INDIAN INSTITUTE OF TECHNOLOGY GOA

At Goa Engineering College Campus
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Enquiry No: IITGOA/2018-19/029 **Date: 12/11/2018**

Sealed quotations are invited from Livermore Software Technology Corporation or from their authorized sales partner in India for LS - DYNA software package. IIT Goa is interested to purchase following LS - DYNA packages as listed below.

Sl. No.	Description of Items	Qty
1.	**LS – DYNA** (Specifications Attached)	**32 Core**

Terms and conditions:

1. Quotation must be valid for at least 60 days.
2. The GSTIN should invariably be mentioned in your offer.
3. Price justification documents should be supplied along with the quote.
4. Supplier should provide one-year free AMC and free installation, commissioning and training of package.
5. Supplier should provide free installation service of the software for the change of installed licence server if required.
6. Supplier should organize two days' training for the students and faculties at IIT Goa.
7. Prices should be quoted in Indian Rupees inclusive of taxes and any shipping charges.
8. Delivery and installation must be made within 4 weeks of getting a confirmed order.
9. Payment: Within 30 days after the delivery and successful installation.
10. IIT Goa reserves the right to accept and/or reject any/all bids without assigning any reason.
11. Quotations shall be submitted in two parts;
    1) **Part – I (Technical)** should contain all the technical details and specification of the product. It should contain unpriced bid along with terms and conditions, AMC details etc. This envelope should be marked as "Technical Bid"
    2) **Part -II (Financial)** The financial bid of the above item should be in a sealed envelope marked as "Financial Bid" and should contain financial terms and conditions.
12) For any clarification, you may kindly contact Dr. Sachin Kore (Contact No.,0832-2490871 / e-mail: sachin@iitgoa.ac.in) till 23rd November, 2018.
13) All quotations must reach to the Assistant Registrar (Stores & Purchase), IIT Goa, at Goa College of Engineering Campus, Farmagudi, Ponda, Goa by 15.00 Hrs on or before 03th December, 2018".

Sd/-

Asst. Registrar (S&P)

Specifications

1. **Software : LS-DYNA latest version as of 05.11.2018. (Unix, Linux & Windows)**
   License Type : LS-DYNA Perpetual Licenses
   Quantity : 32 Core Parallel Computing

2. **Annual Maintenance Contract (AMC: for 1 Year)**

   AMC should include installation, documentation, upgrades, additional license discount and server change on license due to unavoidable circumstances like machine or OS failure/change/upgrade etc.

3. Training for students and faculties of IIT Goa

LS-DYNA With following Capabilities

LS-DYNA is a general-purpose finite element program capable of simulating complex real world problems. It is used by the automobile, aerospace, construction, military, manufacturing, and bioengineering industries. LS-DYNA is optimized for shared and distributed memory Unix, Linux, and Windows based, platforms, and it is fully QA'd by Livermore Software Technology Corporation. The code's origins lie in highly nonlinear, transient dynamic finite element analysis using explicit time integration.

LS-DYNA's analysis capabilities include:

- Multiphysics Coupled Electromagnetic and Structural for Electromagnetic Forming and Welding
- EM (Electromagnetism)
- Full 2D & 3D capabilities
- Nonlinear dynamics
- Rigid body dynamics
- Quasi-static simulations
- Normal modes
- Linear statics
- Thermal analysis
- Fluid analysis
  - Eulerian capabilities
  - ALE (Arbitrary Lagrangian-Eulerian)
  - FSI (Fluid-Structure Interaction)
  - Navier-Stokes fluids
  - Compressible fluid solver, CESE (Conservation Element & Solution Element)
- FEM-rigid multi-body dynamics coupling (MADYMO, Cal3D)
- Underwater shock
- Failure analysis
- Crack propagation
- Real-time acoustics
- Implicit springback
- Multi-physics coupling
- Structural-thermal coupling
- Adaptive remeshing

- SPH (Smoothed Particle Hydrodynamics)
- EFG (Element Free Galerkin)
- Radiation transport

Material Library

LS-DYNA's material library includes:

- Metals
- Plastics
- Glass
- Foams
- Fabrics
- Elastomers
- Honeycombs
- Concrete & soils
- Viscous fluids
- User-defined materials

Element Library

LS-DYNA's element library includes:

- Beams (standard, trusses, discrete, cables, and welds) (with over 10 beam element formulations)
- Discrete Elements (springs and dampers)
- Lumped inertias
- Lumped masses
- Accelerometers
- Sensors
- Seatbelts
  - Pretensioners
  - Retractors
  - Sliprings
- Shells (3, 4, 6, and 8-node including 3D shells, membranes, 2D plane stress, plane strain, and axisymmetric solids) (with over 25 shell element formulations)
- Solids (4 and 10-node tetrahedrons, 6-node pentahedrons, and 8-node hexahedrons) (with over 20 solid element formulations)
- SPH Elements
- Thick Shells (8-node)

Contact Algorithms

LS-DYNA's contact algorithms include:

- Flexible body contact
- Flexible body to rigid body contact
- Rigid body to rigid body contact

- Edge-to-edge contact
- Eroding contact
- Tied surfaces
- CAD surfaces
- Rigid walls
- Draw beads

Applications:

Aerospace

LS-DYNA is widely used by the aerospace industry to simulate bird strike, jet engine blade containment, and structural failure.

Aerospace applications include:

- Blade containment
- Bird strike (windshield, and engine blade)
- Failure analysis

Automotive Crashworthiness & Occupant Safety

LS-DYNA is widely used by the automotive industry to analyze vehicle designs. LS-DYNA accurately predicts a car's behavior in a collision and the effects of the collision upon the car's occupants. With LS-DYNA, automotive companies and their suppliers can test car designs without having to tool or experimentally test a prototype, thus saving time and expense.

Specialized automotive features include:

- Seatbelts
- Slip rings
- Pretensioners
- Retractors
- Sensors
- Accelerometers
- Airbags
- Hybrid III dummy models
- Inflator models

Earthquake Engineering - Soil-Structure Interaction

Large civil structures such as concrete dams, nuclear power plants, high-rise buildings and bridges are massive enough that their vibration due to earthquake excitation affects the motion of the soil or rock supporting them, which in turn further affects the motion of the structure itself. This interaction between the structure and the soil needs to be modelled accurately in order to design earthquake resistant structures and to correctly evaluate the earthquale safety of existing structures.

Metal Forming

One of LS-DYNA's most widely used applications is sheetmetal forming. LS-DYNA accurately predicts the stresses and deformations experienced by the metal, and determines if

the metal will fail. LS-DYNA supports adaptive remeshing and will refine the mesh during the analysis, as necessary, to increase accuracy and save time.

Metal forming applications include:

- Metal stamping
- Hydroforming
- Forging
- Deep drawing
- Multi-stage processes

Multiphysics

Pursuing its objective of solving coupled multiphysics problem, LS-DYNA R7 includes three new solvers :

- Incompressible CFD
- Electromagnetics
- Electromagnetic forming
- Electromagnetic Welding
- CESE/ Compressible CFD and Chemistry

New Multiphysics Solvers

LS-DYNA includes three new solvers for multiphysic purposes :

- Incompressible CFD (ICFD)
- Electromagnetics (EM)
- CESE/ Compressible CFD and Chemistry

Pursuing LSTC's objective of offering a unified simulation environment for an always wider range of applications, those three new solvers are automatically included and available for any registered DYNA user (starting from R7, double precision executables only).

Incompressible CFD

The adoption of new materials in the design of lighter and more fuel efficient cars and the introduction of movable parts for active aerodynamic control create new challenges to the traditional model of separated CFD/structural mechanics departments in the automotive industry. New structural materials may exhibit unpredictable behaviors under flow loads and temperatures at road test conditions.

It is LSTC's belief that fully coupled thermal/structural/CFD simulations will become increasingly necessary to avoid last minute surprises in the design chain. LS-DYNA offers a simple solution to incorporate the structural model into the CFD analysis using some of the most state of the art Finite element technology applied to fluid mechanics. The ICFD solver can run as a stand alone for pure CFD applications (the study of drag lift around bluff body and vehicles for example), or be coupled to the thermal and structural mechanical problems for linear and non-linear complex FSI and conjugate heat transfer applications. It also makes use of an automatic mesh generator for the fluid volume thus greatly reducing the cost of setting up the model. For more details, please refer to the associated menu links.

Electromagnetics

The Electromagnetism solver solves the Maxwell equations in the Eddy current (induction--diffusion) approximation. This is suitable for cases where the propagation of electromagnetic waves in air (or vacuum) can be considered as instantaneous. Therefore, the wave propagation is not solved. The main applications are magnetic metal forming or welding, induced heating, and so forth. The EM module allows the introduction of a source of electrical current into solid conductors and the computation of the associated magnetic field, electric field, as well as induced currents. The EM solver is coupled with the structural mechanics solver (the Lorentz forces are added to the mechanics equations of motion), and with the structural thermal solver (the ohmic heating is added to the thermal solver as an extra source of heat). The EM fields are solved using a Finite Element Method (FEM) for the conductors and a Boundary Element Method (BEM) for the surrounding air/insulators. Thus no air mesh is necessary. For more details, please refer to the associated menu links.

CESE/ Compressible CFD

The CESE solver is a compressible flow solver based upon the Conservation Element/Solution Element (CE/SE) method, originally proposed by Dr. Chang in NASA Glenn Research Center. This method is a novel numerical framework for conservation laws. It has many non-traditional features, including a unified treatment of space and time, the introduction of conservation element (CE) and solution element (SE), and a novel shock capturing strategy without using a Riemann solver. To date, this method has been used to solve many different types of flow problems, such as detonation waves, shock/acoustic wave interaction, cavitating flows, and chemical reaction flows. In LS-DYNA, it has been extended to also solve fluid-structure interaction problems with the embedded (or immersed) boundary approach or moving (or fitting) mesh approach. For more details, please refer to the associated menu links.

Other

Other applications include:

- Drop testing
- Can and shipping container design
- Electronic component design
- Glass forming
- Plastics, mold, and blow forming
- Biomechanics (heart valves)
- Metal cutting
- Failure analysis
- Sports equipment (golf clubs, golf balls, baseball bats, helmets)
- Civil engineering (offshore platforms, pavement design)