Department of Systems Engineering
University of Lagos
HISTORY OF THE PROGRAM

The Systems Engineering program of the University of Lagos was established in 2000. It is a hybrid program in which materials are selected from the classical Engineering programmes of Mechanical and Electrical Engineering as well as Computer Science. Systems Engineering was developed in response to the challenges faced by today’s scientific and Engineering community that require the ability to handle large or complex systems. Systems Engineering require interdisciplinary skills and has the objective, like other Engineering disciplines of using advances in science and technology to empower both individuals and the society at large.

The present Department of Systems Engineering evolved out of the teaching and research activities of the Engineering Analysis Unit (EAU) which was established early in the 1970/71 session as a sub-unit within the Civil Engineering Department for the study and development of mathematical techniques in the modeling and solution of Engineering problems. It later became an autonomous academic Unit within the faculty in 1975. Only post-graduate degrees were awarded initially.

In the year 2000, the first set of undergraduate students was admitted. It comprised the following:

- UME Students (100 level),
- students from other Departments of Faculty of Engineering who were crossing over from 100 to 200 level,
- students who just completed the Diploma II programme, (200 level) and
- direct entry students (A-Level and OND) (200 level)

The criteria for admission was a CGPA of 3.50 and above (for Diploma entrants) while the OND direct entry students were expected to have an upper credit.
1.0 ACADEMIC CONTENT

1.1 PHILOSOPHY AND OBJECTIVES OF THE PROGRAMME

The Systems Engineer specializes in engineering modeling and the general deployment of cybernetics and artificial intelligence concepts in the planning, design, operation and management of engineering activities especially in areas such as:

- Information and Communication Technologies
- Reactor devices and processes
- Energy systems
- Engineering manufacturing processes
- Operations, control and monitoring of electro-mechanical devices and systems
- Engineering graphics, simulation and animation
- Risk management in engineering systems.

It is now generally accepted that effective solutions to problems involving both society and technology must be based on broad systems point of view. Such solutions integrate the technical requirements with other increasingly important factors including social, human and political parameters. In fact, when large-scale problems are under study, few people can be expected to be fully knowledgeable in the complete span of factors and parameters, which must be considered. For such cases, inter-disciplinary teams arrive at solutions, where each member contributes his own special expertise. In order to work effectively on such teams, each member needs to be aware of the fundamental systems and design aspects of the problem.

The programme provides students with basic training and skills in analysis, designs, monitoring and control of engineering systems. The programme stresses the importance of humanistic and societal concerns as they shape the designer’s approach to solution of problems confronting the modern society. The Systems Engineer therefore strives to serve the dual needs of the society for the design of reliable and efficient systems, whilst protecting the overall integrity of the host environment. The objectives of the programme are:
• To bridge the gap between management/decision science and the Engineering profession through the integration of decision Science/Management courses to the traditional engineering discipline
• To produce engineers with multidisciplinary skills for today’s complex economy,
• To impart analytical and cutting-edge computing skills in Engineering training,
• To initiate and carry out engineering design, and
• To engage in management and to pursue research and development
1.2 THE CURRICULUM

The undergraduate programme in Systems Engineering provides students with basic training and skills in analysis, design, monitoring and control of engineering systems.

Students have three study options within the major: Operations Research/Manufacturing, Robotics and Systems Modeling and Simulation. The Operations Research/Manufacturing Option combines basic Systems Engineering knowledge with quantified management techniques enabling the Systems Engineer to plan, control, design and manage manufacturing operations. The Robotics option offers the Systems Engineer expertise in the design of functional robots in an engineering environment, while the Systems Modeling and Simulation option provides the engineer with the modern dynamic expertise of modeling stochastic and deterministic systems by simulation and animation. In all these options, emphasis is laid on computer applications and design of engineering systems.

1.2.1 PROGRAM TITLE

Undergraduate courses offered in the Department lead to the award of the B.Sc. (Honours) in Systems Engineering. The Department also offers postgraduate programmes of M.Sc. and PhD degrees in Systems Engineering.

PROGRAMME DETAILS

The attached tables outline the courses required of all Systems Engineering students and the various options offered.
### 1.2.2 SYSTEMS ENGINEERING COURSE STRUCTURE

#### 100 LEVEL

**FIRST SEMESTER**

<table>
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<tr>
<th>Course Code</th>
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<th>Type</th>
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<td>MEG 101</td>
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<td>Use of English I</td>
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<td>MEG 104</td>
<td>Engineering Drawing I</td>
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**TOTAL 15**

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<td>Fluid Mechanics</td>
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<td>EEG 307</td>
<td>Instrumentation and Measurement I</td>
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<td>SSG 303</td>
<td>Math. Modeling for AI systems</td>
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SSG 305  Special Analytic Techniques  2  C  -  
SSG 307  Operations Research I  3  C  -  
SSG 309  Elements of Games Theory  2  C  -  
SSG 313  Programming Languages  2  C  -  
SSG 315  Engineering Materials  2  C  -  

**TOTAL**  23

### SECOND SEMESTER

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<td>SSG 304</td>
<td>Statistical Distributions</td>
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<td>SSG 308</td>
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<td>SSG 310</td>
<td>Rigid body Dynamics</td>
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<td>SSG 312</td>
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<td>SSG 314</td>
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<td>SSG 318</td>
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<td>GEG 401</td>
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<td>SSG 403</td>
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<td>SSG 409</td>
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<td>SSG 411</td>
<td>Stochastic Models</td>
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**SECOND SEMESTER**

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**500 LEVEL**

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<td>SSG 503</td>
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<td>SSG 511</td>
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<td>SSG 513</td>
<td>Tech of Planning and Scheduling</td>
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<td>SSG 504</td>
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**OPTIONAL COURSES:**

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<tr>
<td>SSG 506</td>
<td>Systems Animation</td>
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<td>SSG 508</td>
<td>Manufacturing Systems Automation</td>
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SSG 510  Control of Robots and Human Arms 2 E
SSG 512  Image Processing 3 E
SSG 514  Facilities Planning 2 E
SSG 515  Principles of Modeling and Analysis of Chemical Process Syst. 3 E SSG405
SSG 516  Mechanics of the Continua 3 E

ROBOTICS OPTION REQUIREMENTS: SSG 505, 510, 511, 512.

OPERATIONS RESEARCH/MANUFACTURING OPTION REQUIREMENTS: SSG 506, 507, 511, 512.

SYSTEMS MODELING AND SIMULATION OPTION REQUIREMENTS: SSG 506, 507, 511, 512

MINIMUM CREDIT REQUIREMENT FOR THE AWARD OF B.Sc. SYSTEMS ENGINEERING:

(i) ROBOTICS OPTION: 190 units
(ii) OPERATIONS RESEARCH AND MANUFACTURING OPTION: 192 units
(iii) SYSTEMS MODELING AND SIMULATION OPTION: 191 units.
COURSE CONTENTS

GEG 101- ENGINEERING PURE MATHEMATICS I (3,0)

GEG 102 - ENGINEERING PURE MATHEMATICS II (2, 0)

GEG 103 – ENGINEERING APPLIED MATHEMATICS I (3, 0)

GEG 104 – ENGINEERING APPLIED MATHEMATICS II (2, 0)

FSC 105: INTRODUCTORY PHYSICS 1 (3 UNITS)

MEG 101 WORKSHOP PRACTICE I (1, 1)
Introduction to basic equipment in wood, machine, fitting and welding workshops. Element of safety practice with the various tools used in the workshops. Discussion on general safety precaution. General principles governing the various workshop machines. Selection and use of tools for specific operations in the various workshops. Practical demonstration of use of tools and machines in performing basic workshop processes.

MEG 102 WORKSHOP PRACTICE II (1, 1)
Introduction to more advanced machinery and equipment in the workshops. Introduction to sketching and labeling of machines parts and tools. Emphasis is laid on the ability of students to be able to competently handle standard workshop equipment.
Machining: Practical work on machines for the purpose of carrying out individual projects. Detection of faults in work pieces. Fitting: Shaping and finishing of metallic objects. Welding: Preparation of pieces for welding visual examination of welds, etc. Woodwork: Introduction to constructional technique of woodwork joints. Simple individual projects in different aspects of workshop practice.

MEG 104 ENGINEERING DRAWING (1, 1)
Introduction to drawing instruments and their proper use. Use of scales, line-work, lettering, and dimensioning. Geometrical constructions including tangents, normal, polygons, etc. Loci, including paths

**PHS 101  INTRODUCTORY PHYSICS II (3 UNITS)**

**PHS 102  INTRODUCTORY PHYSICS III (3 UNITS)**

**PHS 103 INTRODUCTORY PRACTICAL PHYSICS (2 UNITS)**
Simple experiments illustrating the key topics covered in FSC 105, PHS 101 AND PHS 102 theoretical courses.

**ENG 105: THE USE OF ENGLISH I**
The courses are designed to enable students to acquire improved study skills and better communicative skills in the use of English for general and academic purposes at the university level. The emphasis in GST 105 is on developing through lectures/discussions and weekly exercise students’ study skills, listening, reading and comprehension skills: improved knowledge of English grammar and usage; vocabulary development, etc. all of which are needed to provide a smooth transition from the secondary school to the university in terms of the language needs for academic purposes.

**ENG 106: THE USE OF ENGLISH II**
This segment of the course will focus on developing the various aspects of writing skills ( Mechanical and functional) which students will need in their various writing tasks in the university. In addition, attention
will be given to the specific English needs of student according to their subject specialization. Emphasis will be on developing the students’ oral and written communicative skills in English through the identification of relevant tasks and appropriate enabling skills. Exercises will be given in the use of appropriate registers and varieties of English.

**GEG 201 – ENGINEERING MATHEMATICS I (3, 0)**

Elementary Vector Space Theory: Linear vector spaces and matrices; dimensionality of space; summation convention. Matrices and Linear transformations. Elementary complex Analysis: Logarithmic, Exponential and Circular complex functions. Mapping by elementary complex functions; Limit, Continuity and Differentiability of Complex functions; Cauchy-Riemman’s Equations; Line Integrals. Integration of functions of Complex Variables. Cauchy’s Integral Theorem; Cauchy’s Integral Formula; Residue Theorem.Introduction to Differential Equations; Classification of Ordinary Differential Equations; Order, Degree and linearity. Types and Techniques of solution of first order ODEs; Picard’s iterative method; Types and Techniques of solution of second order ODEs. Systems of Linear ODEs. Engineering Applications of ODEs.

**GEG 202 – INTRODUCTORY ENGINEERING STATISTICS (3, 0)**


**GEG 203 – SURVEYING MATHEMATICS (3, 0)**


**MEG 201 FUNDAMENTALS OF THERMODYNAMICS (2, 0)**

MEG 202 FLUID MECHANICS (2, 0)

EEG 201 * - FUNDAMENTALS OF ELECTRICAL ENGINEERING I

EEG 202: FUNDAMENTALS OF ELECTRICAL ENGINEERING II
Emf: Generation, Single phase; rms means, form factor, peak factor, phasor and phasor diagram. Series and parallel resonance circuit. Resonance, Q- factor, impedance and power P,S, and Q3 phaser, delta and star conversion line and phase voltages. Complex Notation and its Application to RLC circuits. Resonance, Q-factor, impedance and power P,S, and Q.3 phaser, delta and star conversion line and phase

**EEG 203: SIGNALS AND SYSTEMS (SIGNAL THEORY)**
Continuous and discrete signals, transformations and inverse transformations, spectral analysis of steps, ramps and impulse, signal descriptions by impulse and step functions. The independent variable; Definitions of rise-time setting time, overshoot, period magnitude and duration of a signal. Fourier Analysis, Perseval Theorem.

**MEG 203 MECHANICAL MEASUREMENTS AND INTRUMENTATION (2, 0)**

**CEG 202 MECHANICS OF MATERIALS**
Prerequisite: MEG 210

**MEG 205 ENGINEERING MECHANICS I: STATICS (2, 0)**
Fundamentals of mechanics. Forces in space equipment systems, equilibrium of rigid bodies, distributed forces, centroid, centre of mass, internal actions, analysis of simple structures and machines parts, principle of virtual work.
Prerequisite: GEG 103.
**SSG 204 – DIFFERENTIAL EQUATIONS I (3, 0)**

**SSG 205 – INTRODUCTION TO ENGINEERING COMPUTING (1, 1)**
Introduction to Computer systems. Flow charts and basic data processing cycles. The mathematics of computing. Introduction to Programming Languages: Programming in QBASIC, FORTRAN and C.

**SSG 206 – NUMERICAL METHODS IN ENGINEERING I (3, 0)**

**GEG 208 – ENGINEER IN SOCIETY (1, 0)**
Philosophy of Science. History of Engineering technology. Safety in Engineering and introduction to risk analysis. The role of Engineers in nation building. Invited lectures from Professionals.

**GEG 301 – ENGINEERING MATHEMATICS II (3, 0)**

**GEG 302 – OPERATIONAL METHODS I (2, 0)**

Fourier series: periodic functions; Dirichlet conditions; odd and even functions; half-range Fourier sine and cosine series. Parseval’s identity. Differentiation and integration of Fourier series. Boundary value problems.
The Laplace transform and applications (excluding the use of inversion integral and convolution theorem).

**EEG 301 CIRCUITS AND SYSTEM I**


**MEG 316: INDUSTRIAL ENGINEERING (3, 0)**


**MEG 311: MECHANICAL ENGINEERING TECHNOLOGY (3, 0)**

Description of methods of corrosion control and prevention. Introduction of metals and metal alloy systems. The metallic bond and structure of alloys.

**SSG 303 – MATHEMATICAL MODELING FOR ARTIFICIAL INTELLIGENCE SYSTEMS (2, 0)**

Introduction to Artificial Intelligence (AI); Fundamentals of artificial reasoning and expert systems, Mathematical basis of AI. Introduction to MATLAB software; introduction to neural networks; elements of conventional AI search techniques; Cantor set search technique.

**SSG 304 – STATISTICAL DISTRIBUTIONS (2, 0)**


**SSG 305– SPECIAL ANALYTICAL TECHNIQUES (2, 0)**

Elements of Fuzzy set and fuzzy logic. Introduction to Graph theory. Methods of fractiles; Heuristic Search Techniques: Tabu Search, Simulated Annealing and Evolutionary Algorithms such as Genetic and Ant-colony algorithms.

**SSG 306 – DIFFERENTIAL EQUATIONS II (3, 0)**


**SSG 307 – OPERATIONS RESEARCH I (3, 0)**

Introduction to operations research. Linear programming models; primal and dual problems; graphical solutions, simplex method; post optimality analysis; special algorithms; trans-shipment and assignment problems. Maximal flow, shortest route, minimum spanning tree; travelling salesman problems. Inventory problems.
SSG 308 – OPERATIONS RESEARCH II (2, 1)
Integer programming; dynamic programming; non-linear programming algorithms: direct search, gradient method, separable programming, complex optimisation method. Sequential unconstrained maximisation algorithm (SUMT).

SSG 309 – ELEMENTS OF GAMES THEORY (2, 0)

SSG 310 – RIGID BODY DYNAMICS (3, 0)

SSG 312 – CONTROL THEORY I (2, 0)

SSG 313 - PROGRAMMING LANGUAGES - (2, 1)
Object-oriented C++ Programming: Introduction to the concept of Object-oriented Programming (OOP); Properties of OOP with C++ as a case study - Object definition, language elements, data abstraction, Composition and Inheritance; Illustrations using Vector class, matrices and arrays.
**SSG 314 - ALGORITHMS AND DATA STRUCTURES - (2, 0)**

Review of elementary algorithm and flow chart; Algorithmic Design Method; sorting and Order statistic; Recursive algorithm; Dynamic Information structure; Number system and their representation; Code, error, detection and correction; Data item; elementary item; structured data; Item (array, Ordered list, pare matrices, tack, Queue). Tree, simple sorting and searching technique. Concept of record and file: Record formats and label; logical file, definition label, record blocking and deblocking.

**SSG 315: ENGINEERING MATERIALS - PROPERTIES AND SELECTION FOR USE (2,0)**

Introduction to the science and structure of engineering materials classified into the following major groups - Metals and alloys, Polymers and Rubber, Ceramics and glasses and composites. Mechanical (i.e strength, toughness and stiffness), chemical (i.e oxidation resistance and corrosion) and physical (i.e. density, thermal conductivity, electrical conductivity and magnetic) properties.

Manufacturing methods, uses and major application of each engineering material. Selection and use of engineering materials - motivation for selection, cost basis for selection and establishment of service requirements and failure analysis. Selection for mechanical properties (i.e static strength, toughness, stiffness, fatigue, creep and temperature resistance), selection for surface durability (i.e. corrosion resistance and resistance to wear). Case studies in materials selection (e.g. materials for gas turbine, bearings, engines and power generation, ship structures, screw driver, hammer, aeroplane design and construction etc.

**SSG 316 : ENGINEERING MATERIALS AND THE ENVIRONMENT (1,0)**

GEG 403 – ENGINEERING STATISTICS

CPE 407: INTRODUCTION TO SYSTEMS PROGRAMMING.
Concepts and uses of macro-assemblers and conditional assembly. Use of access methods control for 1/0 device. Job control languages and file structures, File and storage management. Use of linkers and loaders in load modules creation.

EEG 405: CLASSICAL CONTROL SYSTEMS ANALYSIS
Modeling of physical systems, Dynamic equation of mechanical, electrical, thermal and fluid flow systems.

SSG 401 – NUMERICAL METHODS IN ENGINEERING II (3, 0)

SSG 403 – OPERATIONAL METHODS II (2, 0)
SSG 405 – MATHEMATICAL MODELS OF CHEMICAL ENGINEERING SYSTEMS (3,0)
Basic Chemical Engineering Systems: Series of Isothermal CSTR'S, Heated Tanks, Gas-phase, pressurized CSTR, Non-isothermal CSTR, Single-component vaporizer, Multicomponent Flash Drum, Batch Reactor, Reactor with mass transfer, Ideal Binary Distillation Column, Multicomponent non ideal distillation column.
Simulation Examples of models: Gravity-Flow Tank, CSTRs in Series, Non isothermal CSTR, Binary Distillation Column, Multicomponent.

SSG 407 – MECHANICS OF ROBOTIC SYSTEMS I

SSG 409 – SYSTEMS SIMULATION I

SSG 411 – STOCHASTIC MODELS (2, 0)

GEG 501 : ENGINEERING ECONOMICS
GEG 502: ENGINEERING MANAGEMENT

Part I - Contract. (Law)

Part 2: Management

MEG 507: PRODUCTION ENGINEERING I (2,1)
Prerequisite: MEG 314

MEG 512 AUTOMATIC CONTROL (3,0)
Prerequisite: MEG 409

SSG 501 – CONTROL THEORY II (2, 0)
The phase plane portrait. Determination of the qualitative behaviour of non-linear second order systems by Linearisation (Lyapunov’s first method). Envelop methods; the Popov and circle criteria. Limit cycles and relaxation oscillations. Liennard’s equation. Gradient system decomposition.
SSG 502 – ENGINEERING SYSTEMS ANALYSIS (2, 0)
Fundamental concepts: Dynamic system variables. Fundamental postulates of systems analysis. The concept of information, signal and feedback.

SSG 503 – ARTIFICIAL INTELLIGENCE (2, 0)
Introduction to search methods in AI problems. Self organising systems, information theory, rational decision making, pattern recognition, parametric and non-parametric training for developing pattern classifiers; problem solving. The Minimax and alpha-beta algorithms and heuristic approaches to state space search problems.

SSG 504 – AUTOMATED REASONING (1, 1)

SSG 505 MECHANICS OF ROBOTICS SYSTEMS II (2, 1)

SSG 506 – SYSTEMS ANIMATION (1, 2)
Procedural modeling and animation. The use of animation software; the Proof Animation and others. Problems drawn from different systems models.
SSG 507 – SYSTEMS SIMULATION II (1, 1)
Discrete event simulation. Examples in different production and service systems. Principles and computer languages e.g. GPSS/H, SLX, ARENA, PROMODEL, EXTEND. Model Validation. Analysis of Simulation data.

SSG 508 – MANUFACTURING SYSTEMS AUTOMATION (2, 0)
Computer assisted manufacturing systems: NC, CNC, DNC; robotics, materials handling, group technology, flexible manufacturing systems, process planning and control. Computer Integral Manufacturing (CIM).

SSG 509 – SYSTEMS RELIABILITY (2, 0)

SSG 510 – CONTROL OF ROBOTS AND HUMAN ARMS. (3, 0)

SSG 511 – COMPUTER GRAPHICS (1, 1)
The study of fundamental mathematical algorithmic and representational issues in graphics: Graphics process, projective geometry, homogenous coordinates; projective transformation, quadrics and tensors; line drawing; surface modeling and object modeling; reflectance models and rendering, texture mapping; polyhedral representations. Procedural modeling.

SSG 512 – IMAGE PROCESSING (2, 1)
Psychophysics of vision. Properties of images sampling, digitizing and displaying images; geometric and algebraic processing, spatial filtering; image coding and transmission, binary image analysis,
segmentation; description of lines and shapes. Representation. Software and hardware systems. Applications. Scene analysis.

SSG 513 – TECHNIQUES OF PLANNING AND SCHEDULING (3, 0)
Project definition and work breakdown structure, scheduling and control models and techniques such as AOA, AON, Bar charting, line of balance and time & location. Allocation of resources. Optimal schedules. Documentation and reporting services. Time and cost control. Progress monitoring evaluation. Computer applications.

SSG 514 – FACILITY PLANNING (3, 0)
Basic theory of facility location. Facility layout and material handling systems design with emphasis on applications in a wide variety of industries. Design principles and analytical solution procedures presented with emphasis on modern practice including computerised approaches.

SSG 515 – PRINCIPES OF MODELLING & ANALYSIS OF CHEMICAL PROCESS SYSTEMS (3,0)

SSG 516 – MECHANICS OF THE CONTINUA (3, 0)
Non-Academic Staff

Miss. F.M. Balogun

Mrs. A.M. Ajayi

Mr. S. Sanusi

Mr. O.E. Sotomide
**Qualification/ Specialization**

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