DEPARTMENT OF
MECHANICAL ENGINEERING

Scheme of Instruction and Syllabi
of
M.E. (Mechanical)

Specialization:
TOOL DESIGN

Full time / Part time

(2012-13)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, A.P., INDIA
# Scheme of Instruction & Examination

**M.E. (Mechanical Engineering) 4 Semesters (Full Time)**

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<th>Sl. No</th>
<th>Subject</th>
<th>Periods per week</th>
<th>Duration (Hrs)</th>
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Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only  
** 50 marks awarded by the project guide and 50 marks by the internal committee.  
*** Excellent / Very Good / Good / Satisfactory / Unsatisfactory
**Scheme of Instruction & Examination**  
M.E. (Mechanical Engineering) 6 Semesters (Part Time)

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Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars should normally be completed by the end of semester IV.

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Scheme of Instruction & Examination of Post Graduate course in Mechanical Engineering with specialization in **Tool Design**

Course duration: 4 Semesters (Full – time), 6 semesters (Part – Time)

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*Excellent/Very Good/Good/Satisfactory/Unsatisfactory"
ADVANCED METROLOGY

ME 518

Instruction 3 Periods/Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
End & line standards for length, Airy & Bessel points, desirable features of end standards, slip gauge manufacture, calibration of end standards by interferometry. NPL gauge interferometer, calibration of line standards by micrometer microscope − superposition, coincidence and symmetric straddling, photoelectric microscope and Moir fringe techniques, measurement of large displacements using lasers, calibration of Tomlinson gauges by interferometry. Photoelectric Autocollimator, calibration of polygons & circular scales. Types of interchangeability, dimensional chains.

UNIT-II
Fixed & Indicating Gauges: Taylor’s principles of gauge design, limitations of ring & plug gauges, position and receiver gauges, types of indicating gauges.
Comparators: Multirange Sigma comparator, Back pressure and free flow type pneumatic comparators, Differential back pressure gauge, usage of different types of jets, contact & non contact tooling. Amplification selection. Air to electric transducer, Differential transducer, Variation transducer, Pre process, In-process & Post process gauging, computation & match gauging. Usage of LVDT & Capacitive type gauge heads, Automatic inspection.

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:

2. ASTME, Hand Book of Industrial Metrology, Prentice Hall of India Pvt Ltd.
ME 563

MATERIAL SCIENCE & TECHNOLOGY

Instruction /Week 3 Periods
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II
Testing of Materials: Review and brief discussion on stress strain diagram of steel and the parameters for ductility toughness, strain hardening, and tensile strength percentage of elongation etc. Fracture toughness and crack growth measurement. Failure analysis, Factor-graphy and scanning electronic Microscope. Fatigue and Creep testing, testing for Residual stresses.

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
7. IS Standards, BIS, New Delhi.
ME 564

METAL CUTTING & FORMING

Instruction 3 Periods/Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Tool Materials: Tool material properties – HSS, Carbides, coated carbides, ceramic and CBN and diamonds, sialons, powder coatings – Relative advantages.
Estimation of shear angle experimentally. Metal cutting friction. Real area of contact-Rules of dry sliding, stress distribution of tool face-variation of co-efficient of tool face friction with the rake angle.

UNIT-II

UNIT-III
Recent development in metal cutting: Hot machining. Rotary machining – High speed machining, rapid proto typing.

UNIT-IV

UNIT-V

Suggested Reading:
With effect from the academic year 2012 - 2013

ME 565

DESIGN OF METAL CUTTING TOOLS & ACCESSORIES

Instruction /Week
Duration of University Examination
University Examination
Sessional

3 Periods
3 Hrs
80 Marks
20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Readings:

### DESIGN OF PRESS TOOLS

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**UNIT-I**

**UNIT-II**

**UNIT-III**

**UNIT-IV**

**UNIT-V**

**Suggested Reading:**

DESIGN OF DIES

UNIT-I
Design principles for dies of thermo-plastic and thermo-setting components. Impression core cavities, strength of cavities, guide pillars and bushes, ejection systems, cooling methods, bolster types. Split moulds, methods of actuating the splits, moulds of threaded components, internal & external under cuts, moulds with under – feed systems. Design principles and standards for Transfer and compression moulding dies.
Design of Tools: Mould for a spindle component with sleeve, pin ejection. Mould with splits Multi-cavity mould with stripper plate, inserts, ejectors.

UNIT-II
Design of Dies for metal mould Castings, Die casting, Shell moulding.
Design of casting cavity, sprue, slug, fixed and movable cores, finger cam, core, pin, draft, ejector pins, ejector plate, gate, goose-neck, nozzle, over-flow, platen plunger, runner, slot, slide, vent, water line. Design of hot chamber, cold chamber machines, vertical, horizontal, die locking machines, toggle and hydraulic systems, injection systems, rack and pinion, knockout pins and plates, hydraulic ejection. Other parts of die casting machines.

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
3. I.S. Standards, BSI., New Delhi.
ME 501

AUTOMATION

Instructions 3 periods/week
Duration of university Examination 3 hours
University Examination 80 Marks
Sessional 20 Marks

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

Suggested Reading:

ME 508

FINITE ELEMENT TECHNIQUES

Instruction 3 Periods/Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II
Analysis of trusses and frames: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node.
Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.

UNIT-III
Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmetric solids subjected of axisymmetric loading with triangular elements.
Convergence requirements and geometric isotropy.

UNIT-IV
Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.
Time dependent field problems: Application to one dimensional heat flow in a rod.
Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT-V
Finite element formulation of three dimensional problems in stress analysis.
Finite Element formulation of an incompressible fluid. Potential flow problems
Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.

Suggested Reading:
ME 509

PROGRAMMING METHODOLOGY AND DATA STRUCTURES

Instruction 3 periods / week
Duration of University Examination 3 hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT - I
Programming Methodology: Introduction, Algorithm, Data Flow Diagrams, Decision Tree, Decision Table and Life Cycles of Project Development.

UNIT - II
Programming in ‘C’: Data types & Memory size, Expressions, Statements, Operators, Control flows, Arrays, Pointers, Structures, Functions, Dynamic Memory Allocation and Simple programs in Mechanical Engineering.

UNIT - III
Sorting and Searching Techniques: Selection sort, Quick sort, Radix sort, Heap sort. Linear search, Binary search trees and Applications in Mechanical Engineering.

UNIT - IV
Data Structures: Classification of Data Structures, Definitions of Linked Lists, Double Linked Lists, Stacks and Queues. Operations and Implementations of Stack, Queues and Linked List. General and Mechanical Engineering Applications

UNIT - V
Advanced Data Structures: Tree, Basic Terminology, Binary Trees, Operations on Binary tree, Tree traversals, Graph, Graph representation Adjacency matrix, Adjacency Lists and Applications.

Suggested Reading:

ME 510

COMPUTER AIDED MODELLING & DESIGN

Instruction /Week 3 Periods
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Introduction to CAD. Criteria for selection of CAD workstations, Shigle Design Process, Design criteria,
Geometric modeling, entities, 2D & 3D Primitives.
2D & 3D Geometric Transformations: Translation, Scaling, Rotation, Reflection and Shearing,
concatenation. Graphics standards: GKS IGES, PDES.

UNIT-II
Synthetic curves – Cubic, Bezier, B-Spline, NURBS.

UNIT-III
Surface Modeling: Surface entities, Surface Representation.
Analytic Surface – Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.
Synthetic Surface-Cubic, Bezier, B-spline, Coons.

UNIT-IV
Solid Modeling Techniques: Graph Based Model, Boolean Models, Instances, Cell Decomposition &
Spatial – Occupancy Enumeration, Boundary Representation (B-rep) & Constructive Solid Geometry
(CSG).

UNIT-V
Advanced Modeling Concepts: Feature Based Modeling, Assembling Modeling, Behavioural Modeling,
Conceptual Design & Top Down Design.
Capabilities of Modeling & Analysis Packages such as solid works, Unigraphics, Ansys, Hypermesh.
Computer Aided Design of mechanical parts and Interference Detection by Motion analysis.

Suggested Reading:
2. Foley, Van Dam, Feiner and Hughes, Computer Graphics Principles and Practice, 2nd Ed., Addison –
ME 511

OPTIMISATION TECHNIQUES

Instruction 3 Periods/week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT – I
Simulation: Introduction, Types of Simulation, Simulation Models, Monte Carlo Simulation, Random Number, Pseudo Random Number, Mid-Square Method of generating Random Numbers, Application & Limitation, Application of Simulation to Inventory Control and Queuing Problem

UNIT – II
Decision Theory: Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment:
Decision making under certainty – Expected Monetary Value (EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information (EVPI) Criterion
Decision making under risk- Criterion of Pessimism or Manimax, Criterion of Optimism or Maximin, Minimax Regret Criterion, Criterion of Realism & Criterion of Rationality
Decision making under uncertainty and Decision tree analysis: Introduction, Procedure of Constructing Decision Trees & Solution through Decision Tree Analysis.

UNIT – III

UNIT – IV

UNIT – V
Classical Optimization: Introduction; Unconstrained problems of maxima and minima, constrained problems of maxima and minima; Constraints in the form of equations – Lagrangian method; Constraints in the form of inequalities -Kuhn-tucker conditions.

Suggested Reading:
ME 512

NEURAL NETWORKS AND FUZZY LOGIC

Instruction 3 Periods /Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Concepts of fuzzy sets: Introduction – Crisps sets, notation of fuzzy sets, basic concepts of fuzzy sets, operation, fuzzy compliment, union, intersection, Binary relation, Equivalence and similarity relations, belief and plausibility measures, probability measures, computability, relations, ordering morphisms, possibility and necessary measures.

UNIT-II
Adaptive fuzzy systems: Neural and Fuzzy intelligence, Fuzziness as multivalent, fuzziness in probabilistic world, randomness verses ambiguity.

UNIT-III

UNIT-IV
Introduction to Neural networks: Knowledge base information processing, general view of knowledge based algorithm, neural information processing, Hybrid intelligence, and artificial neurons.

UNIT-V
Characteristics of artificial Neural Networks: Single Neural Networks, Multi Layer Neural Networks, Training of ANN – objective, supervise training, unsupervised training, overview of training.

Suggested Reading:
ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Instruction 3 Periods /Week
Duration of University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Artificial Intelligence: Definition, Study of AI techniques, problems and Problems space, AI characteristics, Heuristics.

UNIT-II
Computer Vision: Perception, early processing, representation and recognition of scenes, Guzman's algorithms of spurting objects in a scene, Waltz algorithm.

UNIT-III
Neural Language understanding problems, syntactic analysis, semantic analysis, augmented transition networks.

UNIT-IV
Knowledge representation (Logic): Representing facts in logic predicate logic, resolution, unification, question answering, mathematical theorem proving.
Knowledge representation (Structured): Declarative representation, Semantic nets, procedural representation.

UNIT-V
Learning: Learning as induction, failure drive learning, learning by teaching, learning through examples (Winston's program) skill acquisition.

Suggested Reading:

ME 505

COMPUTER INTEGRATED MANUFACTURING

Instruction 3 periods/week
Duration of university Examination 3 hours
University Examination 80 Marks
Sessional 20 Marks

UNIT – I Introduction to CIM

UNIT – II CIM database and database management systems
Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Data models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

UNIT – III CIM Technology and Systems

UNIT – IV Enterprise Wide Integration in CIM and CIM Models

CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

UNIT – V Future Trends in Manufacturing Systems

Suggested Reading:

3. P.Radakrishnan, S.Subramanyam: CAD/CAM/CIM, New Age International
4. Alavudeen, Venkateshwaran: Computer Integrated Manufacturing, Printice-Hall India
MACHINE TOOL DESIGN

Instruction /Week: 3 Periods
Duration of University Examination: 3 Hrs
University Examination: 80 Marks
Sessional: 20 Marks

UNIT-I


UNIT-II

UNIT-III

UNIT-IV

UNIT-V

Suggested Reading:
ME 516

THEORY OF ELASTICITY AND PLASTICITY

Instruction 3 Periods/week
Duration of University Examination 3 Hrs.
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Basic Concepts of Stress : Definition, State of Stress at a point, Stress tensor, invariants of stress tensor, principle stresses, stress ellipsoid, derivation for maximum shear stress and planes of maximum shear stress, octahedral shear stress, Deviatoric and Hydrostatic components of stress, Invariance of Deviatoric stress tensor, plane stress.

UNIT-II
Basic concepts of Strain : Deformation tensor, Strain tensor and rotation tensor; invariants of strain tensor, principle strains, derivation for maximum shear strain and planes of maximum shear strain, octahedral shear strain, Deviatoric and Hydrostatic components of strain tensor, Invariance of Deviatoric strain tensor, plane strain.

UNIT-III
Generalized Hooke's Law : Stress-strain relationships for an isotropic body for three dimensional stress space, for plane stress and plane strain conditions, differential equations of equilibrium, compatibility equations, Material (D) matrix for Orthotropic Materials.

UNIT-IV

UNIT-V
Analysis methods: Slab method, Slip line field method, uniform deformation energy method, upper and lower bound solutions. Application of Slab method to forging, wire drawing, extrusion and rolling processes.

Suggested Reading:
1. Timoshenko and Goodieer, Theory of Elasticity, Mcgraw Hill Publications 3rd Edition,
2. Madleson, Theory of Plasticity,
ME 517

EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS

Instruction /Week 3 Periods
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I

UNIT-II

UNIT-III

UNIT-IV
Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization. Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

UNIT-V

Suggested Reading:
ME 519

PRODUCT DESIGN AND PROCESS PLANNING

Instruction 3 Periods
/Week
Duration of University Examination 3 Hrs
University Examination 80 Marks
Sessional 20 Marks

UNIT-I
Product design and process design functions, selection of a right product, essential factors of product
design, Morphology of design, sources of new ideas for products, evaluation of new product ideas.
Product innovation procedure - Flow chart. Qualifications of product design Engineer. Criteria for

UNIT-II
Product reliability, Mortality Curve, Reliability systems, Manufacturing reliability and quality control.
Patents: Definitions, classes of patents, applying for patents. Trademarks and copyrights. Cost and
quality sensitivity of products, Elements of cost of a product, costing methods, cost reduction and cost
control activities. Economic analysis, Break even analysis Charts. Value engineering in product design,
creativity aspects and techniques. Procedures of value analysis – cost reduction, material and process
selection.

UNIT-III
Various manufacturing processes, degree of accuracy and finish obtainable, process capability studies.
Methods of improving tolerances. Basic product design rules for Casting, Forging, Machining, Sheet
metal and Welding. Physical properties of engineering materials and their importance on products.
Selection of plastics, rubber and ceramics for product design.

UNIT-IV
Industrial ergonomics: Man-machine considerations, ease of maintenance. Ergonomic considerations in
product design - Anthropometry, Design of controls, man-machine information exchange. Process sheet
detail and their importance, Advanced techniques for higher productivity. Just-in-time and Kanban
System. Modern approaches to product design; quality function development, Rapid prototyping.

UNIT-V
Role of computer in product design and management of manufacturing, creation of manufacturing data
base, Computer Integrated Manufacturing, communication network, production flow analysis, Group
Technology, Computer Aided product design and process
Planning. Integrating product design, manufacture and production control.

Suggested Reading:
1. Niebel, B.W., and Draper, A.B., Product design and process Engineering, Mc Graw Hill – Kogalkusha
   Ltd., Tokyo, 1974.
   New Delhi, 2004.
With effect from the academic year 2012 - 2013

ME/Ph.D 521

ENGINEERING RESEARCH METHODOLOGY

Instruction: 3 Periods/week
Duration of University Examination: 3 Hrs.
University Examination: 80 Marks
Sessional: 20 Marks

UNIT-I
Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

UNIT-II
Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT-III

UNIT-IV
Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's 't' test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

UNIT-V

Suggested Reading:
1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
With effect from the academic year 2012 - 2013

**ME 567**

**INDUSTRIAL TRIBOLOGY**

<table>
<thead>
<tr>
<th>Instruction</th>
<th>3 Periods</th>
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<tbody>
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<td>/Week</td>
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<tr>
<td>Duration of University Examination</td>
<td>3 Hrs</td>
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<td>80 Marks</td>
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<td>Sessional</td>
<td>20 Marks</td>
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**UNIT-I**

Introduction to Tribology. Surface Topography: Texture measurement, profilometry, cartography, photogrammetry, Texture depth, out flow meter, surface prints, statistical features, mathematical representation, parameter selection, model and Ideal surface.

**UNIT-II**


**UNIT-III**


**UNIT-IV**

Lubrication: Basic Principles of lubrication, choice of lubrication type, selection of lubricating oils, oil-feed system, hydrodynamic, boundary and electrodynamics, lubrication. Oil changing and oil conservation, lubricant testing and specification, lubricant monitoring and Health & Safety aspects.

**UNIT-V**


**Suggested Reading:**

With effect from the academic year 2012 - 2013

ME 520

RAPID PROTOTYPING PRINCIPLES AND APPLICATIONS

Instruction 3 Periods/Week
Duration of University Examination 3 hours
University Examination 80 Marks
Sessional 20 Mraks

UNIT – I

UNIT – II


UNIT – III


UNIT – IV

Rapid Prototyping Software’s: Features of various RP software’s like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT – V

Suggested Reading:

PRODUCTION ENGINEERING LAB

Instruction 3 Periods/week
Sessional 50 Marks

List of Experiments:

1. Study of the morphology of chips produced from different materials and machining processes.
2. Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3. Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4. Evaluation of cutting forces using 3-D dynamometer in simple turning process.
5. Estimation of torque and thrust on a twist drill and effect of tool geometry and axial feed rate.
7. Roughness of machined surface. Influence of tool geometry and feed rate.
8. Electro chemical machining. Effect of flow rate of electrolyte and material structure on machining characteristics.
9. Study of the ultrasonic machining setup and simple experiments on machinability of glass and other typical materials.
10. Study and operation of abrasive jet machining with simple experiments on M.R. with flow rate and stand off distance.
11. Study of the construction and operating parameters of metal spinning Lathe.
12. Study of the water hammer equipment and hydrostatic extrusion setup.
13. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
14. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
With effect from the academic year 2012 - 2013

ME 524

COMPUTATION LABORATORY

Instruction 3 Periods/week
Sessional 50 Marks

List of Experiments:

1. Introduction to Finite Element Analysis Software.
2. Static Analysis of a corner bracket.
3. Statically indeterminate reaction force analysis.
4. Determination of Beam stresses and Deflection.
5. Bending analysis of a Tee-shaped beam.
6. Analysis of cylindrical shell under pressure.
8. Stress analysis in a long cylinder.
9. Solidification of a casting.
10. Transient Heat transfer in an infinite slab.
11. Transient Thermal stress in a cylinder.
12. Vibration analysis of a Simply supported beam.
14. Thermal-Structural contact of two bodies.
15. Drop test of a container (Explicit Dynamics).