Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Technology and Science

Choice Based Credit System (CBCS) in Light of NEP-2020

M.Tech in Thermal and Design Engineering

(2021-2023)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTME115	DSE	Optimization Methods in Engineering	60	20	20	0	0	2	1	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
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Course Educational Objectives (CEOs):

(A)Introduce methods of optimization to engineering students, including linear programming, network flow algorithms, integer programming, interior point methods, quadratic programming, nonlinear programming, and heuristic methods. (B)Advanced optimization techniques such as Evolutionary search algorithms, Multi objective optimization are briefly introduced. (C)Numerous applications are presented in civil, environmental, electrical (control) engineering, and industrial engineering. The goal is to maintain a balance between theory, numerical computation, and problem setup for solution by optimization software, and applications to engineering systems.

Course Outcomes (COs):

The student will be able to understand:

1. basic theoretical principles in optimization
2. formulation of optimization models
3. solution methods in optimization
4. methods of sensitivity analysis and post processing of results
5. applications to a wide range of engineering problems

Syllabus

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Unit-I **(8Hrs)**

Introduction and Basic Concepts - Historical Development; Engineering applications of Optimization; Art of Modeling; Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems Classification of optimization problems Optimization techniques – classical and advanced techniques

Unit-II **(9Hrs)**

Optimization using Calculus - Stationary points; Functions of single and two variables; Global Optimum; Convexity and concavity of functions of one and two variables; Optimization of function of one variable and multiple variables; Gradient vectors; Examples; Optimization of function of multiple variables subject to equality constraints; Varangian function Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values Kuhn-Tucker Conditions; Examples

Unit-III **(10Hrs)**

Linear Programming - Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations; Graphical method for two variable optimization problem; Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems; Revised simplex method; Duality in LP;Primaldual relations; Dual Simplex method; Sensitivity or post optimality analysis Other algorithms for solving LP problems – Karmarkar's projective scaling method

Linear Programming Applications- Use of software for solving linear optimization problems using graphical and simplex method; Examples for transportation, assignment and other optimization problems

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Unit-IV **(8Hrs)**

Dynamic Programming- Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality; Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP) Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.
Dynamic Programming Applications - Problem formulation and application in Design of

continuous beam and Optimal geometric layout of a truss; Water allocation as a sequential process; Capacity expansion and Reservoir operation

Unit-V **(8Hrs)**

Integer Programming - Integer linear programming; Concept of cutting plane method; Mixed integer programming; Solution algorithms.
Advanced Topics in Optimization - Piecewise linear approximation of a nonlinear function; Multi objective optimization – Weighted and constrained methods; Multi level optimization; Direct and indirect search methods; Evolutionary algorithms for optimization

References:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P) Ltd., New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.

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3. H.A. Tasha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb,"Optimization for Engineering Design Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nags Kumar, "Multicriterion Analysis in Engineering and anagement", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288

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MTME125	DSE	Micro and Smart Systems	60	20	20	0	0	2	1	0	3

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Course Objectives:-

1. Introduce various aspects of micro systems and scaling effects.
2. Familiarize the students with micro fabrication, modeling and simulation.

Course Outcomes:-

1. Classify the presently available micro sensors and actuators available in the market.
2. Understand the conventional and silicon based micro machining technologies for smart structure development.
3. Compute the coupled response of an electro mechanical smart system using finite element method.
4. Identify the credibility of various electronic circuits and control methods used to develop micro and smart systems.

Syllabus

Unit-I **(8Hrs)**

Introduction:

Smart materials and systems: an overview and Introduction of Micro and smart systems, Processing of Sensors, Actuators and micro structures, Applications in diverse fields including Biomedical, Defense, Automobile and Aerospace Engineering and Examples of smart systems: structural health monitoring and vibration control

Unit-II **(9Hrs)**

Micro Fabrication Processes:

Introduction of Micro Machining Technologies, conventional and silicon micro machining techniques, Ultrasonic machining, sandblasting, laser ablation, spark erosion and photo lithography and Smart material processing.

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Unit-III **(8Hrs)**

Modeling and Mechanics:

Stresses and deformation: bars and beams and Solid mechanics concepts for Micro and smart systems, Solid Modeling in Micro systems and Frequency response; damping; quality factor.

Unit-IV **(8Hrs)**

Finite Element Method:

Types of Numerical Methods for solving partial differential equations, FEM applications for modeling and analysis of Coupled Electromechanical Systems

Unit-V **(9Hrs)**

Electronics and Packaging:

Integration of mechanical components with electronics, Electronic circuits and control for micro and smart systems, scaling effects and Case-study Pressure sensor and Accelerometer

References Books:

1. G. K. Anantha Suresh, "Micro and Smart Systems", Wiley India Pvt. Ltd., 2010
2. Kasudev Aatre, "Micro and Smart Systems: Technology and Modeling", John Wiley & Sons, 2012.
3. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture", Tata McGraw Hill Education Private Limited, 2002.

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MTME215	DSE	Advanced Heat and Mass Transfer	60	20	20	0	0	2	1	0	3

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Course Objectives:-

The basic objective of the subject is to have goal of achieving a workable system and of designing an optimum system. The possibility of optimization represents one of the few facets of this subject. Pre requisites: Thermodynamics, Heat & Mass Transfer.

Course Outcomes:-

1. Students able to learn basic principles and mode of transfer of heat energy by convection, conduction and radiation.
2. Students able learn basic Application of empirical relations to variation geometries for laminar and turbulent flows.
3. Students will be able to understands the physical mechanisms involved in radiation heat and mass transfer.

Syllabus

UNIT- 1 **(8Hrs)**

Introduction To Different Modes Of Heat Transfer

Conduction: General heat Conduction equation-initial and boundary conditions. Transient heat conduction: Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction-2D transient heat conduction-product solutions.

UNIT- 2 **(8Hrs)**

Finite Difference Methods For Conduction

ID & 2D steady state and simple transient heat conduction problems-implicit and explicit methods. Forced Convection: Equations of fluid flow-concepts of continuity, momentum equations-derivation of

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energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis..

UNIT- 3 **(9Hrs)**

External Flows

Flow over a flat plate: integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows. Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient-types of flow-constant wall temperature and constant heat flux boundary conditions-hydrodynamic & thermal entry lengths; use of empirical correlations.

UNIT-4 **(6Hrs)**

Convection

Thermal boundary layers - Momentum and energy equations -Internal and external flows- Forced convection over cylinders, spheres and bank of tubes.

UNIT- 5 **(10Hrs)**

Radiation

Radiation ; Recapitulation of fundamentals of radiative heat transfer, radiative properties of surfaces, methods of estimating configuration factors, heat exchange between diffusively emitting and diffusively reflecting surfaces. Radiant energy transfer through absorbing, emitting and scattering media. Combined conduction and radiation systems: fins, Introduction to solar radiation in earth's atmosphere.

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Reference Books:

1. V.S Arpaci, "Conduction Heat Transfer", E.M Sparrow,2005.
2. R.D Cess, "Radiation Heat Transfer", 2000.
3. Sarit K. Das, "Heat & Mass Transfer" , Dhanpat Rai, 2013.
4. P.K.Nag, "Heat Transfer", TMH, 2007.
5. RK Rajput, "Heat Transfer", S.Chand, 2015.
6. SK Som, "Introduction to Heat Transfer", PHI , 2011.
7. Mahesh Rathore, "Engineering Heat & Mass Transfer", Lakshmi Publications, 2015
8. Necati Ozisik, "Heat Transfer", TMH, 2006.
9. Nellis & Klein, "Heat Transfer", Cambridge University Press, 2012.
10. P.S. Ghoshdastidar, "Heat Transfer", Oxford Press, 2000.

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MTME135	DSE	Computer Applications in Design	60	20	20	0	0	2	1	0	3

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Course Objectives:-

1. The primary objective of the course is to describe the Design Concepts with the help of Computer Application.
2. This course Provides comprehensive Knowledge of computer applications including geometric, solid, surface & wireframe modelling and Assemblies of parts & Graphics Standards.

Course Outcomes:-

1. Student will be able to understand the various Design concepts with the help of computer application.
2. Students would be able to get familiarized with the computer graphics application in design and understand the basic 2D & 3D commands of CAD and distinguish the CAD from manual paper drafting, in current industrial & product development scenarios.
3. Students would be able to understand the Solid, Surface & Wireframe modeling to develop product to use in various experiments & real life.
4. On completion of this course the students will be able to acquire knowledge of the applications of computers in design, parts creation & assembling, mechanism and manufacturing activity.

Syllabus

Unit-I **(8Hrs)**

Introduction to Design Concepts with Computer Application

Introduction to CAD , Why CAD Software ,Scope, objective, benefit , limitation & evaluation Engineering design, Engineering Design process, Types of designs, Considerations of a good design, Formulation of the design problem, Importance, Regulatory and social issues in Indian

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context, Conceptual Design, Product Design Cycle, Total life cycle, Digital Prototyping, Product development today.

Unit-II **(10Hrs)**

Computer Graphics Fundamentals

Definition, Software configuration of a Graphic system, Functions of a Graphics package, CAD Interface , Coordinate system , Create Objects, Linear Objects lines , Polylines, Multiline, Rectangle & Polygons, Freehand Sketches Curved Objects Arcs Circles Donuts Ellipses Splines, Helixes, Construction and Reference Geometry, Utility Commands, Modify Objects, Move or Rotate Objects, Copy, Array, Offset, Mirror, Change the Size and Shape of Objects Fillet, Chamfer, Break, or Join Objects, Layers & Blocks, Text, Table & Dimensions , Introducing Printing, Plotting, and Layouts .

Unit-III **(9Hrs)**

Geometric Modeling

Introduction of Geometric Modeling , Types of models, Construction of 3D Solid Primitives , Create 3D Solids from Objects, Extrude , Revolve, Sweep, Loft , Combine or Slice 3D Objects, Move Rotate & Scale 3D Objects, Object Sectioning , Save and Publish Section Objects Wire frame Models, Wire frame Entities, Curve Representation. Parametric Representation of Analytic Curves - Review of Vector Algebra, Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics. Parametric Representation of Synthetic Curves - Hermite Cubic Splines, Bezier Curves, B-Spline Curves, Rational Curves. Curve Manipulations.

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Unit-IV **(9Hrs)**

Surface & Mesh

Introduction Surface Models, Surface Entities, Surface Representation, Parametric Representation of Analytic Surfaces - Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Parametric Representation of Synthetic Surfaces - Hermit Bicubic Surface, Bezier Surface, B-Spline Surface, Coons Surface, Blending Surface , Offset Surface, Triangular Patches, Sculptured Surface, Rational Parametric Surface, Trim and Untrim Surfaces, Create & Edit NURBS & Control Vertices .Create 3D Mesh Primitives , Modify Mesh Objects, Change Mesh Smoothness Levels. Modify Mesh Faces. Meshing algorithms,

Unit-V **(8Hrs)**

Parts Assembly , Visualization & Graphics Standards

Mechanical Assembly: Introduction, Assembly Creation Methods , Design for Assembly (DFA), Assembly Modeling - Parts Modeling & Representation, Hierarchical Relationships, Generation of Assembling Sequences - Precedence Diagram, Assembly Constraints, Mechanism & Mechanism Analysis, Connections, Servo & Force Motors, Mass Properties , Representation schemes - Graph, Creating Visual styles, Materials and Texture, Light Effect , Camera & Animation. Data exchange standards – IGES – STEP – CALS – DXF – STL, Communication standards – LAN, WAN.

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1. George E. Dieter, Linda C. Schmidt, "Introduction to Engineering Design", McGraw Hill, 2013.
2. George Omura, "Mastering CAD", Brian Benton Autodesk.
3. Rao "CAD/CAM: Principles and Applications" 3rd Edition, Tata McGraw Hill, India, 2010.
4. Gerald E. Farin, Hans Hagen, Hartmut Noltemeier and Walter Knödel, "Geometric Modeling", Springer-Verlag,1999.
5. Anupam Saxena, Birendra Sahay, "Computer aided Engineering design", Springer, 2010.

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COURSE CODE	CATE-GORY	COURSE NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTME225	DSE	Gas Dynamics And Jet Propulsion	60	20	20	0	0	2	1	0	3

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To understand the basic concepts and importance of gas dynamics.
2. To understand the phenomena of various flows such as Shock, Fanno and Rayleigh flow.
3. To understand the type of flow takes place in flow and non-flow system.
4. To understand various terms such as mach no., Subsonic, Sonic and Supersonic flow.
5. To understand the thrust equation and its application in aircraft and rocket propulsion.

Course outcomes:

1. Student able understand the basic concepts and importance of gas dynamics.
2. Student able understand the phenomena of various flows such as Shock, Fanno and Rayleigh flow.
3. Student able understand type of flow takes place in flow and non-flow system.
4. Student able understand various terms such as mach no., Subsonic, Sonic and Supersonic flow.
5. Student able understand the thrust equation and its application in aircraft and rocket propulsion.

Unit-I **9Hrs)**

Basic Concepts of Gas Dynamics: Terms related to gas dynamics, Energy Equation for flow process, Various flow regions, stagnation state, velocity of sound, Mach number .,Subsonic, Sonic and Supersonic Flow, Critical mach number, Crocco Number, Mach cone, effect of mach number on compressibility, T-S and h-s diagram for diffuser and nozzle process.

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Unit-II **8Hrs)**

Oblique Shock Waves: Relations and reflections of oblique shock waves, interaction of oblique shock waves, conical shock waves, Expansion waves, Prandtl-Meyer flow, reflection of expansion waves, flow over bodies involving shock and expansion waves, Variable area flow and its equations, characteristitics of Nozzle operation, Supersonic diffusers-Convergent and Divergent. Flow in constant area duct. The fanno line.

Unit-III **(8Hrs)**

Flow with Heat addition or removal:1-D flow in constant area duct, variable area flow with addition of heat, Generalized Quasi 1-D flow, one-dimensional constant area flow with friction and heat exchange, Governing equations for 1-D flow, Two-Dimensional Compressible Flow: Governing equations, velocity potential, linearized subsonic flow, linearized supersonic flow.

Unit-IV **(8Hrs)**

Propulsion: Air craft propulsion, jet engine and its types, flow of energy through jet engines, thrust, power and propulsive efficiency of jet engines. Turbojet components such as diffuser, compressor, combustion chamber, turbines, exhaust systems. Jet Engine-Performance, turbo prop engines, ram jet and pulse jet engines.

Unit-V **(7Hrs)**

Rocket propulsion: Principle of rocket propulsion, Thrust equations, effective jet velocity, performance of rocket engines, specific impulse, thrust application, solid and liquid propellant rockets.

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Reference Books:

1. Patrich.H. Oosthvizen, William E.Carscallen, "Compressible fluid flow", McGraw-Hill, 1997.
2. Rathakrishnan. E., "Gas Dynamics", Prentice Hall of India, New Delhi, 2001
3. Anderson, D. John Jr., 'Introduction to Flights', Mc Graw Hill, ISE, 2004
4. Dr. Somasundaram S.L., 'Gas Dynamics and Jet Propulsion', Newnes – Butterworths & Co Publishers Ltd 1999
5. Patrich.H. Oosthvizen, William E.Carscallen, "Compressible fluid flow", McGraw-Hill, 1997

Text Book:

1. Yahya. S.M., "Fundamental of compressible flow with Aircraft and Rocket propulsion", New Age International (p) Ltd., New Delhi, 2005.
2. Ganesan. V., "Gas Turbines", Tata McGraw-Hill, New Delhi, 1999

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MTIE111	DSE	Ergonomic and Industrial Safety	60	20	20	0	0	2	1	0	3

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Course Educational Objectives (CEOs):

To (A) Explain the psychology of human behavior as it relates to workplace safety, (B) Identify ergonomic hazards, (C) Recommend appropriate controls, and relate the human and workplace factors which contribute to ergonomic hazards.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Explain the psychology of human behavior as it relates to workplace safety.
2. Identify ergonomic hazards; recommend appropriate controls.
3. Relate the human and workplace factors which contribute to ergonomic hazards.

Syllabus

UNIT-1 **(8Hrs)**

Ergonomics: Definition, Application, Brief History, Effectiveness and Cost-Effectiveness of Ergonomics Human Factors and Ergonomics, Systems of the Human Body, Anatomy of Spine and Pelvis Related to Posture Biomechanics, Muscular System, Ergonomics and the Musculoskeletal System, Costs of Back Injuries.

UNIT-2 **(8Hrs)**

Muscular Work and Nervous Control of Movements, Types of Muscular Work, Muscular Fatigue, Types of Muscle Contractions, Measurement of Muscular Strength, Anthropometry:

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Vishwavidyalaya, Indore	Vishwavidyalaya, Indore		

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Definition, Terminology, Myth of the Average Human, Principles of Universal Design, Anthropometric Measurements

UNIT-3 **(8Hrs)**

Design of Workplaces and Hand Tools, Work Design Analysis, Designing for Hand Use, Types of Injuries and Disorders. Work-Related Musculoskeletal Disorders, Types of Work-Related MSD's, Task-related Factors, Personal Risk Factors, Impact on Industry, Ergonomic Program for WMSD's.

UNIT-4 **(8Hrs)**

Heavy Work and Evaluating Physical Workloads and Lifting, Heavy Work, Manual Material Handling & Lifting, Classification and Risks, NIOSH Lifting Guidelines, Job Demands and Workplace Stress, Mental Fatigue/Shift-work Fatigue.

UNIT-5 **(8Hrs)**

Information Ergonomics: Controls, and Displays, Mental Workload Measurement, Primary and Secondary Task Performance, Controls and Displays (Types), Control Layout and Design, How to Implement An Ergonomic Program, Management and Employee Involvement, Setting Up the Ergonomics Program, Problem Identification, Hazard Prevention and Control, Training.

Reference Books:

1. Robert Bridger, "Introduction to Ergonomics", CRC Press; 3rd edition, 2008.
2. Scott, P.A.; Charteris, J.; Bridger, R.S, "Global Ergonomics", Elsevier Science, 2000.

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3. Rieske, David W., Asfahl, C. Ray, "Industrial Safety and Health Management", Pearson, 2018.
4. Joel M. Haight; Jeffery C. Camplin; Chritopher A. Janicak; Anjan K. Majumder; Linda S. Rowley; Kathy, "Principles of Industrial Safety" ASSE, 2009.

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MTME301	PW/I	Dissertation Phase I	0	0	0	300	200	0	0	20	10

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;

Course Educational Objectives (CEOs):

Students obtain a hands-on experience by converting a small novel idea/technique into a working model/prototype or analysis etc. applying multi-disciplinary skills and / or knowledge and working in at team/individual.

Course Outcomes (COs):

At the end of the course, student will be able-

1. To conceptualise a novel idea / technique into a product.
2. To think in terms of multi-disciplinary environment and apply it.
3. To apply multi- disciplinary technical knowledge into project.
4. To take on the challenges of recent scenario work, prepare a presentation in a professional manner, and document all aspects of design/carried out work.

Syllabus

To guide the student in such a way so that they carry out on a topic as a forerunner to full-fledged work to be taken subsequently in Major project, a multidisciplinary project is to be taken up by a team/individual (as per the university guidelines). Development of prototype product, a 3D model, simulation, analysis of particular technical problem etc. blueprint for a larger project and any other development work are permitted. The contribution of the individuals in the project should be clearly brought out. A combined report is to be submitted. Also, a presentation* is to be made for the reviewers* on the work done by the candidate.

*Review or evaluation/ report preparation/presentation will be as per guidelines of university/institute/head.

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