COURSE OUTLINE

I. Society as a Model for Computers
   A. Abstraction & Analogies
      (Primitive Elements)
   B. Natural Processes
      1. Relationships
      2. Responsibilities
      3. Types of Social Organization
      4. Stability
      "COMPUTERS TEND TO MODEL HUMAN BEHAVIOR"
      RESOURCES OR PROCESSES
   C. Natural Resources
      1. Relationship of Resource Life to Process Life
      2. Resource Creation & Destruction & Reversibility
      3. Use of Resources
         a. Sharing
         b. Mutual Exclusion & Waiting
         c. Contention & Arbitration & Deadlocks
      4. Resource Process Relationships
   D. Natural Parallelism
      1. Economic Motivations
      2. Abstraction as an aid to Modeling (Psychological Links)
      3. Scheduling & Economic Optimization
         a. Optimal Scheduling
         b. Scheduling Uncertainties
         c. Elementary Scheduling Theory - GANTT CHART (OR HERT/CAM)
         d. Real Time Scheduling Theory - TIME BOUNDS - JACM Vol. 20 No. 1
         e. Allocation & Reversability - DYNAMIC/STATIC
         f. Unresolved Problems Uncertainty, Levels

II. Formal Models for Computers
   A. State Variable Models
      1. Basic Definitions
      2. Combinations, Coexistence & Concurrence
      3. Computations & Determinacy
      4. Process & Computational Representations
   B. Information & Data Structure Representations
      1. Automata Models
      2. Contour Models
      3. Language Models
      4. Names & Abstraction
   C. Graph Models for Computations
      1. Elementary Graph Theory
      2. Directed Graphs & Petri Nets
      3. Graphs with Extensive Control
      4. Data Queueing Graphs
      5. Parallel Program & Flow Graph Models
      6. Resource Graphs
      7. Gantt Charts
III. Implementation of Parallelism

A. Hardware Structures
1. Identification of Hardware Processes
2. Identification of Software Processes
3. Synchronous & Asynchronous Structures
4. Levels of Parallelism
   a. Micro Machine Structures & Microprogramming
   b. ALU Scheduling
   c. CPU & I/O Concurrency
   d. Multiprocessor Relationships
      1. ASP
      2. Equality & Tight Coupling
      3. Networks of Processors

B. Software Structures
1. Indivisible Instructions
2. Language Representation & Importance to Construction of Software Systems
3. Concurrent Programming Considerations
   a. Decomposition in Space and Time
   b. Identification of State & Stepwise Refinement
4. The Arbitration Problem (Dijkstra 65)
   a. Original Problem & Solution
   b. Invention of New Primitives (P&V)
   c. Recent Reliability Refinements
   d. Semaphore Implementations
5. The Communication Problem
   a. Original Problem & Solution
   b. Communication Primitives
   c. Implementation of Communication Primitives
   d. Network Communication Issues
   e. TCOPS
6. The Resource Problem
   a. Original Problem
   b. Resource Primitives
      1. Memory Resources & Other Physical Resources
      2. Logical Resources
      3. Implementation of Resource Primitives
      4. Resource/Processor & Resource/Resource Issues
      5. Scheduling Considerations
7. The Monitor or Arbiter as a Fundamental Concept
   a. Need for
   b. Hierarchies of Arbitrators
      1. Feasibility & Inconsistency
      2. Separation of Policy & Mechanism
   c. Software/Hardware Arbitration
   d. Level Ø Arbitration
   e. Creation of an Arbiter of System Resources as an Operating System (Level 1)
   f. Weiderman Resource Primitives
   g. Higher Level Arbitration Considerations
8. Structured Concurrence Program
   a. A Review of Current Constructs
   b. Semantic Considerations
   c. Validation & Correctness Considerations
   d. Proposed Constructs & Use
IV. Summary & Conclusions

A. Technological Trends
   1. Proliferation of Processors
   2. Communication & Energy Considerations
   3. Process/Communication Relationships

B. Societal Trends & Role of Computer
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"A Survey of Some Theoretical Aspects of Multiprocessing"
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Spartan Books, New York 1970

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