AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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1. SUBJECT CLASSIFICATION

A. PRIMARY: Education — JG00-0000-0000

B. SECONDARY: Higher and professional education

2. TITLE AND SUBTITLE

An educational program with emphasis on industrialization leading to the degree, Master of Science

3. AUTHOR(S)

(101) Ga.Inst.of Technology. School of Industrial and Systems Engineering

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1976	23p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Ga.IT

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER

PN-AAC-613

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Industrialization
Graduate study

13. PROJECT NUMBER

14. CONTRACT NUMBER

AID/CM/ta-G-73-18 211(d)

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

GEORGIA INSTITUTE OF TECHNOLOGY
School of Industrial and Systems Engineering

EDUCATIONAL PROGRAM
for
A Master of Science Degree
With Emphasis on Industrialization

The curriculum for a Master of Science Degree (with emphasis on Industrialization) is being developed under the auspices of the program "Employment Generation Through Stimulation of Small-Scale Industry" which is funded by the Agency for International Development of the United States Department of State.

Georgia Institute of Technology
School of Industrial and Systems Engineering

EDUCATIONAL PROGRAM
for
A Master of Science Degree
(With Emphasis on Industrialization)

PROGRAM OBJECTIVES -

This program is planned for students who are interested in industrialization of developing regions or countries; and particularly employment generation through the creation and development of small industries. The program objective is to provide practical education at the graduate level for students who will eventually support the industrialization process in any of the following ways:

1. creation and management of small industry
2. professional employment in an industrial development organization.
3. teaching industrialization technology at the university or technical school level.

BACKGROUND REQUIREMENTS -

Entering students are required to hold a bachelor's degree from a recognized institution, and to have graduated in the upper half of his class. There are no restrictions regarding the undergraduate field of study. However, engineering, sciences, or management is preferred and the program of study should have included the following:

Probability and Statistics	6 quarter hrs.
Introductory Operations Research	3 quarter hrs.
Computer Programming	3 quarter hrs.
Linear Algebra	3 quarter hrs.
Engineering Economics	3 quarter hrs.

In the event these prerequisites were not a part of the student's undergraduate program, he may meet the requirements after admission by completing the appropriate courses at Georgia Tech; however, courses taken to meet these requirements cannot be applied toward the hours required in the program of study.

PROGRAM REQUIREMENTS -

Program requirements are summarized in Table 1. The objectives of the program are best served by course selections which provide educational breadth and practicality. In addition, there must be sufficient freedom to permit each student to structure a program of study to meet his own professional goals.

The total required credits is 60 quarter hours. However, the specified credits in each area are minimal requirements. Most students will choose additional courses which they feel will contribute to their professional objectives.

1. REQUIRED SELECTIONS

Course selections are required in each of five areas which are considered to be highly important to both the entrepreneur and the industrialization professional. These areas are as follows:

FINANCIAL RESOURCES (6 CREDITS)

Educational Objective: To provide knowledge concerning the acquisition and management of the financial resources of a business.

PLANT AND EQUIPMENT RESOURCES (9 CREDITS)

Educational Objective: To provide knowledge of how to perform site selection, facilities design and layouts, process design and management functions for any industrial setting.

HUMAN RESOURCES (6 CREDITS)

Educational Objective: To develop an understanding of human relations in an industrial organization, i.e., how individual and group behavior affects is affected by the work environment.

INFORMATION & CONTROL SYSTEMS (6 CREDITS)

Educational Objectives: To introduce the concept of information needs to business management and to provide background knowledge pertaining to the design of management information and control systems.

MANAGEMENT OF IMPROVEMENT AND INNOVATION (12 CREDITS)

Educational Objective: To provide the necessary knowledge for

TABLE 1

PROGRAM REQUIREMENTS

M. S. INDUSTRIALIZATION

Background Requirements:	
Probability and Statistics	6 hrs.
Introductory Operations Research	3 hrs.
Computer Programming	3 hrs.
Linear Algebra	3 hrs.
Engineering Economics	3 hrs.

THESIS		NON-THESIS	
Required Selections:		Required Selections:	
1. Financial Resources	6 hrs.	1. Financial Resources	6 hrs.
2. Plant and Equipment Resources	9 hrs.	2. Plant and Equipment Resources	9 hrs.
3. Human Resources	6 hrs.	3. Human Resources	6 hrs.
4. Information and Control Systems	6 hrs.	4. Information and Control Systems	6 hrs.
5. Management of Improvement and Innovation	12 hrs.	5. Management of Improvement and Innovation	12 hrs.
Electives:	4 hrs.	Electives:	12 hrs.
Thesis:	17 hrs.		
		Project:	9 hrs.
Total	60 hrs.	Total	60 hrs.

systematically identifying significant problems, needs and opportunities for improvement and for managing the implementation of technical change.

In order to provide flexibility, the requirements in each of these areas may be satisfied by courses chosen by the student in consultation with his advisor from among carefully prepared lists of appropriate courses.

2. ELECTIVES

In addition to these required selections, the program of study includes 12 credits of free electives for students who choose the project option and 4 credits of free electives for those who choose the thesis option.

3. PROJECT AND THESIS OPTIONS

While formal class work constitutes the major part of the program, a less structured learning experience providing an opportunity for independent work is also considered to be vital to program objectives. For this reason, each student is required to complete either a project or a research investigation.

3.1. PROJECT OPTION

The educational purpose of the project is to provide a carefully guided practical experience related to industrial development. Suggested projects include feasibility analysis for a new business venture or development planning for a particular region or country. The project carries 9 credits and should be completed over a period of not less than two academic quarters.

A comprehensive examination will be required for all students who elect the project option. The general structure and administration of the comprehensive examination is described in Appendix C of the Master's Program Policy of the School of Industrial and Systems Engineering.

3.2. THESIS OPTION

The thesis option provides an opportunity for the student who is interested in industrial development professional activities to pursue independent investigation of a question related to industrialization. The general procedure for the Master's thesis is described in Appendix B of the Master's

Program Guide of the School of Industrial and Systems Engineering. The Master's thesis carries 17 credits.

COURSE LIST

The courses listed below are recommended as relevant to the areas specified in the Program Requirements. For convenience, courses have been categorized under several topical areas in each major area. The student is encouraged to select courses which contribute to his professional objectives. However, in accordance with the policies of the Institute and the School of Industrial and Systems Engineering at least 35 quarter hours must be at the 6000-7000 level. At the request of the student and with appropriate faculty approval, other courses may be substituted for those in the recommended list.

1. FINANCIAL RESOURCES

Educational Objective: To provide knowledge concerning the acquisition and management of the financial resources of a business.

	COURSE	PREREQUISITE
1.1	Feasibility Analysis	
	ISyE 6211 Analysis and Evaluation of Industrial Projects	ISyE 3025 or equivalent
1.2	Financial Concepts	
	Mgt 6060 Financial Management I	Mgt 6000 or Equivalent and Graduate Standing
	Mgt 6061 Financial Management II	Mgt 6060
1.3	Accounting Concepts	
	Mgt 6000 Management Accounting & Control	Consent of the IM college
1.4	Economic Concepts	
	Econ 3400 The Process of American Industrial Development	Econ 2000, 2001
	Econ 3410 Economic Development	Econ 2000, 2001
	Econ 4330 Regional Economics	Econ 2000, 2001
	Econ 4332 Economics of Location	Econ 3000
	Econ 4420 Comparative Economic Systems	Econ 2000, 2001 (See Note 1)

COURSE	PREREQUISITE
Econ 6000 Micro Economic Analysis and Policy	None
Econ 6320 Managerial Economics	Econ 6000
Econ 6331 Economics of Industrialization	None
Econ 6410 Development of Economic Thought	Econ 6000, 6001 and Consent (See Note 1)
Econ 6430 Research Methods in Development	None
ISyE 6225 Advanced Engineering Economy	ISyE 3025, 3131

2. PLANT AND EQUIPMENT RESOURCES

Educational Objective: To provide the knowledge of how to perform site selection, facilities design and layouts, process design and management functions for any industrial setting.

COURSE	PREREQUISITE
2.1 Designing the Business - General Concepts	
ISyE 4075 Engineering the Manufacturing Environment	ISyE 4102
ISyE 6213 The Design of Manufacturing Enterprises	ISyE 4102 or equivalent
2.2 Facilities Design and Layout	
ISyE 4073 Storage and Distributions Systems Design	ISyE 4102
ISyE 4024 Fundamentals of Material Handling	ISyE 3010, ISyE 3025
2.3 Process Design	
ISyE 6524 Material Flow Systems	ISyE 4101, 4102 or consent
ISyE 6217 Work Center Design	Consent
2.4 Facilities Management	
ISyE 4074 Facilities Management	ISyE 4102
2.5 Facilities Location Theory	
ISyE 6680 Location Theory	ISyE 6669
ISyE 7680 Advanced Location Theory	ISyE 6670, 6680

Note 1. Credit not given for both Econ 4420 & 6410.

3. HUMAN RESOURCES

Educational Objective: To develop an understanding of human relations in an industrial organization, i.e., how individual and group behavior affects and is affected by the work environment.

	COURSE	PREREQUISITE
3.1	Basic Organizational Concepts	
	Mgt 6100 Organization Processes	Consent
	ISyE 6101 Modern Organizations	ISyE 3014 or Equivalent
	Mgt 6107 Organization Theory	None
3.2	Survey of Human Study in Industry	
	Psy 4401 Industrial Psychology	None
	Psy 6601 Advanced Industrial Psychology	Psy 4401
3.3	Understanding Human Behavior in the Organization	
	Psy 4405 Seminar in Organization Psychology	Psy 4401 or Psy 4410
	Psy 6609 Social Psychology of Organizations	Psy 4410 or equivalent and consent
	Mgt 6105 Individuals in Organizations	Graduate standing & consent
	Mgt 6106 Group Processes in Organizations	Mgt 6105
3.4	Controlling and Evaluating Personnel (Techniques)	
	ISyE 4022 Job Evaluation and Wage Incentives	ISyE 3010 or consent
	ISyE 6216 Advanced Work Measurement	ISyE 3115 or equivalent
3.5	Ergonomics & Human Factors	
	Psy 4409 Introduction to Engineering Psychology	None
	Psy 6602 Applied Experimental Psychology	Psy 3304
	ISyE 6217 Work Center Design	Consent
	ISyE 6218 Work System Design	ISyE 6217 or consent
	ISyE 6219 Human Factors Engineering	None
	ISyE 6220 Work Physiology	None
	ISyE 6221 Man-Machine Control Systems	Consent
	ISyE 6222 Ergonomics Seminar	ISyE 6219

4. INFORMATION & CONTROL SYSTEMS

Educational Objective: To introduce the concept of information needs of business management and to provide background knowledge pertaining to the design of management information systems.

	COURSE	PREREQUISITE
4.1 Manufacturing Management		
ISyE 4039	Quality Control	ISyE 3028 or Equivalent
ISyE 6301	Quality Control Systems	ISyE 4039
ISyE 6306	Inventory Systems	ISyE 3027, 3033
Mgt 6350	Manufacturing Management I	None
Mgt 6351	Manufacturing Management II	Mgt 6350
ISyE	Design of Manual Information Systems	
4.2 Production Planning Concepts		
ISyE 6305	Forecasting Systems	Math 4241 or Equivalent
ISyE 6307	Scheduling Theory	ISyE 6656
ISyE 6308	Analysis of Production Operations	ISyE 6306, 6669
ISyE 6656	Queueing Theory	Math 4221 or equivalent
4.3 Financial Control		
Mgt 6030	Financial Control I	None
Mgt 6031	Financial Control II	Mgt 6030 or Equivalent
Mgt 6032	Financial Control III	Mgt 6031
4.4 Marketing Management		
Mgt 6300	Marketing Management I	None
Mgt 6301	Marketing Management II	Mgt 6300
Mgt 6310	Marketing Research and Analysis	Mgt 6300 or Equivalent
Mgt 6320	Marketing Models	Mgt 6300 & Prob. & Stat.
Mgt 6140	Management Systems Analysis	Computer, acct. & mgt

5. MANAGEMENT OF IMPROVEMENT AND INNOVATION:

Educational Objective: To provide the necessary knowledge for systematically identifying significant problems, needs and opportunities for improvement and for managing the implementation of technical change.

COURSE	PREREQUISITE
5.1 The Theory of Innovation, Improvement & change	
5.1.1 Sociological Concepts	
Soc 4306 Technology and Society	None
5.1.2 Business Concepts	
Mgt 6170 The Entrepreneur, Innovations and Change	None
5.1.3 ISyE Concents	
ISyE 4056 Technological Forecasting	Consent
ISyE 6107 Management of Improvement	None
5.2 Practical Techniques Identifying the Need for Improvement	
ISyE 6400 Design of Experiments	ISyE 6739 or Equivalent
ISyE 6401 Applied Regression Analysis	ISyE 3028 or ISyE 6739 or equivalent
ISyE 6669 Linear Deterministic Models of Operations Research	ISyE 3031
ISyE 6806 Introduction to Feedback Dynamics	None
ISyE 6807 Feedback Dynamics Principles	ISyE 6806
ISyE 6808 Feedback Dynamics Applications	ISyE 6806
ISyE 6831 Advanced Simulation	ISyE 4044, ISyE 6400
5.3 Managing Technical Change	
ISyE 4035 Project Management Systems	Sr. Standing
ISyE 6103 Organizational Decision Making	ISyE 6101, 6734
ISyE 6107 Management of Improvement	None
ISyE XXXX Seminar on Management of Improvement	

6. ELECTIVES

Educational Objective: Students who are Primarily interested in the creation and management of an enterprise may select electives to serve either of the following objectives:

(1) to provide specialized knowledge in an area of technology not included in the program (e.g. textile engineering, structures,

electrical equipment design, etc.)

(2) to provide specialized knowledge in one or more than one area included in the program

Students who are primarily interested in professional employment in an industrial development organization will be expected to select electives from either or both of the following two areas:

6.1 NATURAL RESOURCES

Education Objective: To provide background in planning in economic usage of natural resources, and to study the effects of industry on the physical environment.

	COURSE	PREREQUISITE
6.1.1	Land Development	
	City Planning 6010 Land Use Planning	None
	City Planning 6040 Resource Development	None
6.1.2	Economics of Land Development	None
	City Planning 6260 Economics of Urban Development	None
	City Planning 6270 Economic Analysis of Urban Area	None
6.1.3	Techniques in Land Planning	
	City Planning 6350 Introduction to Scientific Methods in Urban and Regional Planning	
	City Planning 6360 Intermediate Scientific Methods in Urban and Regional Planning	C. P. 6300 or Consent
	City Planning 6370 Systematic Planning Methods in Urban & Rural Planning	C. P. 6360 or Consent
6.1.4	Environmental "Control"	
	City Planning 6140 Environmental Aspects of City & Regional Planning I	None
	City Planning 6150 Environmental Aspects of City & Regional Planning II	C. P. 6140

6.2 THE DEVELOPMENT FUNCTION:

Educational Objective: To provide educational background relevant to the overall development planning process for a region.

COURSE		PREREQUISITE
Econ 3410	Economic Development	Econ 2000 - 2001
Econ 4410	Industrial Development in Latin America	Econ 2000 - 2001
Econ 6331	Economics of Industrialization	None
Econ 6430	Research Methods in Development	None
Econ 6435	Development Seminar I	Econ 6410
Mgt 4335	International Marketing	Mgt. 3300
ISyE XXXX	Cases & Histories of Innovation in Developing Countries	

7. PROJECT

The project activity is intended to provide the student with a carefully guided experience related to the creation and development of small scale enterprises. The alternatives described below are suggested.

ALTERNATIVE I -

PHASE ONE — 3 credits

- Opportunity Selection List
- Pre-feasibility Study
- Market Study

PHASE TWO — 3 credits

- Feasibility Study
- Financing Planning
- Organization of the Project
  - Should Include
    - (a) Human Capital
    - (b) Capital & Goods Flow
    - (c) Flow of Money
    - (d) Information System
    - (e) Marketing Strategy

PHASE THREE — 3 credits

- Formal Proposal to Get Financing From Funding Institutions
- Final Project Report

ALTERNATIVE II

PHASE ONE 3 credits

1. Selection of actual region to develop
2. Analysis of Region. Economic Resources; Imports/Exports; Culture, Politics, etc.
3. Report Phase One: Economic Profile of Region

   Note: Region or community

PHASE TWO 3 credits

1. Development of a Conceptual Model for Industrial Development

   Based on:
   - (a) Diagnosis of Needs
   - (b) Population Culture
   - (c) Resource Potential
   - (d) In agreement with the National overall development plans.

   Should Consider:
   - (a) Industrial Development as a function or government.
   - (b) Industrial Development as a function of private organizations.
   - (c) Industrial Development as a function of semi-private organizations. Ex. Power companies, transportation companies, Chamber of Commerce, etc.
   - (d) Industrial Development as a responsibility of the administrators as well as of the population in general.
2. Policies and strategy to implement

   Proposed Model.

   Report Phase II.

PHASE THREE

1. Activities to Support Policy/Strategies selected
   - (a) Type of Organizations needed and coordinations of effort. How feasible with the culture of the region.
   - (b) Activities to develop under this project.
     1. Opportunity selection list

2. Promotion efforts
3. Feasibility and market studies, etc.
4. Organization of the community with the purpose of improving its environment, so it could attract industrial prospects.
5. etc.

(c) Report. Total Report Presentation

Note. This tentative program offers flexibility to develop many alternative projects.

COURSE DESCRIPTIONS

1. FINANCIAL RESOURCES

1.1 Feasibility Analysis

ISyE 6211 ANALYSIS AND EVALUATION OF INDUSTRIAL PROJECTS (3-0-3)
Feasibility analysis of new ventures and other industrial projects. All phases, from idea generation to proposal preparation, are covered.

1.2 Financial Concepts

Mgt. 6060 FINANCIAL MANAGEMENT I (3-0-3)
Instruments and institutions of finance, the creation and modification of the financial structure of the firm.

Mgt. 6061 FINANCIAL MANAGEMENT II (3-0-3)
Procurement and the application of funds within the firm in a manner consistent with predetermined objectives.

1.3 Accounting Concepts

Mgt. 6000 MANAGEMENT ACCOUNTING & CONTROL (3-0-3)
Cover the use of accounting systems to provide information for performance evaluation.

1.4 Economic Concepts

Econ 3400 THE PROCESS OF AMERICAN INDUSTRIAL DEVELOPMENT (3-0-3)
The forces, unique characteristics and problems associated with American industrialization.

Econ 3410 ECONOMIC DEVELOPMENT (3-0-3)
General theories of economic development. Each student will be required to analyze the economy of a developing country.

Econ 4330 REGIONAL ECONOMICS (3-0-3)
Theories of regional income determination and regional growth, spatial economic structure, central-place theory and regional effects of public policy.

Econ 4332 ECONOMICS OF LOCATION (3-0-3)
A survey of economic factors influencing industrial location. Consideration will be given locational patterns, the impact of transfer processing costs and land use competition.

Econ 4420 COMPARATIVE ECONOMIC SYSTEMS (3-0-3)
A critical study is made of the methods by which various economic systems meet common fundamental problems in production, exchange, distribution and capital formation.

Econ 6000 MICRO ECONOMIC ANALYSIS AND POLICY (3-0-3)
Theoretical analysis of the determination of proces and output. The objective is to develop the basic economic concepts.

Econ 6320 MANAGERIAL ECONOMICS (3-0-3)
Relationships between economic concepts and managerial decisions. Topics covered include non-profit goals of the firm, unstructured managerial problems and the determinants of good managerial decisions.

Econ 6331 ECONOMICS OF INDUSTRIALIZATION (3-0-3)
An examination of long-run growth processes seeking causes of underdevelopment, exploring theories of economic growth and applying these explanations to developed and underdeveloped economies.

Econ 6410 DEVELOPMENT OF ECONOMIC THOUGHT (3-0-3)
Development of the various schools of economic thought and their contributions to the present body of economic theories. Credit not given for both Econ 4400 and 6410

Econ 6430 RESEARCH METHODS IN DEVELOPMENT (3-0-3)
General review of research techniques and to acquaint the student with the literature and reference sources in industrial development.

ISyE 6225 ADVANCED ENGINEERING ECONOMY (3-0-3)
Advanced engineering economy topics, including measuring economic worth, economic optimization under constraints, analysis of economic risk and uncertainty, foundations of utility theory.

2. PLANT AND EQUIPMENT RESOURCES

2.1 Designing the Business - General Concepts

ISyE 4075 ENGINEERING THE MANUFACTURING ENVIRONMENT (3-0-3)
Procedures and methods for designing the enterprise environment emphasizing building design concepts, construction methods, environmental systems, plant services, noise and pollution control and their cost factors.

ISyE 6213 THE DESIGN OF MANUFACTURING ENTERPRISES (3-0-3)
Deals with the engineering oriented management aspects in designing a manufacturing enterprise. Covers problems unique to developing a new enterprise.

2.2 Facilities Design and Layout

ISyE 4073 STORAGE AND DISTRIBUTIONS SYSTEMS DESIGN (3-0-3)
Fundamentals of designing efficient materials and product distribution systems emphasizing warehouse planning, materials and information flow, equipment selection, building design and location, automated warehousing and transportation.

ISyE 4024 FUNDAMENTALS OF MATERIAL HANDLING (2-3-3)
Development of procedures and techniques for analysis and solution of materials handling problems. Plant trips and laboratories utilized to illustrate modern materials handling methods.

2.3 Process Design

ISyE 6524 MATERIAL FLOW SYSTEMS (3-0-3)
Methodology useful in analysis and design of in-plant material flow systems and their interfaces with transportation and distribution systems emphasizing quantitative and simulation techniques.

ISyE 6217 WORK CENTER DESIGN (2-3-3)
Advanced study of methods analysis and synthesis with emphasis upon sub-optimizing the work center and on quantitative techniques.

2.4 Facilities Management

ISyE 4074 FACILITIES MANAGEMENT (3-0-3)
Study of functions, activities, procedures and organizational interrelationships involved in managing physical facilities, emphasizing maintenance, construction and modification, security and safety, waste disposal and planning.

2.5 Facilities Location Theory

ISyE 6680 LOCATION THEORY (3-0-3)
Applications of optimization theory to the location of facilities. Area and point location problems in discrete and continuous space are examined. Private and public sector applications are considered.

ISyE 7680 ADVANCED LOCATION THEORY (3-0-3)
Theoretical aspects of location problems are emphasized, drawing upon results from linear and nonlinear programming, graph theory and network analysis. Recent research literature is covered.

3. HUMAN RESOURCES

3.1 Basic Organizational Concepts

Mgt 6100 ORGANIZATION PROCESSES (3-0-3)
Introduction to analysis of individual behavior and to individual and group performance in organizations.

ISyE 6101 MODERN ORGANIZATIONS (3-0-3)
A comprehensive study of the theories of industrial organization with particular emphasis on analyzing, evaluating and integrating organizational activities.

Mgt 6107 ORGANIZATION THEORY (3-0-3)
Background for student to build sound organizational structure within the objectives of the enterprise.

3.2 Survey of Human Study in Industry

Psy 4401 INDUSTRIAL PSYCHOLOGY (3-0-3)
A survey of methods and findings in the scientific study of humans at work. Considered are such topics as selection, training, motivation, accidents and environmental effects.

Psy 6601 ADVANCED INDUSTRIAL PSYCHOLOGY (3-0-3)
A survey of theoretical and pragmatic issues in industrial psychology. Recent developments and experimental findings will be discussed.

3.3 Understanding Human Behavior in the Organization

Psy 4405 SEMINAR IN ORGANIZATION PSYCHOLOGY (3-0-3)
Study of psychological factors in organizational functioning, including theoretical and research issues.

Psy 6609 SOCIAL PSYCHOLOGY OF ORGANIZATIONS (3-0-3)
Engineering psychology is presented as an integral component in the design and evaluation of man/maching systems. Applied problems and general methodological questions are examined.

Mgt 6105 INDIVIDUALS IN ORGANIZATIONS (3-0-3)
Combines the theory of management with a workable knowledge of the behavioral sciences in achieving the objectives of management.

Mgt 6106 GROUP PROCESSES IN ORGANIZATIONS (3-0-3)
Administrative problems that arise in the relationships among people in organizations.

3.4 Controlling and Evaluating Personnel (Techniques)

ISyE 4022 JOB EVALUATION AND WAGE INCENTIVES (3-0-3)
Study of principles used to establish wage rates and salaries. Emphasizes characteristics and objectives of wage incentive plans and design and analysis of incentive formulas.

ISyE 6216 ADVANCED WORK MEASUREMENT (3-0-3)
The history of human work measurement and an examination of research in this field, systems for labor performance evaluation.

3.5 Designing and Evaluating Man-Machine Systems

Psy 4409 INTRODUCTION TO ENGINEERING PSYCHOLOGY (3-0-3)
Engineering psychology is presented as an integral component in the design and evaluation of man/machine systems. Applied problems and general methodological questions are examined.

Psy 6602 APPLIED EXPERIMENTAL PSYCHOLOGY (3-0-3)
Consideration of the application of the methods and data of experimental psychology to the problems of man and his environment, emphasizing the engineering psychology approach.

ISyE 6217 WORK CENTER DESIGN (2-3-3)
Advanced study of methods analysis and synthesis with emphasis upon sub-optimizing the work center and on quantitative techniques.

ISyE 6218 WORK SYSTEM DESIGN (3-0-3)
Advanced study of the design of work systems with emphasis on the human operator and his role in the work system.

ISyE 6219 HUMAN FACTORS ENGINEERING (3-0-3)
Application of information on man's capabilities and limitations in the design process. Design problems are used to aid understanding of application of human factors data.

ISyE 6220 WORK PHYSIOLOGY (3-0-3)
An evaluation of the various factors affecting human physical performance in the industrial environment. Topics: anthropometry, biomechanics, energy expenditure, heat stress, fatigue, training, strength.

ISyE 6221 MAN-MACHINE CONTROL SYSTEMS (3-0-3)
An introduction to the application of systems theory and methodology to the analysis and design of man-machine control systems.

ISyE 6222 ERGONOMICS SEMINAR (3-0-3)
Seminar in the human factors area pertinent to the design of work systems. Topics: shift work, sex difference, aging, rest periods and occupational safety and health.

4. INFORMATION & CONTROL SYSTEMS

4.1 Manufacturing Management

ISyE 4039 QUALITY CONTROL (3-0-3)
Design of quality control systems. Quantitative techniques for establishing product specifications, process controls, acceptance inspection and other techniques of quality assurance.

ISyE 6301 QUALITY CONTROL SYSTEMS (3-0-3)
The design of quality control systems for production and service enterprises. Topics include costs of quality, quality control systems design and evaluation of system performance.

ISyE 6306 INVENTORY SYSTEMS (3-0-3)
An introductory course in inventory theory. Deterministic lot size models, probabilistic models of continuous and periodic review policies, dynamic models and multiechelon systems.

Mgt 6350 MANUFACTURING MANAGEMENT I (3-0-3)
Provides the student an opportunity to combine the theories of economics and management in the production of manufactured products.

Mgt 6351 MANUFACTURING MANAGEMENT II (3-0-3)
Further development and application of managerial and economic concepts in the solution of problems in the manufacturing firm.

ISyE xxxx DESIGN OF MANUAL INFORMATION SYSTEMS
(New Course)

4.2 Production Planning Concepts
ISyE 6305 FORECASTING SYSTEMS (3-0-3)
Techniques and systems for forecasting time series. Statistical methods for generating short term forecasts, analysis of forecast error and design of forecasting systems.

ISyE 6307 SCHEDULING THEORY (3-0-3)
Analysis of sequencing and scheduling activities. Static scheduling problems, dynamic scheduling systems, simulation studies of priority dispatching rules, priority queueing models.

ISyE 6308 ANALYSIS OF PRODUCTION OPERATIONS (3-0-3)
Mathematical models for production planning. Applications of mathematical programming, dynamic programming, network theory and heuristic methods to problems of planning production, inventories and capacity.

ISyE 6656 QUEUEING THEORY (3-0-3)
Topics include a probability review, properties of the Poisson and exponential distributions, one-dimensional and multidimensional birth-and-death queueing models.

4.3 Financial Control
Mgt 6030 FINANCIAL CONTROL I (4-0-4)
The general and cost accounting system of the firm will be studied as a managerial information system.

Mgt 6031 Financial Control II (3-0-3)
Principles, problems and methods of accumulating, analyzing and interpreting accounting data.

Mgt 6032 FINANCIAL CONTROL III (3-0-3)
Applies decision principles developed in Mgt. 6031.

4.4 Marketing Management
Mgt 6300 MARKETING MANAGEMENT I (3-0-3)
Critical analysis of the marketing functions of an industrial enterprise, organizing and control of marketing programs emphasized.

Mgt 6301 MARKETING MANAGEMENT II (3-0-3)
Advanced course in marketing analysis and strategy formulation. Particular emphasis will be given to application of materials from Mgt 6300.

Mgt 6310 MARKETING RESEARCH AND ANALYSIS (3-0-3)
Theory and techniques of marketing analysis and its use in the formulation of policy and strategy.

Mgt 6320 MARKETING MODELS (3-0-3)
Marketing models utilizing probability and statistics as well as behavioral techniques.

Mgt 6140 MANAGEMENT SYSTEMS ANALYSIS (3-0-3)
Concepts and techniques of managerial process simulation, analysis of computer-based management information and control systems.

5. MANAGEMENT OF IMPROVEMENT AND INNOVATION

5.1 The Theory of Innovation, Improvement & Change
Soc 4306 TECHNOLOGY AND SOCIETY (3-0-3)
Analysis of social conditions which promote or retard technological activity. Particular emphasis on the social role of the scientific and engineering professions in that development.

Mgt 6170 THE ENTREPRENEUR, INNOVATIONS AND CHANGE (3-0-3)
The role of the entrepreneur and innovation in economic development.

ISyE 4056 TECHNOLOGICAL FORECASTING (3-0-3)
Emphasizes forecasting future trends and specific developments in areas of technology. Develops methodologies for identifying future functional capabilities and needs. Case histories in technological forecasting utilized.

ISyE 6107 MANAGEMENT OF IMPROVEMENT (3-0-3)
Concepts of the management of improvement endeavors, strategies and tactics for achieving continual improvement within organizations. Theoretical bases and approaches to encourage innovation are studied.

5.2 Practical Techniques Identifying the Need for Improvement

ISyE 6400 DESIGN OF EXPERIMENTS (3-0-3)
Analysis and application of standard experimental designs, including factorials, randomized blocks, latin squares, confounding and fractional replication. Orthogonal polynomials and multiple comparisons are also discussed.

ISyE 6401 APPLIED REGRESSION ANALYSIS (3-0-3)
Analysis of data from unplanned experiments. Emphasis on the application of statistical principles to empirical model building.

ISyE 6669 LINEAR DETERMINISTIC MODELS OF OPERATIONS RESEARCH (4-0-4)
The optimization of linear models, including the revised, dual, and primaldual simplex methods, duality theorems, decomposition, cutting plane algorithms, some network algorithms.

ISyE 6806 INTRODUCTION TO FEEDBACK DYNAMICS (3-0-3)
Philosophy of feedback causality. Methodology for formulation, analysis and synthesis of feedback models and real implementation. Emphasis on large social systems with intangible variables. Student project.

ISyE 6807 FEEDBACK DYNAMICS PRINCIPLES (3-0-3)
Detailed model building. Simulation by hand and DYNAMO. Study of oscillation, growth, frequency sensitivity, phasing, noise in feedback models. Model trouble-shooting and improvement. Student projects.

ISyE 6808 FEEDBACK DYNAMICS APPLICATIONS (3-0-3)
Design/modification of human organizations. Extensive student project illustrates principles presented in ISyE 6806-7 and provides exercise in creative real-system synthesis and recommendation implementation.

ISyE 6831 ADVANCED SIMULATION (3-0-3)
Extension of discrete-event, digital simulation methods presented in ISyE 4044. Emphasis on model building and the design and analysis of simulation experiments for complex systems.

5.3 Managing Technical Change

ISyE 4035 PROJECT MANAGEMENT SYSTEMS (2-3-3)
Project planning and control using activity network analysis. Emphasizes network logic, scheduling computations, resource scheduling, time-cost tradeoff algorithms and multiproject resource allocation.

ISyE 6103 ORGANIZATIONAL DECISION MAKING (3-0-3)
A course integrating behavioral findings with mathematical models of the decision process. The major focus is on these processes in organizational settings.

ISyE 6107 MANAGEMENT OF IMPROVEMENT (3-0-3)
Concepts of the management of improvement endeavors, strategies and tactics for achieving continual improvement within organizations. Theoretical bases and approaches to encourage innovation are studied.

ISyE xxxx SEMINAR ON MANAGEMENT OF IMPROVEMENT
(New Course)

6. ELECTIVES: (suggested electives for students interested in working in a development organization)

6.1 NATURAL RESOURCES

6.1.1 Land Development

C.P. 6010 LAND USE PLANNING (3-0-3)
Factors determining land use; location and interrelationships of various land uses; land use studies and plan preparation; implementation of land use policies and plans.

C.P. 6040 RESOURCE DEVELOPMENT (3-0-3)
A study of natural resources, their adequacy for future needs; influence of technology, evaluation of policies to assure adequate resources for the future.

6.1.2 Economics of Land Development

C.P. 6260 ECONOMICS OF URBAN DEVELOPMENT (3-0-3)
Economic function of urban communities, location of cities; market analysis and economic feasibility studies of retail stores, offices, hotels, housing and industrial developments, new communities, etc.

C.P. 6270 ECONOMIC ANALYSIS OF URBAN AREAS (3-0-3)
An examination of methods and techniques for analyzing the economic base of urban communities; special emphasis on problems of handling population, employment and income data.

6.1.3 Techniques in Land Planning

C.P. 6350 INTRODUCTION TO SCIENTIFIC METHODS IN URBAN AND REGIONAL PLANNING (2-6-4)
Basic concepts of scientific method relevant and applicable to planning practice and theory.

C.P. 6360 INTERMEDIATE SCIENTIFIC METHODS IN URBAN AND REGIONAL PLANNING (2-6-4)
A continuation of 6350, this course covers the intermediate level of modelling and other scientific methods that are relevant and applicable to city planning practice and theory.

C.P. 6370 SYSTEMIC PLANNING METHODS IN URBAN AND REGIONAL PLANNING (2-6-4-)
A continuation of C.P. 6360, this course examines the philosophical and intellectual content of the systems approach to city planning.

6.1.4 Environmental "Control"

C.P. 6140 ENVIRONMENTAL ASPECTS OF CITY AND REGIONAL PLANNING I (3-0-3)
Identification and quantitative analysis of air, water, noise, spatial pollution; influence on urban development, health and well-being. Solutions, environmental controls and management programs evaluated.

C.P. 6150 ENVIRONMENTAL ASPECTS OF CITY AND REGIONAL PLANNING II (3-0-3)
Field analysis of: noise, air, water, and spatial pollution. Students identify, evaluate and apply city planning solutions to environmental problems.

6.2 THE DEVELOPMENT FUNCTION

6.2.1 Case Studies and Industrial Development

Econ 3410 ECONOMIC DEVELOPMENT (3-0-3)
General theories of economic development. Each student will be required to analyze the economy of a developing country.

Econ 4410 INDUSTRIAL DEVELOPMENT IN LATIN AMERICA (3-0-3)
The principles of industrial development in emerging nations. The student prepares an analysis of the problems in a specific Latin American country.

Econ 6331 ECONOMICS OF INDUSTRIALIZATION (3-0-3)
(See Sec. 1.1.4)

Econ 6430 RESEARCH METHODS IN DEVELOPMENT (3-0-3)
General review of research techniques and to acquaint the student with the literature and reference sources in industrial development.

Econ 6435 DEVELOPMENT SEMINAR I (3-0-3)
Planning and researching a project in industrial development.

Mgt. 4335. INTERNATIONAL MARKETING (3-0-3)
Emphasis on international comparative analysis, the role of marketing in economic development, and marketing strategies and policies of multinational firms.

ISyE xxxx CASES AND HISTORIES OF INNOVATION IN DEVELOPING COUNTRIES
(New course)