.

Notes:

1. Tender Documents with detailed terms & conditions can be downloaded from the Central Public Procurement Portal: http://eprocure.gov.in/eprocure/app or Institute website https://www.nitw.ac.in /path/?dept=/Portals
2. ***The bidders are requested go through the complete Notice Inviting Tender and Tender document before submitting their bids.***
3. Bids/Quotations may be submitted directly by the OEM or their Authorized distributors/ Dealers/Resell Agents/Channel Partners with proof of authorization.
4. All the details/document pertaining to the tender such as tender document, pre-bid report (if any), corrigendum and any further updates will be available on NIT, Warangal website and Central Public Procurement Portal.
5. **The Detailed Tender Document with all terms & conditions and Annexures is enclosed.**

NIT Warangal shall not be responsible for non-receipt bid due to internet issues or any other reasons.
For any issues related to tender please contact Store Section. Tel. +0870-246 2910 Ext 2917, 2918 Email; dr_ps@nitw.ac.in, cssupdt@nitw.ac.in

Yours sincerely,

Deputy Registrar
For and on behalf of the Director, NITW
(The Purchaser)

SECTION-1
SCHEDULE OF TENDER

SI. No.	Event	Date and Time/ Remarks
01	Commencement of Downloading of Tender Document	Refer to critical dates on tender details page on http://eprocure.gov.in/eprocure/app
02	Bid Submission Start Date	Refer to critical dates on tender details page
03	Last date & Time of Submission of Bids Online (Technical and Financial Bid)	Refer to critical dates on tender details page
04	Date & Time of Opening of Technical Bids	Refer to critical dates on tender details page
05	Date of Completion of Examination of Technical Bid	To be declared on http://eprocure.gov.in/eprocure/app
06	Date & Time of Opening of Financial Bid	To be declared on http://eprocure.gov.in/eprocure/app
07	All the communications with respect to the tender shall be addressed to:	Deputy Registrar Purchase & Store Section Contact No.: 0870-246 2910 Email :dr_ps@nitw.ac.in
08	For taking assistance, if any	CPP Portal website: www.eprocure.gov.in CPP Portal Help Desk Toll Free No.: 18002337315, 180030702232

Note:

- If the tender is not opened on the above date, due to unforeseen circumstances, then the next working day will be considered as tender opening date.

SECTION-2
PRE QUALIFICATION CRITERIA

Sr. No	Details	Compliance Yes/No	Remarks
1	Bidder must be an Authorised Distributor / Dealer / Re-seller for the Product being offered and must be dealing in the bid item for the last 3 years. (Certificate of Incorporation/ Registration/ Authorization by OEM should be attached)		
2	Bidder Acceptance of Tender Document as per **Annexure-1** attached.		
3	Bid Security declaration as per **Annexure-3** attached.		
4	The Bidder/OEM must have supplied similar software to any of the Govt. Organizations/PSUs/ or CFTIs or any other Government Research/Educational Institutions. Copies of PO must be enclosed along with the bid (Duly filled **Annexure-4** alongwith Purchase orders and satisfactory performance certificates should be attached)		
5	The average annual financial turnover of 'The bidder' during the last three years, ending on 31st March of the previous financial year, should be at **Rs. 60 lakh** as per the annual report (audited balance sheet and profit & loss account) of the relevant period, duly authenticated by a Chartered Accountant/Cost Accountant in India or equivalent in relevant countries.		
6	**Delivery Period:** The material should be delivered within **30 days** from the date of receiving the purchase order.		
7	**Warranty:** One Year with TECS.		
8	**Installation and Commissioning:** Installation & Commissioning to be done at the purchasers premises within the scheduled delivery period**.**		
9	**Training:** 1. Ansys Structural Physics (Ansys Mechanical): 2 Days 2. Ansys Computational Fluid Dynamics Physics (Ansys CFD): 2 Days 3. Ansys Low Frequency Electromagnetics Physics (Ansys Maxwell): 2 Days 4. Ansys High Frequency Electromagnetics Physics (Ansys HFSS): 2 Days		
10	Whether firm is MSEs Unit: If YES, then please Specify the category of ownership: SC/ST or Women: (Please Submit the Documentary Evidence for UAM and ownership details.)		
11	Whether the goods offered are from a country which shares a land border with India		
12	If Yes, the details of Registration with Department of Promotion of Industry & Internal Trade (DPIIT), Government of India.		
13	Vendor should not have been black listed by any Govt. agency or institution		

Note: Bids not complying with the above pre-qualification criteria and non-submitting of the required

documents, lacking the clarity in specification are liable to be rejected.

SECTION-3
DETAILED SPECIFICATIONS / SCOPE OF THE SERVICES

SUPPLY, INSTALLATION & COMMISSIONING OF "ANSYS ACADEMIC MULTIPHYSICS CAMPUS LICENSE WITH ONE YEAR TECS"

Ansys Academic CFD Bundle

The Ansys Academic CFD Bundle should contain the following

1) Fluent (with fluent meshing)
2) CFX
3) Turbogrid
4) Polyflow
5) Forte
6) Chemkin
7) Fensap Ice
8) Ensight Enterprise
9) Blade Modeler
10) Discovery Modeling / Spaceclaim
11) Discovery Simulation
12) Electronics Premium Icepak
13) Ansys Granta mechanical data for simulation
14) Optislang Enterprise
15) Spaceclaim
16) Ansys Workbench meshing
17) ICEM CFD
18) Design Xplorer
18) Built in HPC 16 Cores License

Capabilities

Geometry Modeling Capabilities

- The CAD modeler with below built-in pre-processing capabilities in same GUIenvironment, like:
  - (i) Part/Design Modelling
  - (ii) Assembly Modelling
  - (iii) Sheet Modelling
  - (iv) Detail Drawings
  - (v) CAD Simplification and CAD Cleaning
  - (vi) Working on Faceted Data \Triangulated Surfaces (STL Files), and/or convertingthem back to 3D CAD

(vii) Block Structured, Geometry Decomposed Structured and Unstructured Meshing
(viii) Photorealistic 3D Rendering and Animation with KeyShot.
(ix) Python Scripting

- Geometry Data Import Options should accept all industry standard formats, such as ACIS, AMF, DXF, DWG, IDF, IGES, OBJ, Rhino, SketchUp, STEP, STL, CATIA v4, CATIA v5, CATIA v6, Inventor, Pro/ENGINEER, VDA-FS, NX, Parasolid, Solid Edge, and SolidWorks, ANSYS, ECAD, Fluent Mesh, and ICEM-CFD.
- Geometry Data Export Options should support various industry standard formats, including ACIS, Acrobat 2D & 3D (lightweight), AMF, DXF, DWG, IGES, KeyShot, Rhino, SketchUp, STEP, STL, VRML, OBJ, XAML, Bitmaps, VDA-FS, and Parasolid.
- Creation of design parameters on imported and/or modeled geometry to aid exploring multiple design options during optimization of designs through analysis.
- The software should have design modes, such as Sketch Mode (2D & 3D), Section Mode, and 3D-Mode, to build/work on the CAD model in all three modes.
- It should include Sketching and Editing Tools for efficient modeling.
- Full part and assembly modeling capabilities.
- Tool should be capable of performing Equations based surface creation.
- Detailed drawings, including full 2-D/3-D GD&T (Geometric Dimensioning and Tolerancing).
- CAD modeling options like Pull, Blend, Move, Fill, and Combine to simplify the modeling process.
- An option to extend the selection of objects/entities that are similar or related to the currently selected object.
- Ability to create watertight solids by stitching up surfaces (identifying disconnected faces & connecting them), filling gaps (identifying& healing gaps) or\and holes (identifying & healing the missing faces).
- Features to check geometry validity and ensure design accuracy.
- Repair tools for cleaning/simplifying geometry, such as fixing Missing Faces, Free Faces, Small Faces, Small Edges, Hard Edges, Simplify, Inexact Edges, Rounds, Interference, andShort Edges, which are essential for high-quality mesh generation.
- Features for extracting internal fluid volume and/or creating a flow domain.
- The ability to work directly on triangular facet data (like STL files) to clean up and enhancesurface quality or convert back to CAD. Additionally, measuring the deviation of a surfaceto faceted/CAD data should be possible.
- Easy conversion of DXF/DWG files into 3D data.
- Supports Direct Modeling, Dynamic Editing, and Additive Manufacturing processes.
- It should be able to edit and modify the existing features of models/designs without creating sketches regardless of where the model was created, whether imported as a neutral format or created in any major CAD package.
- Capability to create and find topology sharing/contacts and interference among objects

for precise analysis and design verification.

- Support for mouse gestures to enhance user productivity.
- Accurate wrapping of electric traces to any substrate shape for electronics design.
- The ability to fly through designs from the inside out, exploring inner details without hiding components or using cross-sections.
- Automatic unfolding of virtually any sheet metal parts, with the option to export to DXF/DWG format.
- Scripting capabilities in Python language, which can help automate 3D modeling/editing tasks and overcome receptivity challenges.
- Viewing and reviewing CAD files in a web-based environment for collaborative work.
- The ability to generate Hex mesh based on Geometry Decomposition, Block Decomposition, and Bounding Box Blocking within the same GUI of the Geometry Modeler.
- Photorealistic 3D Rendering Capabilities using KeyShot for advanced visualizations.
- The BladeModeling capabilities, offering specialized capabilities in turbomachinery blade design, including turbo-specific CAD geometry creation, unified CAD definitions for both Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA), flow path and blade geometry generation, creation of variable radius blade blends with high fidelity, design of splitter blades, and the ability to produce flank-milled blades.
- Should have ability to get first cut solution for a model without generating any mesh
- Geometry interfaces for Parasolid, SAT, Solidwork, SolidEdge, Autodesk, NX, CATIA V5& V6, Creo parametric and Elements/Direct Modeling, JT are supported.

Meshing / Pre-processor Capabilities

- Should be capable of generating various types of meshes, including Quadrilateral, Triangular, Hexahedral, Tetrahedral, Polyhedral, Prism, Pyramid, and Mixed elements using one or more modules/methods.
- It should have an automatic meshing process with physics and solver-based refinement controls for efficient mesh generation.
- The mesh should be independent of the underlying surface topology, allowing defeaturing of geometry based on virtual topology, mesh, and pinch controls.
- The ability to match the mesh for periodic faces is essential for certain analysis scenarios.
- The software should offer various volume and surface mesh methods, such as Tetrahedral meshing methods like Patch Conforming Algorithm and Patch Independent Algorithm, and Hexahedral meshing methods like General Sweep Method, Thin Sweep Method, Multizone Method, Hex Dominant, and Cutcell Cartesian Method. It should also include Surface (Shell) Meshing options like Quad Dominant, Uniform Quad & Tri/Quad meshes.
- The user should have control over mesh at different levels, including global settings like physics preference, advanced size function refinement (Curvature, Proximity, Fixed), transition/growth settings of boundary/surface, smoothing settings, quality settings, and boundary layer settings. Local controls at the region or boundary level should allow

specifying mesh method, sizing, sphere of influence, curvature-based refinement, and contact sizing.

- A dedicated module for generating multi-block structured meshes with scripting capabilities, along with the ability to create o-grid, tetrahedral (hybrid) meshes with prism layers.
- A dedicated module for generating high-quality hexahedral meshes for Turbomachines should be available.
- Within the Solver GUI, there should be a dedicated module for generating unstructured meshes, including Tetrahedral, Polyhedron, and Hexcore meshes (Tet-Hexcore & Poly-Hexcore) with robust surface wrapper & remeshing tools. It should include size functions optimized for CFD calculations, tools for checking, repairing, and improving boundary mesh, and the ability to create meshes directly from faceted geometry or existing meshes. These meshes should be able to be glued together, and the software should utilize parallel processing for generating 3D meshes on High-Performance Computing (HPC) systems without additional cost/licensing.
- The availability of advanced algorithms like Mosaic-enabled poly-hexcore is essential, as it facilitates parallel distribution at all stages of volume meshing. This parallel processing should be utilized for cells in the viscous boundary layer, Cartesian core, and polyhedral cells connecting the boundary and core cells simultaneously, across different partitions in parallel processing.
- Should be included with Dynamic Meshing with various algorithms, including remeshing, layering, smoothing, and overset to handle complex problems like moving meshes effectively allowing users to update the mesh within the session, eliminating the need toswitch to external tools and enhancing user-friendliness.
- Should also include Immersed-solid/MST method for moving parts.
- The software should be scriptable for batch execution to enhance automation and productivity.
- Dedicated object-based workflows should be present for clean & dirty non-watertight CAD for volume mesh generation, like Watertight CAD and Fault Tolerant CAD Workflowsto enhance productivity.

Post-Processor

- The CFD solver should have an intuitive GUI integrated within it, featuring standard viewer controls for various visualization tasks, such as creating Isosurfaces, generating Contours, Velocity Vectors, and Pathlines, Displaying Scenes i.e. composing multiple results like Vectors, Contours overlaying Pathlines, creating Exploded Views, Animations (including sweep animation), and displaying results in successive streamwise planes. TheGUI should also enable generating XY-Plots and surface & volume integral reports.Additionally, the software should allow data export to other formats, including ABAQUS,ASCII, CGNS, CFD- Post, EnSight, EnSight Case Gold, Fieldview Unstructured, I-DEAS Universal, Mechanical APDL, NASTRAN, PATRAN, TAITherm, and Tecplot. Automation through scripting should be supported for both Graphical and Numerical Post Processing.

Standard and user- defined color-maps, the ability to provide external forces & momentson overall wall surfaces and along the length of wall surface, and advanced visualization options should be available.

- The general & all-purpose post-processing tool to analyze CFD/multi-physics simulations, featuring the capability to compare cases, and offering volume rendering options. Furthermore, there should be another dedicated tool to extend post-processing capabilities to consolidate data from multiple engineering simulations and other sources, facilitating the exploration of complex systems and processes. This tool should handle simulation data from various physics, including CFD, Structures, FEA Crash, Electromagnetics, DEM, Rigid Bodies, and other simulation data. Additionally, it should support Fluid-Structure Interaction post-processing within the same GUI, enabling batch operations through Python scripting or interactive operations with local data or client- server utilization.
- The software should provide an option to share and analyze results as viewer files supporting various interactive features, including zoom, pan, and rotate in 3-D, creating cross-sections, exploding multi-part models, highlighting, showing, and hiding individual parts, annotating in 2-D and 3-D, saving, and reloading views, and playing a sequence of images. Moreover, the viewer file should support embedding in PowerPoint presentations and word documents, enabling visualization of simulation models and data for effective communication.
- Post-processing capabilities in the simulation software should include enabling parallel processing, allowing for faster and more efficient analysis of simulation data across multiple computing cores or nodes. Additionally, the post-processing tool should be capable of handling data from different physics simulations, enabling users to analyze results from various simulation types within the same software. Moreover, Python scripting support should be provided to empower users to automate tasks, customize workflows, and streamline their post-processing operations.

Design Exploration / Optimization

- The software should allow the selection of design parameters on geometry irrespective of the CAD source (should support the widely used neutral & commercial CAD file formats). These parameters can be altered during Design of Experiments (DoE) studies or optimization, ensuring bi-directional associativity between CAD and CFD (Computational Fluid Dynamics) for seamless design iterations.
- The platform should offer the ability to perform Design Point Studies within the same technology, giving users the option to retain only the output parameters or the entire simulation results for further analysis and comparison.
- It should include essential tools for correlation, design of experiments, response surface creation and analysis, optimization, and six sigma analysis, enabling comprehensive exploration and improvement of designs based on simulation results.
- The software should be capable of generating Reduced Order Models (ROM) from the simulations, allowing users to create simplified representations of complex models without compromising accuracy. ROMs are beneficial for faster simulations in later stages of design exploration.
- Additionally, the platform should provide an Adjoint Solver specifically for Shape/Topology Optimization. This solver should allow for morphing the mesh to optimize the

shape or topology of the geometry based on simulation results, enhancing the design performance.

- The CFD solver should offer parametric exploration capabilities, allowing users to conduct systematic studies by varying simulation parameters within the solver itself. These parametric explorations should also be usable for 3rd party applications, enabling integration with external tools or Design of Experiments (DOE) data, for a comprehensive analysis of simulation results. Additionally, the CFD solver should support ACT apps provided by the original equipment manufacturer (OEM), allowing users to access and utilize additional specialized tools and functionalities to enhance their simulation workflow.
- The software should iteratively explore different design variations without generating a mesh for the preliminary shape optimization of model to get optimal design solution in less time.
- The software should feature a specialized workflow tailored for parametric design, exploration, and optimization to facilitate sensitivity analysis, design refinement through optimization, robustness assessment, model calibration, generation of Reduced Order Models (ROM), and seamless integration with both ANSYS and non-ANSYS tools. This comprehensive approach enables the delivery of efficient and effective solutions for diverse optimization processes.

High Performance Computing

- The software should support Parallel Solving on both local PCs and over a network, with no additional cost for up to 4 cores+ additional 12 floating cores per research task, enabling faster simulations.
- It should have support for both CPU and GPU, leveraging the computational power of GPUs foraccelerated simulations whenever available.
- The software should provide a utility for launching both serial and distributed parallel jobs directly from Windows desktops, simplifying the process of running simulations.
- Utilities for load management via third-party software (such as LSF and SGE) should be available, allowing users to efficiently manage computational resources and optimize job distribution. In the absence of 3rd party load management, there should be in-house job monitoring/managementutilities.
- The software should make use of vendor-optimized message passing libraries, ensuring efficient communication between computing resources, and enhancing simulation performance.
- Users should have the option to flush file cache buffers, helping to maintain data consistency and performance during simulations.
- The software should include a client application that allows dynamic interrupting, restarting calculations, modifying the problem setup, or reporting the results for the running simulation (standalone or batch job or job submitted through scheduler) at any time, without exiting or stopping the active session. This feature enables greater flexibility in managing ongoing simulations and making real-time adjustments.

Physical Modeling Capabilities

Basic Capabilities

Feature	Description
Solvers Type	• The Solver should come in Bundles, enabling the CFD solver to be utilized as a Python model/object and with aaS (as-a-Server) capability, allowing coupling with external programming tools such as Matlab or Python for co-simulation and multidisciplinary analysis. Inbuilt Adjoint Solver should be present. • Leveraging integration with Python to develop custom workflows and automated solutions, requires 1-time internet connectivity. • Live results of Mechanical, Fluids, Electromagnetics simulations
Flow Types	• 2D and 3D flows, including steady-state and transient flows, covering all speed regimes (low subsonic to hypersonic), and supporting laminar, turbulent, and transitional flows.
Turbulence Models	• Full range of turbulence models, including Zero, one-equation models and Two-equation models such as K-epsilon (Standard, k-ε, RNG k-ε, k-ω, BSL, SST), Reynolds Stress Model, RST (second-moment closure): LRR, SSG, QI, ω, BSL Detached Eddy Simulation, Delayed Detached Eddy Simulation, Scale Adaptive Simulation, Large Eddy Simulation such as Smag or insky, dynamic, WALE, and Embedded-Large Eddy Simulation., SBES/SDES hybrid RANS-LES models with automatic blending functions. Explicit algebraic Reynolds stress models (EARSMs): k-ε, BSL. Scalable wall functions and automatic near-wall treatment with integration to the wall, User-defined turbulent wall functions and heat transfer, Rough wall treatment for ω-based models, including with transition , Curvature correction for swirling flow for two- equation models, Detached eddy simulation (DES)p, Scale adaptive simulation (SAS)p, Predictive Menter-Langtry $\gamma-\theta$ laminar-turbulent transition model. • Tuning/customizing RANS k-ω model using Adjoint Solver and Machine Learning.
Boundary Condition Specifications	• Inlets- Subsonic, supersonic, and mixed (combined subsonic and supersonic), Velocity, mass flow and flow direction, static pressure and direction, total pressure and direction, velocity and static or total pressure

Feature	Description
	(Supersonic), static pressure and total pressure and direction (supersonic), zero gradient, Total temperature, total enthalpy, static temperature. • Outlets - Subsonic and supersonic - Mass flow (with pressure profile or circumferential average pressure profile), velocity, uniform static pressure, average static pressure, radial equilibrium pressure distribution, circumferential average static pressure, degassing condition, meridional pressure profile, supercritical, zero gradient, pressure far field, and outflow conditions. Non -reflecting boundary condition. • Opening (mixed inflow/outflow) - velocity, total (in)/static (out) pressure and direction, static (in)/static (out) pressure and direction, local flow direction or entrainment • Wall - No slip, free slip, finite slip, specified wall shear, smooth, rough, moving, adiabatic, temperature specified, heat flux specified, heat transfer coefficient and reference temperature specified, opaque, black body, radiation intensity. • Symmetry • Thin surfaces/baffles • 1-D or 2-D profile specifications for any quantity using C Functions or Expressions.
General Grid Interfaces	• Connection of multiple meshes from independent sources with precise boundary condition control at non-overlapping portions. Rasterized or direct mesh intersection algorithms for accurate multi-domain and domain interface models. • Translational and rotational periodic connections, including options for pressure change or mass flow rate. Fluid-solid interfaces with pitch and shape change capabilities. • Porous domains with conservative algebraic fluid-porous interfaces. Thin surfaces between fluid and solid domains for modeling conduction, thermal contact resistance, coatings, and additional variables transfer. • Stationary and rotating frames of reference with an alternate rotation velocity advection model. Multiple frames of reference interface models, such as stage interface, frozen rotor, and transient rotor/stator interface models. Profile Transformation model for transient blade row simulations with pitch change.
Heat Transfer and Radiation	• Capabilities for conduction, convection (forced and natural), radiation modeling (including various models and effects like discrete ordinate, P1, view factor-based approach, particle effects, soot effects, etc.), and phase

Feature	Description
	change heat transfer (condensation, evaporation, boiling, solidification/melting). • Thermal energy and total energy ,Natural convection (buoyancy), Viscous heating, Conjugate heat transfer (CHT) solids , Porous CHT domains, Advection in rotating and translating CHT solids, Gray, multi-band, and multi-gray (weighted sum of gray gases) spectral models ,Spectral material property dependencies, Radiation scattering, Radiation models such as P1 (diffuse), Rosseland, Discrete transfer for participating media and surface to-surface radiation, Monte Carlo for participating media and surface-to-surface radiation.
Multiphase Modeling	• Multiple multiphase modeling options, such as cavitation models, mixture model, Eulerian-Eulerian model, Eulerian-Granular model, Lagrangian Dispersed phase model, Dense Dispersed phase model, Volume of Fluid model for free surface flow, and non-shared velocity formulation for Volume of Fluid model. • Ablation model. • Eulerian MP models, Homogeneous or fluid-dependent mass and momentum Equations, Homogeneous or fluid-dependent turbulence equations, Homogeneous or fluid-dependent energy equations, Unlimited number of phase, Drag force model such as Schiller–Naumann, Wen Yu and Gidaspow drag models for solid particles. Singhal model ,Zwart-Gerber-Belamri model , Schnerr and Sauer model .Ishii–Zuber and Grace drag models for drops and bubbles General user-defined drag coefficient Non-drag force models, Lift force models, Turbulent dispersion force model, Virtual mass force model Wall lubrication models and Solids pressure force model-
	Software should have capabilities of hydrogen simulation including models for green hydrogen production, hydrogen consumption in fuel cells, and validated models. - A new Proton Exchange Membrane (PEM) and alkaline electrolysis models for green hydrogen production. - Extended Polymer Electrolyte Membrane (PEMFC) and Solid Oxide (SOFC) models for hydrogen consumption in fuel cells. - Validated models for hydrogen combustion.

Combustion Modeling	• Extensive combustion modeling capabilities, including fast chemistry and finite rate chemistry models, pollutant formulation models (NOx, soot, SOx), discrete phase combustion, engine ignition, various breakup models,surface reactions, and more.
6DOF Solver	• Rigid body six degree of freedom solver for accurate motion calculation of the store with rotation, translation, dynamic mesh, flow-driven solid motion, and numerical methods for Navier-Stokes equations using pressure-based and density-based solvers.

Feature	Description
User Defined Functions	• Capability to modify solver using User Defined Functions or User Fortran, Expressions, access to memory for user-defined functions, volumetric sources specification, custom physical properties, user-defined density, customized boundary/initial conditions, and more. UDF should be capable to deform or manipulate the surface of a geometry during the simulation.
Material Properties	• Handling constant or variable fluid properties, comprehensive database with user-modifiable material properties, custom database creation, and support for temperature and composition dependence. • Unrivaled, diverse catalog of materials reference data, combined with flexible materials selection and data management software.
Mesh Manipulation Capabilities	• Ability to handle unstructured mesh with various element types, non-conformal mesh interfaces, mesh smoothing and improvement tools, transportation equation-based mesh smoothing, hybrid mesh generation, grid-to-grid solution interpolation, mesh morpher and optimizer, and Cartesian re-meshing.
Acoustics Modeling	• Broadband noise model, FWH model, and CAA model for acousticsimulations.
Chemical Reaction Modeling	• The integrated capabilities of this CFD package offer a comprehensive solution for advanced chemical reaction modeling. With features like species transport, finite-rate chemistry, and multiphase reactions, pollutant, and soot modeling, along with plasma reactions and surface kinetics. • Dynamic cell clustering and adaptive chemistry, the ability to use model fuel library mechanisms and predict flame speeds. • Internal combustion engines specific solutions, 0-D/1-D/2-D Reactor Models and Reactor Networks • Reaction analysis, mechanism reduction, and surrogate blend formulation
Ice Accertion Modeling	• Comprehensive suite of capabilities for ice accretion simulation and analysis covering a range of icing environments, including standard droplets, SLD, and ice crystals, while considering vapor/humidity effects. • The software should enable simulations in compliance with Appendices C, O, and D icing conditions, encompassing rime, glaze, and mixed icing scenarios.

Feature	Description
	• Should support single and multi-shot icing simulations with mesh deformation and automatic re-meshing, predicting ice accretion and aerodynamic degradation. • Should facilitate Conjugate Heat Transfer (CHT) for anti and de-icing simulations, accounts for ice cracking, and models ice shedding events.
Electronic Coolingsolution	• Capable to handle types of heat transfer: Conduction, Convention and radiation: Combination of all modes of heat transfer • Import of mechanical 3D models: o Should be able to import CAD geometries from solid works, PRO_E. Auto Cad, etc. and should be able to cleanup and simplify the CAD models if needed. o Should be able to identify electronics objects from the imported CAD geometry and convert them automatically in native objects o Should be able to maintain bi-directional connectivity with CAD software's o Should be able to handle STEP, IGES, ACIS or Para solid formats. • Import for ECAD-and PCB models: o Should be able to import PCB models along with board, vias with layers connectivity from software's like cadence, Allegro, Cadstar etc. o Should be able to import gerber, gds, ODB++, AEDB files. o Should be able to import and model traces with complete details. o Creation of models: o Should be able to build components required for cooling of PCB along with details such as vias, layers, Packages, Sources, heat sinks, Vents, fans, filters etc. • Libraries: o Materials: ▪ Metals like aluminum, aluminum alloys, copper, nickel gold etc. should be available. The different types of material grades and conditions of aluminum namely HE30, HE 15 etc. to be available. ▪ Data base of non-metals like ceramics, polymers, laminates, glasses,minerals should be available. ▪ Components: Inbuilt package libraries like TO-220, SOIC, TO-241, SIP, DIP, FPGa's, CPLD's etc. to be provided. ▪ Thermo-Electronic coolers: Data base of single & multistage TEC to be provided.

	▪ Data base of interface materials like thermal components (manufactures like 3M, Aavid, etc) to be provided. ▪ Heat sinks: Standard heat sinks of different manufactures like Aavid, Thermshield etc to be provided. Minimum of 500 No's of heat sink database to be provided. ▪ Database of two-resistor components to be available. ▪ 2D & 3D heat source elements for power generation devices. ▪ Ability to create custom-built database and libraries to be provided. • Post Processing: o 2D & 3D color shades of temperature at various planes and locations: Result at any particular point should be available even though monitoring points are not marked before start of simulation. o Ability to perform the post processing of multiple projects in single window for comparison o Ability to perform automatic post processing for similar cases in case of parametric trials. o Isosurface contours to locate min & Max variable quantities o Contours on various cutting planes (x,y,z & user defined planes). o Summary options to build custom summary reports o Automatic generation of summary report in MS office • Types of flow: o Laminar, transition & turbulent flows to be available o Ability to model multiple fluids to be available. • Simulation: o Transient, steady state and parametric analysis to be available o Joule heating in objects with temperature dependent properties supported o In case of transient simulation, ability to model variables as a function of time should be available. o Capability to parameterize all geometry details, material properties, boundary conditions and even make the objects active and in-active. o Ability to perform optimization on any of the variables like: material properties, object location, power dissipation, presence and absence, turbulence models, flow regime etc. • Materials: o Constant and variable input material properties Variable resistance, temperature dependent resisting modeling. • Multiphysics Simulations:

	○ Bi-directional coupling with SIwave for electro-thermal analysis with automatic transfer of power dissipation on PCB along with temperature dependency on material properties ○ Bi-directional coupling with Q3D, Maxwell, HFSS for node to node EM loss mapping and coupled electro-thermal simulation ○ Bi-directional coupling with Mechanical for thermo-structural analysis • Importing of Chip Thermal model powermap from Apache Redhawk for accurate power dissipation from chip level tool along with die level metal distribution
Parallel Computing	• Support for parallel processing on shared and distributed memory systems, faster file I/O in parallel, automatic load balancing between cores based on mesh count or physical models.
Built-in Modules	• Ability to import a large assembly into the app for viewing the assembly, search and select any sub-component to "move" into the built-in CAD Modeler, Automatic Shape Optimization, ROM Extract, and the ability to load any app written/developed in the same ecosystem.
Multi-Physics	• Co-simulation capability with in or external of the tool to connect with structural and electromagnetic tools, server software development kit for local or remote client applications to connect and communicate with CFD solver (coupling with Python or Matlab), and ability to perform communications for geometric modification during optimization or DoE studies between the CAD package and CFD tool. Capability to transfer data from different software for multiphysics applications within a common framework, facilitating Structural, Thermal, and Electromagnetics calculations.
Intrinsic Fluid Structure Interaction(FSI)	• One-way FSI coupling with solutions for steady-state analysis. Two-way FSI capability for transient or steady-state analysis with moving/deforming geometry. Conservative profile-preserving interpolation for fluid dynamic forces and heat flows in the FSI analysis. Everything solving inside CFD solveronly without any additional license.

Feature	Description
Software architecture	• Ensure the presence of an innovative project schematic that facilitates connecting different projects in a flowchart form for efficient data transfer between physics and imported loads in downstream applications. Implement a drag & drop Multiphysics concept to enable tight integration between component applications, simplifying setup and solution of complex Multiphysics simulations with ease. • Design the analysis systems to be persistent and straightforward, guiding users seamlessly through the analysis process from top to bottom. Ensure the platform supports parametric variations, allowing users to explore different design scenarios by adjusting CAD parameters, material properties, boundary conditions, and derived result parameters using a tabular design point approach. Incorporate an automatic project level update feature that efficiently manages the execution of required applications to update the project automatically, significantly reducing the cost of performing design iterations.
Numerical Scheme	• Utilize the Finite-Volume Method based on fully unstructured meshes for solving the Navier-Stokes equation. • Implement the adaptive time stepping option for implicit schemes in the numerical solver. • Allocate dynamic memory appropriately for the computational process. • Employ the Non-Iterative (NITA) transient solution options for efficient and accurate simulations. • Apply the Pseudo-Transient Relaxation method to improve convergence during computations. • Ensure conservation of the rothalpy transport equation during the solving process. • Choose between Pressure-Based and Density-Based solvers based on specific requirements. • Implement the Pressure-Based Segregated Solver for solving the Navier-Stokes equation. • Use decoupled solutions for all mean flow qualities in the Pressure-Based Segregated Solver. • Select either first-order or second-order implicit time discretization schemes for the solver. □

Extensive Customer Support

Customer support with online and offline documentationOn-Line Help

Users should take advantage of the software's extensive help manuals, covering installation procedures, verification and validation processes, user guidance on underlying theories and applications, tutorial examples, text user interface instructions, and user-defined functions and customization guides. Furthermore, users should make use of the complete online documentation, which includes helpful videos and grants access to the customer portal. Theyshould utilize this portal to download the latest product release and find solutions for variousqueries.

Offline-documentation access

The software should provide offline documentation access, which should include user guides, tutorials, and reference manuals. Users should be able to download the documentation package from the Customer Portal or Help Viewer and access it without an internet connection. This feature should allow convenient browsing and searching for relevant information offline, ensuring access at any time.

Workbench Framework

The software should be equipped with the Workbench Framework, a powerful simulation environment that integrates various tools and solvers in a unified user interface. This framework should enable seamless data transfer between different applications, allowing for efficient pre-processing, solving, and post-processing of simulations. Additionally, it should support parametric capabilities for design optimization and sensitivity analysis, streamlining the workflow and promoting collaboration between different engineering disciplines.

Sl.No.	Details
1	**Innovative Project Schematic**: The innovative project schematic within the Workbench platform changes the way engineers work with simulation. Projects are represented as connected systems in flowchart form. Engineering intent,data relationships and the state of the analysis project can be understood briefly.
2	**Automatic Transfer of Data:** The workbench should host a set of systems (Any analysis, be it CFD, FEA, can be system). Connecting one system to a compatible system requires only just a click of a button. Once the CFD results are connected to FEA system and proper surfaces are selected, the data will be shared automatically. This reduces the manual labor tremendously by avoiding manual file management
3	**Integrated Parameter Management:** The applications hosted in the Workbench platform support parametric variations, including CAD parameters, material properties, boundary conditions and derived result parameters. Parameters defined within the applications are managed from the project window, making it easy to investigate multiple variations of the analysis. From within the projectwindow, a series of design points can be built up in tabular form and executed to complete a what-if study with a single operation
4	**Automatic Project Level Update:** Changes can be made to any portion of the analysis, and the Workbench platform will manage the execution of the required applications to update the project automatically, dramatically reducing the cost of performing design iterations.

TECHNICAL SPECIFICATIONS

S.NO	Technical Specifications Ansys Academic Research HF HFSS Package
1	**Technical Requirement For HIGH-Frequency Simulation Package** • The package should have the capability to simulate any arbitrary 3D model or planar PCB structure to capture its electromagnetic performance. It should also have the ability to integrate multiple electromagnetically analyzed models to carry out a system-level analysis. • HFSS, Designer, Q3D Extractor,Siwave, EMIT, EMCPLUS,Optimetrics,SBR+
2	Numerical Solver Technology:HFSS . SBR , SIWAVE The tools should have: • 3D full-wave Frequency Domain-based electromagnetic field solver based on the Finite Element Method (FEM). • 3D full-wave Frequency Domain-based electromagnetic field solver based on Integral Equation Method (MoM). • 3D full-wave Time Domain-based electromagnetic field solver based on Discontinuous Galerkin (DG) and FEM Time Domain Methods. • 3D full-wave Frequency Domain-based Asymptotical electromagnetic field solver based on Shooting and Bouncing Ray + (SBR+) method. • 3D full-wave Frequency Domain, Eigen Mode Solver, based on FEM • 3D Full-wave Frequency Domain Characteristic Mode Analysis Solver based on MoM • 3D Multipaction solver for finding RF breakdown inside High Power RF components • 3D simulation tools support Hybridization FEM, IE and SBR+/PO solver in a single design. • 3D HF solver should combine FEM + IE (Integral Equation) + SBR • 2D Low Frequency Electromagnetic Solver (Static and Transient) for Motor, Transformer, Actuators, bus bar, etc. • 2D EM solver for Transmission line, for Analyzing cross section of different Transmission models • 1D Power Spectral Based solver for finding RF interference between different Microwave system • System-level solver for Integrating physics-based model with multi-domain based components, Power Electronic circuits, etc. • ID circuit simulation capability for following RF simulations o Linear analysis o DC analysis o Oscillator Analysis o Harmonic Balance Analysis (1-Tone and N-Tone) o Transient Analysis o Time Varying noise Analysis o Phase noise Analysis o Multi-tone harmonic balance analysis o Envelope analysis o Load pull analysis and model support o Periodic transfer function analysis • SBR+ solver should automatically combine following asymptotic methods to arrive at an accurate solution o Physical Optic (PO), o Geometrical Optic (GO),

- Physical Theory of Diffraction (PTD),
- Uniform Theory of Diffraction (UTD),
- Creeping Wave (CW)

- The asymptotic solver should enable all SBR solver like PTD, UTD, and CW in a single simulation
- PO and SBR+ asymptotic solver should support lossy dielectrics
- SBR solver should support multilayer dielectrics
- FEM frequency-domain solver should have the capability to simulate even in THz region for applications such as metamaterials, FSS etc.
- There should be an option of using 2.5D MOM or FEM solver to analyze planar layouts.
- There should be a capability to solve just the 2D cross-section of transmission lines to extract its characteristic impedance.
- Automatic and adaptive meshing capability requiring minimal user input.
- Tools should include Antenna Design toolkit with (60+) antenna models
- Solution convergence and control:Convergence based on S parameter, field quantities or user-defined expressions
- The software should have the capability for adaptive meshing across different frequencies of broadband structures.
- Eigenmode solver should be able to find the natural resonances and quality factor of the lossy structure.
- The solver (FEM) should have an option to

  - physically divide the simulation model into the different sections
  - Enable parallel meshing and solving for each section individually
- Solver has the capability for solving a single unit cell of an array for Active Element Patterns using Periodic Boundary Conditions
- The solver should have the ability to create and solve Finite Array Simulation by combining different types of unit cells.
- Finite Array simulation should support features like Array Mask creation for arbitrary sparse array configuration.
- Scattered field simulation for solving RCS problems. Provision for both bistatic and monostatic RCS along with incident field excitations.
- RCS calculation should be able to conduct with FEM, IE and SBR+ solvers
- RCS simulation using SBR solver should automatically combine additional solvers like PTD, UTD and CW in a single design

- Broadband frequency sweeps with the capability to take into account dispersive ports, materials and skin effect.
- The IE and SBR should have an option to create an ISAR image, Near Filed Radar ROM (Waterfall plot) of the Radar target

- Mulitpaction solver should support multiple port simultaneous excitations for RF breakdown analysis

- Basic Solver should enable 16 cores HPC (High Performance Computation) capability.
- Built-in Antenna model for RF interference and SBR+ simulation: Short Dipole, Half-wave dipole, Quarter wave Monopole, Pyramidal Horn, Small Loop, Parametric Beam Antenna, Wire Monopole
- SBR solver should have the ability to simulate Radar Simulation
  - Able to incorporate multiple transmitting and receiving antenna
  - Able to create Radar simulation scenarios
  - Scenario simulation with respect to time
  - Calculate Range, Velocity and Angle of Arrival
- Power Spectral solver should provide following RFI matrics across

	multiple Transmitter and Receiver platform: EMI Margin, Sensitivity, Availability, Desense, Noise In-Band EMI Margin • Power Spectral solver should provide RF interference of Mulitple Transmitter to the single receiver. • Power Spectral solver should support Non-Linear Interference Effects in RF interference analysis • 2D low-frequency electromagnetic solver should be able to o Extract Torque, Power, current variations o Capability to do the demagnetization study, help to extract Torque Speed characteristics o Inbuilt circuit solver to a model electronic circuit like inverters, rectifiers, etc and connect with 2D Electromagnetic model o Extract losses as output for CFD (Thermal) Analysis • System solver should have o Build power electronic circuits using IGBT, BJT, MOSFET, etc. o Capability to characterize semiconductor switches from manufacturer datasheet o Capability to do time and frequency domain simulations o Capability to co-simulate with physics-based models o Capability to import Reduced-Order Models generated for Physics-based simulations
3	Graphical User Interface for EM analysis The software package should have the following features: • Tools should have an option or toolkit to automatically setup simulations for following RCS/Radar simulation: Range Profile, ISAR, Range Doppler Prcoessing and waterfall. • The tool should have an option to encrypt the 3D component, which a user can share with others without revealing the IP • The tool should have an option to import/export encrypted/unencrypted 3D component models for simulation. • The tool should have templates for setting up EMI EMC simulation like Radiated Emission, Conducted Emission, ESD, BCI • The tool should have the capability to model and parameterize any arbitrary 3D model • The tool should have the capability to do operations such as unite, subtract, intersect different objects to create a model • There should be a provision for creating equation-based curves/surfaces for creating more complex models. • There should be provision for wrapping sheets onto curved surfaces. • The software should have the ability to import, edit, simplify and parameterize 3D CAD models from third-party tools. • The tool should support the import of following 3D DATA: ACIS, Acrobat 3D, 2D PDF, AMF, AutoCAD, CATIA, Creo Elements/Direct Modeling, Design Modeler, ECAD IDF, IGES, Image Files, Inventor, JT Open, Acrobat PDF 2D, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image files, NX, Parasolid, Point curve text, Pro/ENGINEER • The tool should support the export of following 3D DATA: ACIS, Acrobat PDF 3D, Acrobat 2D PDF, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image Files, Inventor, JT Open, Keyshot, Acrobat PDF 2D, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image files, NX, Parasolid, Point curve text, POV-Ray, Rhino, SketchUp, SolidWorks, STEP, STL • The capability to clean up 3D CAD and detection tools for Short Edges, Overlap Faces, Corrupt Faces • The tool should allow users to edit STL files directly and leverage

	automatic repair tools
	• Options for cleaning imported 3D models
	  ○ Options for analyzing individual objects of the complete 3D model to locate any faults in the modelling
	  ○ Possibility to find inter-object misalignments
	• There should option for healing the geometry
	• Capability to import ECAD layouts format like .brd, .mcm, .sip, ODB++, IPC2581, GDS.
	• There should be provision to model layouts into a stackup based environment and simulate in the same environment
	• Layout interface should have options to change the stackup, trace widths, via and padstack.
	• PCB Trace modelling options in the Layout interface
	  ○ Surface roughness – Huray and Groisse
	  ○ Options for Etching

5	ptions
	• Use tetrahedron element for 3D models and triangles for sheet structures
	• Option to have curvilinear mesh elements for accurately solving curved geometries
	• Mesh Control
	  ○ Options to specify surface deviation, normal deviation and aspect ratio to control mesh density
	  ○ Ability to restrict the number of elements/size of the elements within an object or just on the surface of the object
	  ○ Skin-depth based seeding capability
	• Advanced capability like Assembly Meshing: Independent component meshing allows mesh reuse, no re-meshing in parametric variations, independent mesh settings for different components and more robust meshing for models with a significant difference in scale. Especially useful for Antenna Placement and scattering problems where mesh reuse can be done.
	• Phi mesher (Prism elements) for faster meshing of the planar structures.

6	Advanced Material Library which should include; • A comprehensive materials database containing permittivity, permeability, electric and magnetic loss tangents for common substances. • Users must be able to include anisotropic materials, ferrites, temperature and frequency-dependent material properties. Frequency-dependent material models like Debye and Djordjevic-Sarkar models to ensure that the material satisfies causality conditions. • Provision for Spatially dependent material properties and boundary conditions.

7	Excitation and Boundary Condition
	• Excitation for Ports SYZ parameter excitation
	  ○ Arbitrary internal and external ports – Waveport and Lumped Port
	  ○ Ability to solve all ports in one solution and not port-by-port
	  ○ Floquet ports for antenna arrays, frequency selective surfaces (FSS) and other periodic structures
	  ○ The software should have a provision for extracting fields/active S parameter as per user specified excitation magnitude and phase
	• Option to provide voltage source and current source
	• Magnetic bias for ferrite models
	• Incident wave excitations available from following wave types:
	  ○ Plane Wave, Hertzian dipole wave, Cylindrical wave, Gaussian Beam Wave

	○ Linear Antenna wave, Far Field Wave, Near Field Wave ○ Far-field wave and near field wave can be from another design or the measurement. • Boundary conditions available: ○ Radiating, perfectly matched layers and FEBI ○ Impedance boundary ○ Layered Impedance with shell elements which can account for thickness even when modelled as sheets ○ Lumped RLC boundary ○ Symmetry boundary for reducing the problem size ○ Period boundary condition for solving arrays ○ Finite conductivity boundary with the capability to include metal roughness using Huray or Groisse algorithm ○ Fresnel Boundary
8	General Solver Options • Direct or Iterative approach for solving the matrices • Hybrid solver with Integral equation solver should support matrix solving with ACA (Adaptive Cross Approximation) or MLFMM (multilevel fast multipole method). • Basis functions are available as zero, first, second and mixed order for simulation of various class of problems. • Import mesh to design from other similar design • Frequency sweep options ○ Interpolation sweep ○ Discrete sweep ○ Fast sweep • Broadband frequency sweeps with the capability to take into account dispersive ports, materials and skin effect. • Enforce passivity / enforce causality for the broadband sweep • DC point solver option for PCBs for accurate DC point characterization
9	Post-processing options- The output from the tool should be • Network parameters like SYZ • Characteristic port impedances and propagation constants • Capability to observe near field and far-field radiations • Far field antenna parameters like ○ Gain ○ Directivity ○ Radiation efficiency ○ Axial ratio • Capability to observe co-pol and x-pol antenna patterns • Observe antenna array patterns based on array factor and pattern multiplication • Characterize RCS of structure ○ Monostatic RCS and Bistatic RCS • SAR plot • Capability to dynamically link electromagnetic models to circuit simulator for further system analysis. There should be an option to push excitation back from circuit to the electromagnetic solver to observe fields based on actual excitation • The electromagnetic solver should have the option to export s parameter data in touchstone format, generate equivalent RLGC models, export W element model, export equivalent spice models • Field Animation ○ Capability to animate E-field/H-field and Current density • User Defined Field Calculations using Field Calculator

	• RF Link Budget analysis: using simulation or measured data • Option to add rain and atmospheric attenatuion in RF interference and Link budget calculation. • Wireless Propagation Models support for RF interference and Link Budget calculation: Hata model, S parameter model, Path loss coupling, two ray path loss coupling, Log distance coupling, Walfisch-Ikegami model, Erceg Coupling, Indoor propagation model, Two-ray ground-reflection model • The tool should have option or toolkit to automatically post process and display the following RCS/Radar outputs: Range, Range Doppler, ISAR, Waterfall • The tool should have option or toolkit to automatically calculate Power Density and Cumulate Derivtive Function from phased array or antenna simulations
10	Advanced analysis features and parallel solve • Analytical derivatives to find output sensitivity to design parameters without resolving structure. • Capability for simulation of very large models across a network of machines using all of the available memory using Domain Decomposition. • Data link for field-to-field 3D electromagnetic linking – Enabling fields from one simulation to be used as source in another simulation. • Dynamic link for circuit and EM co-simulation with smith tool capability for matching circuit design. • The capability of tools to integrate with other application such as Thermal, Mechanical for Multiphysics Problems • Should be capable of doing: o Queuing the projects for solving o Support for remote analysis with client and server each on any supported platforms • 64-Bit Support: o The software should be able to support 64-bit CPU architecture on Windows and Unix Operating system for both solver and user interface. o Should support unbounded 64-bit Solver Memory allocation.
11	Optimetrics – For optimizing designs • Integrated optimization capability including: o Parametric analysis o Optimization analysis o Sensitivity analysis o Statistical analysis • Optimizer should have these algorithms: o Pattern search algorithm o Quasi-Newton search algorithm o Sequential Non-Linear Programming (SNLP) Optimizer o Genetic optimization algorithm o Link to Matlab for custom optimization codes o Screening (Shifted Hammersley) o MOGA (Multi-Objective Genetic Algorithm) o NLPQL (Non-linear Programming by Quadratic Lagrangian) o MISQP (Mixed-Integer Sequential Quadratic Programming Method) o Adaptive Single-Objective o Adaptive Multiple-Objective • Analytical derivatives to find output sensitivity to design parameters without resolving structure. • Capability to solve parametric variations of a design in parallel using processor cores in a single machine or spread over networks

12	Automation and distributed computing • Scripting options for model creations, plotting, exporting results thus providing automation • Scripting languages o VB script o Iron python script o Java script • Able to use multiple cores in simulation for faster simulations. o Multiple cores can be a single machine or across the network • Domain Decomposition Method for solving electrically large model o Automatically break the large problem into smaller domains and solve them in parallel • Distribute frequency points and solve in parallel • Should be capable to Queue the projects for solving • Support for remote analysis with client and server each on any supported platforms
	o Ansys Icepack
	o It should have feature to do electrothermal analysis of PCBs
	o Easy-to-Use Slider Bar Meshing o Mechanical and Electrical Cad-Centric o User-Friendly Ribbons and Tabs Interface o Automated MCAD Healing and Simplification o IronPython and VBS Scripting with Recording o Integrated Dynamic Links for Electro-Thermal Interaction o User Experience Comparable to Ansys HFSS, Ansys Maxwell, Ansys SIwave and Ansys Q3D Extractor o Integrated Material Library for Electrical, Thermal and Mechanical Properties o ECAD Metal Fraction Analysis o Thermal-Mechanical Coupling o AC and DC Electro-Thermal Coupling o Solver with Four Cores o HPC, Cloud and Scheduler Support o Parametric Variations and DoE Support for “What-if” Analyses o Transient Thermal Analyses for Conduction, Convection and Radiation HT o Commercial Library for Fans, Heatsinks, Blowers*, TECs* and Thermostats* o Steady-State Thermal Analyses for Conduction, Convection and Radiation HT

Ansys Academic Research Lumerical

SL. No	Design module/area	Specification
		Ansys Lumerical Strengths: ▪ **Application Gallery with wide range of application examples** ▪ **Lumerical AIC/ALH courses** ▪ **Automation API with Python** ▪ **Inbuilt scripting** ▪ **Powerful CAD Environment** ▪ **Stability** ▪ **Foundry collaboration** ▪ **EPDA with Cadence and Siemens** ▪ **Interoperability with Zemax and Speos: end-to-end optical simulation** ▪ **Popularity across Academics and Industry**
1.	Optical waveguide design and analysis in 3D and 2D	**3D analysis** • The software should use 3D/2D Maxwell Solver with Finite Difference Time domain method. • The software should have multi-coefficient models for accurate material modelling. • The software should have wide range of non-linear, negative index and gain models. • The software should support PML, Symmetric and Anti-symmetric, Bloch and periodic boundary conditions to simulate photonic structures. • The software should have conformal meshing algorithm to get accurate results for coarse mesh. • The software should have a library of photonic crystal models. • The software should have the option to export 3D data in GDS II file catering to foundry supports. • The software should have 3D CAD Environment with STL and GDS II file import option. • The software should support surface import option. • There should be capable to convert SEM image to 3D object. • The software should have broadband fixed angle source technique for simulating broadband sources. • The software should consist integrated Mode source along with other types of sources (e.g. Gaussian source, dipole source and plane wave source etc.) • The software should support import of custom source profile from monitor data or equations. • It should support export of field results in the form of movie (.mp4) • The software should have the option for dedicated scripts for parameter sweep, optimization and S-parameter calculations in the same window. • The software should have dedicated analysis groups for solar cells, electro-optic and thermo-optic modulators etc. **2D analysis** • The software should have waveguide solver using 2.5D var FDTD, Finite difference Eigenmode and bidirectional EigenMode Expansion solving techniques. • The software should have the option for virtual prototyping of large integrated optical components, reducing the need for expensive, time-consuming manufactured prototypes. • The software should have dedicated analysis tabs like modal, frequency and overlap analysis etc. • The software should have dedicated scripts for parameter sweep, optimization and S-parameter calculations in the same window. • The software should be capable to model surface roughness of the waveguide. • The software should consist of a library of primitive and complex structures like rounded corners, waveguide bends, helix and spiral structures and surface roughness etc. • The software should have 3D CAD Environment with STL and GDS II file import. • The software should support surface import. • The software should be capable of converting SEM image to 3D object. • The software should have custom time signal and spectrum source. • It should support PML, Symmetric and Anti-symmetric, Bloch and periodic boundary condition to simulate photonic structure.

		• It should support the export of field results in the form of movie (.mp4) • The software should have the option to export 3D data in GDS II file catering to foundry supports. • The software should be capable of integration with Ansys tools.
2.	Charge transport analysis	• The software should have dedicated charge transport solver to calculate charge flow in opto-electronic and photonic devices. • The software should have wide library incorporating temperatures, doping and high-field effects.
3.	Heat transport analysis	• The software should have dedicated finite element heat solver to handle conductive, convective and radiative effects.
4.	3D electromagnetic and waveguide Simulation	• The software should have Discontinuous Galerkin Time domain solver for complex geometries. • The software should be capable to model surface roughness of the waveguide. • The software should have dedicated finite element Maxwell solver for curved and complex waveguides.
5.	Optical Multilayer simulation	• The software should have multilayer thin-film simulator used for AR coatings, filters, Lasers, also captures interference and micro cavity effects.
6.	Quantum mechanical simulation	• The software should be capable of computing quantum mechanical band-structure calculations using k-p method. • The software should be capable of computing gain and spontaneous emission in multi-quantum well structures.
7.	Photonic Integrated Circuit (PIC) system design and simulation	• The software should have the capability to design, simulate and analysis of photonic integrated circuits, photonic components and optical interconnects in time and frequency domain. • The software should have hierarchical schematic editor with an extensive library of elements. • The software should have foundry specific PDK elements. • The software should have integrated laser simulations. • The software should be interoperable with industry related EDA and PDA tools. • The software should have dedicated analysis tools for PBG devices. • The software should have High Performance Parallel Computing (HPC) Support to get faster simulations. • The software should have APIs with other industry leading products like Zemax, Mentor Graphics, Cadence, MATLAB, Python. • The software should have photonic model development kit. • It should have automation API to support optimization and scripting. • The software should have inbuilt library of laser models • The software should have in-built library of photonic crystal models • The software should easily couple with Ansys tools.

Sl. No	Specifications
1.	A software shall have provision of extensive element library to model multi-physics problems including solid elements, structural elements like shells, beams, trusses, membrane elements, rigid and mpc elements, special elements like springs, dashpots etc. It shall also have the provision for creating user defined elements. **Software Should have capabilities in following geometric Idealization** 1. Spring 2. Mass 3. Damper 4. Spar 5. Beam 6. Pipe/Elbow 7. Shell - Thin 8. Layered Shell - Thin (Composite) 9. Shell - Thick (Solid Shell) 10. Layered Shell - Thick (Solid Shell) 11. 2D Plane / Axisymmetric 12. 3D Solids / Cyclic symmetric/ Periodic boundary condition 13. Layered 3D Solids (Composite) 14. Infinite Domain 15. Reinforced 16. Substructuring / Matrix
3.	**FEA Software Should have following Modeling Capabilities** • Contact - Linear • Contact - Nonlinear • Thermal conductivity for Contact • Joints • Spot Welds • Element Birth and Death • Gaskets • Rezoning and Adaptive Remeshing (NLAD) • Inverse Analysis
4.	**FEA Software should support following types of Materials** • Basic Linear Materials (Linear, Anisotropic, Temperature Dependent). • Basic Nonlinear Materials (Hyper, Plasticity, Rate Independent, Isotropic, Concrete). • Advanced Nonlinear Materials (Rate dependent, Anisotropic, Damage Models, Geomechanics Materials, and Multiphysics). • Reactive Materials • Fracture Mechanics and crack growth • User-Defined material model

	FEA Software should have capabilities in modeling of Composite Materials • Material Definitions • Layers Definitions • Interface Plies • Advanced Modeling Features • Variable Material data

	• Solid Extrusion • Lay Up Mapping • Advanced Failure Criteria Library • First-ply Failure • Last-Ply failure • Delamination • Draping
	FEA Software should have following capabilities with structural solver • Linear Static • Nonlinear Static • Pre-Stress effects, Linear perturbation • Nonlinear Geometry • Buckling - Linear Eigenvalue • Buckling - Nonlinear Post Buckling • Steady State Analysis applied to a Transient Condition • Advanced Wave Loading
	FEA Software should have capability for topology Optimization • Structural Optimization • Modal Optimization • Thermal Loads • Inertial Loads • Optimized Design • Validation • Manufacturing Constraints • Stress constraints • Symmetry
	FEA Software should have capabilities for multi Analysis types • Submodeling • Fluid structure interaction (1way & 2 way) • Multiphysics Data Mapping (fluid/thermal to structure etc) • Advanced Multi-Stage 2-D to 3-D Analysis • Fluid and FEA solver should be launched from a single Platform and should have two ways coupled simulation option between them.

	FEA Software should have following types of vibrations analysis capabilities • Modal • Modal - Pre-Stressed • Modal - Damped/Unsymmetric • Transient - Mode-Superposition • Harmonic - Mode-Superposition • Harmonic - Full • Spectrum/ Seismic • Random Vibration • Mistuning • Rotordynamics • Modal Acoustic • Harmonic Acoustic
	FEA Software Should have Nonlinear Transient Dynamics capabilities

	• Rigid Body Mechanisms & Multi body dynamics • Rigid Body Dynamics with flexible bodies • Full method of Transient analysis • Component mode synthesis with Substructuring analysis
	FEA Software should have below Explicit Dynamics capabilities • FE (Lagrange) Solver • Meshless Solvers • Implicit-Explicit Deformations • Implicit-Explicit Material States • Mass Scaling • Natural Fragmentation • Erosion Based on Multiple Criteria • Fluid and Structural Interaction (FSI)
	FEA Software should have below Durability/Fatigue analysis • Stress-Life (SN) • Strain-Life (EN) • Safety Factor
	FEA Software should have below Wave Hydrodynamics capabilities • Diffraction and Radiation • Frequency & Time Domain Motions Analysis • Moorings, Joints & Tethers • Load Transfer to Structural Analysis
	FEA Software should have below Thermal analysis capabilities • Steady State Thermal • Transient Thermal • Conduction • Convection • Radiation to Space • Radiation - Surface to Surface • Phase Change • Thermal Analysis of Layered Shells and Solids
	FEA Software Should also support following additional Physics • Piezoelectric • Piezoresistive • Electroelastic • Electromagnetic • Diffusion-Thermal • Structural-Electric • Structural-Thermal- • Electric-Magnetic
	FEA Software Should have dedicated module for following ways of optimization analysis Capabilities • Parameters • Design Point Studies • Correlation Analysis • Design of Experiments • Sensitivity Analysis • Goal Driven Optimization • Six Sigma Analysis

	• Adjoint Solver for Shape Optimization • Adjoint solver supports rotating reference frames & conjugate heat transfer • Multi-objective-constrained optimization
	FEA Software should Include following modules • Customization option • Batch run capability • Parallel Solving on Local PC Option (4 Cores HPC included) • CDB and 3rd party FE • Model Import
	FEA Software Should have following CAD geometry modeling and Meshing feature ➢ **Photo realistic rendering in Pre- & Post-Processing** ➢ **CAD-Cleaning or Model Preparation for CAE** • Direct Modeling Technology • Feature Based Modeling Technology • Open Data from All Major CAD Systems • Export Data to Neutral File Formats • Modify Imported Geometry • Defeaturing and Simplification Tools • Model Repair • Add Parameters for Design Exploration • Extract Mid-Surfaces/Shells and Beams • Extract Volumes & Create Inner Fluid Domains • Extract Outer Air Enclosures • Shared Topology for Conformal Meshing • Booleans and Slicing • Create Weld Bodies • Boundary Condition Mapping • Scripting • Sketching and Editing Tools • 3D Comparison Tools • Repair and Edit Faceted Data • Icepak Integration • Reverse Engineering • Faceted Data ➢ **General Purpose & Unified Meshing Solution** • Physics-aware meshing • Auto Meshing • Hexahedral default • Tetrahedral mesh alternate • Automated size controls • Automated inflation • Automated part repeat • Auto update with parameters • Patch conforming mesh

- Patch independent mesh
- Defeaturing based on CAD
- Defeaturing based on mesh
- Mesh matching
- Mapped mesh control
- Mesh control - move, merge, edit
- Assembly meshing

➢ **Dedicated Structured/Block Meshing**

- Hexamesher - Multi-block structured volume meshes
- Hexamesher - Unstructured hexahedral volume meshes
- Conversion free blocks to mapped blocks
- O-Grid generation
- "Patch independent" meshing methods to work with dirty cad and does not require that surfaces be formed into solids or that flow volumes be extracted
- Generate mesh from a range of sources including CAD data, faceted data, scan data or even combinations of CAD, facets and mesh.
- Tetra mesher with prism mesh generation
- Journal for batch execution

➢ **Dedicated Tetrahedral Meshing**

- Embedded in the Solver Interface
- Generate mesh from a range of sources including CAD data, faceted/STL data, scan data or even combinations of CAD, facets and mesh.
- Variety of Surface mesh repair (quality & connectivity) tools
- Surface wrapping and remeshing
- Volume Mesh Generation Methods – Tetrahedral, Hexcore, CutCell, Thin Volume, Prisms, Poly, poly-hexcore
- Scriptable for batch execution

➢ **Dedicated Meshing for Blades**

- Fully Automatic Topology and Meshing
- Tailored for Turbomachinery
- Automated Tip Clearance Meshing
- Rapid Mesh Quality Feedback

➢ **Post-Processing**

- Read and visualize data from most popular simulation programs
- Data Visualization (Iso-surfaces, contour lines, streamlines, volume rendering, deformation of parts, etc.)
- Visualize Fluid–Structure Interaction and Multiphysics simulations
- Query data and make plots
- Variables and Calculator – for deriving other results & build own variables
- Automate Post-Processing with Python scripting
- Animation with CAE data. Compare experimental data with simulation by playing both simultaneously.
- Compare multiple runs, datasets, physics, graphs in a single window

FEA Software should have following Capabilities in Model Preparation for CAE

	• Open data from any CAD system • Edit designs and prepare them for simulation • Simplify geometry by removing features (e.g. rounds and holes) • Clean up and repair dirty geometry to create watertight solids • Create parameters on imported geometry to enable optimization of designs through analysis • Extract mid-surfaces/shells and beams solid models for efficient meshing and solving • Extract volumes/create inner fluid domains and outer air enclosures for CFD • Create shared topology among bodies to generate conformal meshes • Slicing of models into hex meshable bodies • Create weld bodies to simulate welds between shells • Define regions of symmetry for symmetric analysis • Define named selections to aid in scoping of loads and boundary conditions • Define general CAD attributes • 2D drawing and editing tools • 2D dimensioning and constraints • Supply 3D markups and compare models to document changes to design teams • Repair and edit faceted files for further FEA topological optimization and CFD analysis • Early Concept Design (bid modeling/ brainstorming/concepting) • Create new concepts quickly and easily with four tools: Pull, Move, Fill, Combine • Use Cut, Copy, Paste, etc for fast ideation from existing designs • Enable 2d and 3D communication and collaboration with 3D Markup, Dimensions, and Drawing tools • Create BOM to evaluate weights and lengths for cost calculations • Use automated tools to repair dirty geometry • Use top down or bottom up modeling • Create 2D drawings Import and edit large assemblies
	Ansys Sherlock PCB Reliability solver with Following capabilities FLEXURE/BENDING Determines if any post-soldering processes could induce excessive flexure that would cause component cracking, pad cratering or solder fracture. CONFORMAL COATING/ POTTING Allows the user to evaluate the effect of staking compounds, underfills, conformal coatings and potting materials on the reliability of electronic hardware. CAE INTERFACE Import to and export from finite element analysis (FEA) solvers. THERMAL DERATING Flags devices being used outside of the specified operation or storage temperature range. TRACE MODELING Allows the user to explicitly model all PCB features over the entire circuit board or in a particular region. Can be exported for current density, thermal or structural analysis. CERAMIC CAPACITOR WEAROUT Predicts time to failure for ceramic capacitors (MLCC). ELECTROLYTIC CAPACITOR WEAROUT Predicts time to failure for aluminum liquid electrolytic capacitors. INTEGRATED CIRCUIT WEAROUT Predicts failure rate and end of life of integrated circuits using degradation algorithms for electromigration, time-dependent dielectric breakdown, hot carrier injection and negative bias temperature instability. HEATSINK EDITOR Create pin- and fin-based heatsinks using fill-in fields and drop-down menus and attach them to

components or PCBs.
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Allows the user to semi-automate the creation of a component-level DFMEA. Can be exported into any form/spreadsheet, including SAE J1739.
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Predicts solder fatigue reliability under thermomechanical and mechanical environments for all electronic parts (die attach, BGA, QFN, TSOP, chip resistor, through hole, etc.).
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Incorporates the effect of system-level mechanical elements (chassis, module, housing, connectors, etc.) on solder fatigue analysis.
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Captures stackup from output files (Gerber, ODB++, IPC-2581). Automatically calculates weight, density and in-plane and out-of-plane modulus, coefficient of thermal expansion and thermal conductivity.
Following Libraries
Parts Library - Electronic parts. Tracks manufacturer, part number, technology type, electrical ratings, temperature ratings and packaging information. Packages Library - Includes package types for semiconductor and discrete and passive electronic parts. Includes BGAs, QFNs, SOIC, QFP, EIA case sizes, axial, radial, etc. Materials Library - Electronic materials, including encapsulants, underfills, thermal interface materials, staking compounds, conformal coatings and potting materials. Laminates Library - Approximately 800 laminate materials from 24 different manufacturers. Includes CEM1, FR4, BT, CE, polyimide, high-temperature and flex. Solders Library - Includes nine solder materials, including SnPb, SAC305, SN100C, 90Pb10Sn, Innolot*, MaxRel*, SACm*, 90iSC* (*available upon request) and M794. Glass Style Library - Approximately 100 glass styles common to the PCB industry.

Sl. No	Specifications
1.	A software shall have provision of extensive element library to model multi-physics problems including solid elements, structural elements like shells, beams, trusses, membrane elements, rigid and mpc elements, special elements like springs, dashpots etc. It shall also have the provision for creating user defined elements. **Software Should have capabilities in following geometric Idealization** 17. Spring 18. Mass 19. Damper 20. Spar 21. Beam 22. Pipe/Elbow 23. Shell - Thin 24. Layered Shell - Thin (Composite) 25. Shell - Thick (Solid Shell) 26. Layered Shell - Thick (Solid Shell) 27. 2D Plane / Axisymmetric 28. 3D Solids / Cyclic symmetric/ Periodic boundary condition 29. Layered 3D Solids (Composite) 30. Infinite Domain 31. Reinforced 32. Substructuring / Matrix
3.	**FEA Software Should have following Modeling Capabilities** • Contact - Linear • Contact - Nonlinear • Thermal conductivity for Contact • Joints • Spot Welds • Element Birth and Death • Gaskets • Rezoning and Adaptive Remeshing (NLAD) • Inverse Analysis
4.	**FEA Software should support following types of Materials** • Basic Linear Materials (Linear, Anisotropic, Temperature Dependent). • Basic Nonlinear Materials (Hyper, Plasticity, Rate Independent, Isotropic, Concrete). • Advanced Nonlinear Materials (Rate dependent, Anisotropic, Damage Models, Geomechanics Materials, and Multiphysics). • Reactive Materials • Fracture Mechanics and crack growth • User-Defined material model

	FEA Software should have capabilities in modeling of Composite Materials • Material Definitions • Layers Definitions • Interface Plies • Advanced Modeling Features • Variable Material data

	• Solid Extrusion • Lay Up Mapping • Advanced Failure Criteria Library • First-ply Failure • Last-Ply failure • Delamination • Draping
	FEA Software should have following capabilities with structural solver • Linear Static • Nonlinear Static • Pre-Stress effects, Linear perturbation • Nonlinear Geometry • Buckling - Linear Eigenvalue • Buckling - Nonlinear Post Buckling • Steady State Analysis applied to a Transient Condition • Advanced Wave Loading
	FEA Software should have capability for topology Optimization • Structural Optimization • Modal Optimization • Thermal Loads • Inertial Loads • Optimized Design • Validation • Manufacturing Constraints • Stress constraints • Symmetry
	FEA Software should have capabilities for multi Analysis types • Submodeling • Fluid structure interaction (1way & 2 way) • Multiphysics Data Mapping (fluid/thermal to structure etc) • Advanced Multi-Stage 2-D to 3-D Analysis • Fluid and FEA solver should be launched from a single Platform and should have two ways coupled simulation option between them.

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TECHNICAL SPECIFICATIONS

S.NO	Technical Specifications Ansys Academic Research HF HFSS Package
1	**Technical Requirement For HIGH-Frequency Simulation Package** • The package should have the capability to simulate any arbitrary 3D model or planar PCB structure to capture its electromagnetic performance. It should also have the ability to integrate multiple electromagnetically analyzed models to carry out a system-level analysis. • HFSS, Designer, Q3D Extractor,Siwave, EMIT, EMCPLUS,Optimetrics,SBR+
2	Numerical Solver Technology:HFSS . SBR , SIWAVE The tools should have: • 3D full-wave Frequency Domain-based electromagnetic field solver based on the Finite Element Method (FEM). • 3D full-wave Frequency Domain-based electromagnetic field solver based on Integral Equation Method (MoM). • 3D full-wave Time Domain-based electromagnetic field solver based on Discontinuous Galerkin (DG) and FEM Time Domain Methods. • 3D full-wave Frequency Domain-based Asymptotical electromagnetic field solver based on Shooting and Bouncing Ray + (SBR+) method. • 3D full-wave Frequency Domain, Eigen Mode Solver, based on FEM • 3D Full-wave Frequency Domain Characteristic Mode Analysis Solver based on MoM • 3D Multipaction solver for finding RF breakdown inside High Power RF components • 3D simulation tools support Hybridization FEM, IE and SBR+/PO solver in a single design. • 3D HF solver should combine FEM + IE (Integral Equation) + SBR • 2D Low Frequency Electromagnetic Solver (Static and Transient) for Motor, Transformer, Actuators, bus bar, etc. • 2D EM solver for Transmission line, for Analyzing cross section of different Transmission models • 1D Power Spectral Based solver for finding RF interference between different Microwave system • System-level solver for Integrating physics-based model with multi-domain based components, Power Electronic circuits, etc. • ID circuit simulation capability for following RF simulations o Linear analysis o DC analysis o Oscillator Analysis o Harmonic Balance Analysis (1-Tone and N-Tone) o Transient Analysis o Time Varying noise Analysis o Phase noise Analysis o Multi-tone harmonic balance analysis o Envelope analysis o Load pull analysis and model support o Periodic transfer function analysis • SBR+ solver should automatically combine following asymptotic methods to arrive at an accurate solution o Physical Optic (PO), o Geometrical Optic (GO),

- Physical Theory of Diffraction (PTD),
- Uniform Theory of Diffraction (UTD),
- Creeping Wave (CW)

- The asymptotic solver should enable all SBR solver like PTD, UTD, and CW in a single simulation
- PO and SBR+ asymptotic solver should support lossy dielectrics
- SBR solver should support multilayer dielectrics
- FEM frequency-domain solver should have the capability to simulate even in THz region for applications such as metamaterials, FSS etc.
- There should be an option of using 2.5D MOM or FEM solver to analyze planar layouts.
- There should be a capability to solve just the 2D cross-section of transmission lines to extract its characteristic impedance.
- Automatic and adaptive meshing capability requiring minimal user input.
- Tools should include Antenna Design toolkit with (60+) antenna models
- Solution convergence and control:Convergence based on S parameter, field quantities or user-defined expressions
- The software should have the capability for adaptive meshing across different frequencies of broadband structures.
- Eigenmode solver should be able to find the natural resonances and quality factor of the lossy structure.
- The solver (FEM) should have an option to

  - physically divide the simulation model into the different sections
  - Enable parallel meshing and solving for each section individually
- Solver has the capability for solving a single unit cell of an array for Active Element Patterns using Periodic Boundary Conditions
- The solver should have the ability to create and solve Finite Array Simulation by combining different types of unit cells.
- Finite Array simulation should support features like Array Mask creation for arbitrary sparse array configuration.
- Scattered field simulation for solving RCS problems. Provision for both bistatic and monostatic RCS along with incident field excitations.
- RCS calculation should be able to conduct with FEM, IE and SBR+ solvers
- RCS simulation using SBR solver should automatically combine additional solvers like PTD, UTD and CW in a single design

- Broadband frequency sweeps with the capability to take into account dispersive ports, materials and skin effect.
- The IE and SBR should have an option to create an ISAR image, Near Filed Radar ROM (Waterfall plot) of the Radar target

- Mulitpaction solver should support multiple port simultaneous excitations for RF breakdown analysis

- Basic Solver should enable 16 cores HPC (High Performance Computation) capability.
- Built-in Antenna model for RF interference and SBR+ simulation: Short Dipole, Half-wave dipole, Quarter wave Monopole, Pyramidal Horn, Small Loop, Parametric Beam Antenna, Wire Monopole
- SBR solver should have the ability to simulate Radar Simulation
  - Able to incorporate multiple transmitting and receiving antenna
  - Able to create Radar simulation scenarios
  - Scenario simulation with respect to time
  - Calculate Range, Velocity and Angle of Arrival
- Power Spectral solver should provide following RFI matrics across

	multiple Transmitter and Receiver platform: EMI Margin, Sensitivity, Availability, Desense, Noise In-Band EMI Margin • Power Spectral solver should provide RF interference of Mulitple Transmitter to the single receiver. • Power Spectral solver should support Non-Linear Interference Effects in RF interference analysis • 2D low-frequency electromagnetic solver should be able to o Extract Torque, Power, current variations o Capability to do the demagnetization study, help to extract Torque Speed characteristics o Inbuilt circuit solver to a model electronic circuit like inverters, rectifiers, etc and connect with 2D Electromagnetic model o Extract losses as output for CFD (Thermal) Analysis • System solver should have o Build power electronic circuits using IGBT, BJT, MOSFET, etc. o Capability to characterize semiconductor switches from manufacturer datasheet o Capability to do time and frequency domain simulations o Capability to co-simulate with physics-based models o Capability to import Reduced-Order Models generated for Physics-based simulations
3	Graphical User Interface for EM analysis The software package should have the following features: • Tools should have an option or toolkit to automatically setup simulations for following RCS/Radar simulation: Range Profile, ISAR, Range Doppler Prcoessing and waterfall. • The tool should have an option to encrypt the 3D component, which a user can share with others without revealing the IP • The tool should have an option to import/export encrypted/unencrypted 3D component models for simulation. • The tool should have templates for setting up EMI EMC simulation like Radiated Emission, Conducted Emission, ESD, BCI • The tool should have the capability to model and parameterize any arbitrary 3D model • The tool should have the capability to do operations such as unite, subtract, intersect different objects to create a model • There should be a provision for creating equation-based curves/surfaces for creating more complex models. • There should be provision for wrapping sheets onto curved surfaces. • The software should have the ability to import, edit, simplify and parameterize 3D CAD models from third-party tools. • The tool should support the import of following 3D DATA: ACIS, Acrobat 3D, 2D PDF, AMF, AutoCAD, CATIA, Creo Elements/Direct Modeling, Design Modeler, ECAD IDF, IGES, Image Files, Inventor, JT Open, Acrobat PDF 2D, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image files, NX, Parasolid, Point curve text, Pro/ENGINEER • The tool should support the export of following 3D DATA: ACIS, Acrobat PDF 3D, Acrobat 2D PDF, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image Files, Inventor, JT Open, Keyshot, Acrobat PDF 2D, AMF, AutoCAD, CATIA, ECAD IDF, IGES, Image files, NX, Parasolid, Point curve text, POV-Ray, Rhino, SketchUp, SolidWorks, STEP, STL • The capability to clean up 3D CAD and detection tools for Short Edges, Overlap Faces, Corrupt Faces • The tool should allow users to edit STL files directly and leverage

	automatic repair tools
	• Options for cleaning imported 3D models
	  ○ Options for analyzing individual objects of the complete 3D model to locate any faults in the modelling
	  ○ Possibility to find inter-object misalignments
	• There should option for healing the geometry
	• Capability to import ECAD layouts format like .brd, .mcm, .sip, ODB++, IPC2581, GDS.
	• There should be provision to model layouts into a stackup based environment and simulate in the same environment
	• Layout interface should have options to change the stackup, trace widths, via and padstack.
	• PCB Trace modelling options in the Layout interface
	  ○ Surface roughness – Huray and Groisse
	  ○ Options for Etching

5	ptions
	• Use tetrahedron element for 3D models and triangles for sheet structures
	• Option to have curvilinear mesh elements for accurately solving curved geometries
	• Mesh Control
	  ○ Options to specify surface deviation, normal deviation and aspect ratio to control mesh density
	  ○ Ability to restrict the number of elements/size of the elements within an object or just on the surface of the object
	  ○ Skin-depth based seeding capability
	• Advanced capability like Assembly Meshing: Independent component meshing allows mesh reuse, no re-meshing in parametric variations, independent mesh settings for different components and more robust meshing for models with a significant difference in scale. Especially useful for Antenna Placement and scattering problems where mesh reuse can be done.
	• Phi mesher (Prism elements) for faster meshing of the planar structures.

6	Advanced Material Library which should include; • A comprehensive materials database containing permittivity, permeability, electric and magnetic loss tangents for common substances. • Users must be able to include anisotropic materials, ferrites, temperature and frequency-dependent material properties. Frequency-dependent material models like Debye and Djordjevic-Sarkar models to ensure that the material satisfies causality conditions. • Provision for Spatially dependent material properties and boundary conditions.

7	Excitation and Boundary Condition
	• Excitation for Ports SYZ parameter excitation
	  ○ Arbitrary internal and external ports – Waveport and Lumped Port
	  ○ Ability to solve all ports in one solution and not port-by-port
	  ○ Floquet ports for antenna arrays, frequency selective surfaces (FSS) and other periodic structures
	  ○ The software should have a provision for extracting fields/active S parameter as per user specified excitation magnitude and phase
	• Option to provide voltage source and current source
	• Magnetic bias for ferrite models
	• Incident wave excitations available from following wave types:
	  ○ Plane Wave, Hertzian dipole wave, Cylindrical wave, Gaussian Beam Wave

	○ Linear Antenna wave, Far Field Wave, Near Field Wave ○ Far-field wave and near field wave can be from another design or the measurement. • Boundary conditions available: ○ Radiating, perfectly matched layers and FEBI ○ Impedance boundary ○ Layered Impedance with shell elements which can account for thickness even when modelled as sheets ○ Lumped RLC boundary ○ Symmetry boundary for reducing the problem size ○ Period boundary condition for solving arrays ○ Finite conductivity boundary with the capability to include metal roughness using Huray or Groisse algorithm ○ Fresnel Boundary
8	General Solver Options • Direct or Iterative approach for solving the matrices • Hybrid solver with Integral equation solver should support matrix solving with ACA (Adaptive Cross Approximation) or MLFMM (multilevel fast multipole method). • Basis functions are available as zero, first, second and mixed order for simulation of various class of problems. • Import mesh to design from other similar design • Frequency sweep options ○ Interpolation sweep ○ Discrete sweep ○ Fast sweep • Broadband frequency sweeps with the capability to take into account dispersive ports, materials and skin effect. • Enforce passivity / enforce causality for the broadband sweep • DC point solver option for PCBs for accurate DC point characterization
9	Post-processing options- The output from the tool should be • Network parameters like SYZ • Characteristic port impedances and propagation constants • Capability to observe near field and far-field radiations • Far field antenna parameters like ○ Gain ○ Directivity ○ Radiation efficiency ○ Axial ratio • Capability to observe co-pol and x-pol antenna patterns • Observe antenna array patterns based on array factor and pattern multiplication • Characterize RCS of structure ○ Monostatic RCS and Bistatic RCS • SAR plot • Capability to dynamically link electromagnetic models to circuit simulator for further system analysis. There should be an option to push excitation back from circuit to the electromagnetic solver to observe fields based on actual excitation • The electromagnetic solver should have the option to export s parameter data in touchstone format, generate equivalent RLGC models, export W element model, export equivalent spice models • Field Animation ○ Capability to animate E-field/H-field and Current density • User Defined Field Calculations using Field Calculator

	• RF Link Budget analysis: using simulation or measured data • Option to add rain and atmospheric attenatuion in RF interference and Link budget calculation. • Wireless Propagation Models support for RF interference and Link Budget calculation: Hata model, S parameter model, Path loss coupling, two ray path loss coupling, Log distance coupling, Walfisch-Ikegami model, Erceg Coupling, Indoor propagation model, Two-ray ground-reflection model • The tool should have option or toolkit to automatically post process and display the following RCS/Radar outputs: Range, Range Doppler, ISAR, Waterfall • The tool should have option or toolkit to automatically calculate Power Density and Cumulate Derivtive Function from phased array or antenna simulations
10	Advanced analysis features and parallel solve • Analytical derivatives to find output sensitivity to design parameters without resolving structure. • Capability for simulation of very large models across a network of machines using all of the available memory using Domain Decomposition. • Data link for field-to-field 3D electromagnetic linking – Enabling fields from one simulation to be used as source in another simulation. • Dynamic link for circuit and EM co-simulation with smith tool capability for matching circuit design. • The capability of tools to integrate with other application such as Thermal, Mechanical for Multiphysics Problems • Should be capable of doing: o Queuing the projects for solving o Support for remote analysis with client and server each on any supported platforms • 64-Bit Support: o The software should be able to support 64-bit CPU architecture on Windows and Unix Operating system for both solver and user interface. o Should support unbounded 64-bit Solver Memory allocation.
11	Optimetrics – For optimizing designs • Integrated optimization capability including: o Parametric analysis o Optimization analysis o Sensitivity analysis o Statistical analysis • Optimizer should have these algorithms: o Pattern search algorithm o Quasi-Newton search algorithm o Sequential Non-Linear Programming (SNLP) Optimizer o Genetic optimization algorithm o Link to Matlab for custom optimization codes o Screening (Shifted Hammersley) o MOGA (Multi-Objective Genetic Algorithm) o NLPQL (Non-linear Programming by Quadratic Lagrangian) o MISQP (Mixed-Integer Sequential Quadratic Programming Method) o Adaptive Single-Objective o Adaptive Multiple-Objective • Analytical derivatives to find output sensitivity to design parameters without resolving structure. • Capability to solve parametric variations of a design in parallel using processor cores in a single machine or spread over networks

12	Automation and distributed computing • Scripting options for model creations, plotting, exporting results thus providing automation • Scripting languages o VB script o Iron python script o Java script • Able to use multiple cores in simulation for faster simulations. o Multiple cores can be a single machine or across the network • Domain Decomposition Method for solving electrically large model o Automatically break the large problem into smaller domains and solve them in parallel • Distribute frequency points and solve in parallel • Should be capable to Queue the projects for solving • Support for remote analysis with client and server each on any supported platforms
	o Ansys Icepack
	o It should have feature to do electrothermal analysis of PCBs
	o Easy-to-Use Slider Bar Meshing o Mechanical and Electrical Cad-Centric o User-Friendly Ribbons and Tabs Interface o Automated MCAD Healing and Simplification o IronPython and VBS Scripting with Recording o Integrated Dynamic Links for Electro-Thermal Interaction o User Experience Comparable to Ansys HFSS, Ansys Maxwell, Ansys SIwave and Ansys Q3D Extractor o Integrated Material Library for Electrical, Thermal and Mechanical Properties o ECAD Metal Fraction Analysis o Thermal-Mechanical Coupling o AC and DC Electro-Thermal Coupling o Solver with Four Cores o HPC, Cloud and Scheduler Support o Parametric Variations and DoE Support for “What-if” Analyses o Transient Thermal Analyses for Conduction, Convection and Radiation HT o Commercial Library for Fans, Heatsinks, Blowers*, TECs* and Thermostats* o Steady-State Thermal Analyses for Conduction, Convection and Radiation HT

Ansys Academic Research EM Bundle Maxwell	
Finite Element Analysis Software-Maxwell	
Simulation	Low-frequency electromagnetic field simulation and analysis using FEM for 3D/2D structures. Solve static, frequency domain and time-varying electromagnetic and electric fields including quasi static parameters
Modelling	Electric motors and generators, transformers, bus bars, relays, solenoids, power electronics both individually and as a complete system including any or all of the above
Types of analysis	Electromagnetic Analysis Magnetostatic Analysis Eddy Current Analysis Transient Magnetic Analysis Electrostatic Analysis DC Conduction Analysis Electric Transient Analysis
Transient-nonlinear analysis	Motion-rotation, translational,non-cylindrical rotation including animation for various parameters
Capability of solvers	Solvers that accurately solve for force, torque, capacitance,inductance, resistance, and impedance, as well as generateboth nonlinear equivalent circuits and state-space models to beemployed into the further system and circuit simulation analysis
Extended Analysis	External circuit coupling
	Permanent magnet demagnetization analysis
	Core loss computation
	Time domain Multiplexing Capability for the transient solver
	Lamination modelling for 3-D
AC electromagnetic	Analysis of devices influenced by skin/proximity effects, eddy/displacement currents
Magnetostatic	Nonlinear analysis with automated equivalent circuit model generation
Electric field	Transient, electrostatic/current flow analysis with automated equivalent circuit model generation
Mesh Creation	Automatic, adaptive mesh creation
	Fault-tolerant meshing algorithms
	Mesh-generation feedback
	Mesh-based model resolution
Display of data/visualization of results	Field visualization and animations (shaded, contour and vector plots)
	Mesh visualization (full, partial)
	Current, induced voltage, flux linkage
	Power loss, stored energy
	Core loss, eddy, excess, hysteresis loss (including the minor loop effects)
	Impedance, inductance, capacitance
	Flux linkages, Back emf - readymade plots apart from Torque, speed, current
	Custom reports of user-defined solution data
Multiphysics Analysis	Project schematic view for multiuser environments and coupling with Multiphysics tools- Link to Thermal, Fluent, Structural analysis
Scripting	VB Script, Java Scipt and Python Scipt support
Excitation	Data table, current, voltage, function, external circuit, Circuit editor within the FE tool for external excitation and link to Simplorer for cosimulation
Automatic Post Processing	Machine design toolkit for automated post processing of IPM and SPM machine FEM analysis with Python scripting support
Calculator	Field calculator for evaluating complex equations and set convergence criteria for parametric analysis

Magnetisation	Element-by-element or object-based magnetizationcapability based on the original non-remnant B(H)-curve for both ferromagnetic materialsand permanent magnets. Study thepermanent magnet demagnetization characteristics extended into thethird quadrant
Rotating Machine Design-RMxprt	
Design Templates for these machines	Induction machines Single-phase motors Three-phase motors Wound-rotor motors and generators Synchronous machines Line-start PM motors Salient-pole motors and generators Non-salient pole motors and generators Brush commutated machines DC motors and generators Permanent magnet DC motors Universal motors Electronically commutated machines Brushless DC motors Adjustable-speed PM motors and generators Switched reluctance motors Claw-pole generators Synchronous Reluctance Motor
Machine-specific template editor	Rotor, Stator, Slots, Running strategies, Drive circuits, Auto-design feature Slot size, Coil turns and wire diameter, Starting capacitance, Winding arrangement, Graphical winding editor, Cross section Editor, Customizable design sheet, Entry of insulation thickness
Slot and winding editor	Option to draw any slot shape using predefined templates and winding table entry option for variable pitch, variable turns winding
Machine Design Evaluation	Performance curves, Torque, Power, Efficiency, Output waveforms, Current Cogging torque, Flux in the air gap, Cost evaluation
Load Options	Fan load, constant torque, constant speed, constant power
FE Model generation	Create Finite element 2D & 3D models for all the motor mentioned above including automatic setup of external circuit for permanent magnet machines
Complete system design- Twinbuilder/Simplorer	
Model, simulate, analyse and optimize complex systems including electromechanical, electromagnetic, power electronics and other mechatronic designs	
Prototype all aspects of a system including the electronics, sensors/ actuators, motors, generators, power converters, controls and embedded software	
Modelling Techniques	Circuits - fast and numerically stable circuit simulation. Includes multilevel semiconductor modeling, and powerful data exchange between models Block Diagrams - signal flow based models for linear, nonlinear, continuous, time-discrete hybrid-systems. State Machines - event driven approach for complex modeling and logic control (i.e. space vector control, PWMs) Equation Blocks - quickly include equation based modeling in the system State Space Modeling - based on External matrix of multi-domain components
Modelling Languages	VHDL-AMS, C/C++, SML, Python
Design domains	Analog, digital, and mixed signal multi-domain designs
Device	Characterisation of IGBTs and other semiconductor devices

Characterisation	
Integrated Development Environment	Develop virtual prototypes that can be shared among hardware and software design groups allowing users to emulate hardware and simulate the software
Statistical Analysis and Optimization	Parameter sweep, Statistical Analysis (Monte Carlo) includingthe SAE (Society of Automotive Engineers), VHDL-AMS Statistical Package, Sensitivity, Optimization, Sequential nonlinear programming, Sequential mixed integer nonlinearprogramming, Quasi Newton, Pattern search, Genetic algorithm, Tune
Library	Auto library SMPS library VHDL-AMS capability System Level components Library Device Level Component Library Sensor library
Requires Facilities	System Level Simulation Partial pivoting access setting Jacobi update settings Time step settings
Post-processing	- 2-D and 3-D families display - 2-D and 3-D polar families display views - Digital plots with families display - Rectangular stacked families display - Bode and Nyquist families display - Interactive data table view - Histogram - Sensitivity report - Range function capabilities
Scripting	Visual Basic, Java
Co-Simulation	Direct coupling with FE Analysis tools for analysing the component modelled using
Coupling	Finite element methods for further system analysis (including circuit, thermal, stress etc)
Co-Simulation and Model Generation	Third Party products- MATLAB/Simulink, MathCAD, C/C++, ModelSim, QuestaSim, RTW, HFSS, Unigraphics, SIwave,Fluent, ANSYS Rigid Dynamics, ANSYS Mechanical
Inductor Design and Transformer Design -PExprt	
Library	Epcos, Magnetics, Ferroxcube manufacturer libraries
Design	Template driven Waveform based inductor and transformer design
	Template driven inductor and transformer design for boost, buck, flyback converter etc.
Machine sizing , thermal, structural and drive cycle based analysis software-Motor CAD	
Motor Topologies	Evaluate motor topologies and concepts across the full operating range and produce designs that are optimized for size, performance and efficiency
Modules	Electromagnetic, thermal, structural, laboratory
E Mag	Calculation of torque, power, losses, voltages, currents, inductances, flux linkages and forces. Input and optimize designs easily with the module's extensive range of parameterized templates and geometries.
Thermal	calculate the temperature of the motor components in steady-state and transient operating conditions for accurate modelling of thermal behaviour within seconds of calculation. Understanding the main heat transfer paths gives motor designers opportunities to significantly improve motor efficiency power output and make design decisions with confidence
Laboratory	Rapid and accurate analysis of any electric machine design over the full

	operating envelope. It couples to both the EMag and Therm modules and provides outputs such as efficiency maps and torque/speed characteristics Generates efficiency and loss maps. Calculates the peak torque/speed characteristic. Calculates the continuous (thermally constrained) torque/speed characteristics. Analyzes performance over complex driving cycles. Uses maximum torque/amp and maximum efficiency control strategies
Structural	Calculates stress and displacement in rotors during operation. Optimizes the design of the rotor to maximize electromagnetic performance within the mechanical limits.
Coupling	Coupling With Ansys Multiphysics Packages
	Ansys Motor CAD
Library	MOTOR CAD package with Template-Based Electromagnetic and Thermal Design Electromagnetic-Thermal-Control Coupling Simulation Design for Field Weakening Temperature Dependent Continuous-Torque and Peak-Torque Simulation Manufacturing Effects and Housing Interfaces. Ratio-Based Optimization Magnetic Force Analysis Rotor Stress Analysis

Ansys Academic Research Mechanical + CFD Bundle Specs

Aqwa, Structural, Autodyn, Additive & Mechanical , CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery , ROCKY

Note:
All the technical specification for Ansys Academic teaching and Ansys Academic research are the same.

SECTION-4

PRICE BID

Sl. No.	Item Description	Subscription Period	Rate (Rs.P.)	GST (Rs.P.)	Total with GST (Rs.P.)
1	Supply, Installation and Commissioning of "ANSYS ACADEMIC MULTIPHYSICS CAMPUS LICENSE with 1 YEAR TECS"	01 Year			
	• ANSYS Academic Teaching Mechanical Bundle - Aqwa, Structural & Mechanical **50 Tasks** • ANSYS Academic Teaching CFD Bundle - CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery **50 Tasks** • ANSYS Academic Teaching HFSS Bundle **50 Tasks** • ANSYS Academic Teaching EM Bundle - EM, Maxwell **50 Tasks** • Ansys Learning HUB - ALH - Annual Subscription – **30 Nos** • ANSYS academic Research Mechanical Bundle - Aqwa, Structural, Autodyn, Additive & Mechanical **10 Tasks** • Ansys Academic Research CFD Bundle – CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery **10 Tasks** • ANSYS Academic Research HFSS **10 Tasks** • ANSYS Academic Research EM **10 Tasks** • Ansys Academic Research Mech + CFD Bundle - Aqwa, Structural, Autodyn, Additive & Mechanical , CFX, Fluent, ICEngine, Polyflow, ICEM, CFD Post, CFD Turbo Machinery , ROCKY **10 Tasks**				

	• ANSYS Academic Research Lumerical Bundle – Annual Lease **05 Tasks**	01 Year			
	• ANSYS Academic Research Optics Bundle – Annual Lease **05 Tasks**				

LIST OF DOCUMENTS TO BE UPLOADED WITH TECHNICAL BID

S. No.	Documents
1	Copy of OEM Authorization certificate/Registration Certificate
2	Copy of Tender Acceptance Letter as per **Annexure-1**
3	Copy of Bid Security declaration as per **Annexure-3**
4	Copy of Past Experience as per **Annexure-4,** and work orders
5	Duly filled Pre-Qualification criteria
6	Copy of Average Annual turnover for last 3 years as per **Annexure 5** duly signed by a CA
7.	Technical Compliance Sheet