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## **INDUSTRIAL ENGINEERING EXAMINATIONS SYLLABUS**

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### **GROUP A COMPULSORY EXAMINATIONS (6 REQUIRED)**

#### **98-Ind-A1    Operations Research**

Formulation and solution of prototype models of allocation, production and inventory control, scheduling, queuing, replacement and routing. Decision analysis value. Linear programming problems: simplex method, duality and sensitivity analysis; solution of transportation, transshipment and assignment problems, integer programming problems and their solution by Branch and Bound. Network problems: shortest route, spanning tree, maximal and minimal flow problems, C.P.M. and P.E.R.T. methods. Discrete and continuous dynamic programming. Simulation techniques. Elementary stochastic processes. Heuristics for combinatorial optimization problems.

#### **98-Ind-A2    Analysis and Design of Work**

Methods of work analysis, including process analysis, activity charts, person machine charts, operation analysis, micromotion study, fundamental hand motions and film analysis. Principles of motion economy, method study, motion and time study, rating factor, performance factor, allowances and standard data. Pre-determined motion time systems. Work sampling. Wage payment. Motivation and work. Wage incentives. Job enrichment. Software available in the field of analysis and design of work.

#### **98-Ind-A3    Facilities Planning**

Strategic planning, site selection, product, process, schedule, activity relationship and space requirements, personnel requirements. Developing solutions, including material handling systems and equipment, layout and computer aided layout. Functions, including receiving and shipping, storage and warehousing, production, offices and services. Evaluating solutions, including deterministic and probabilistic models. Selection, implementation, and periodical review of the layout.

## **98-Ind-A4    Production Management**

Production systems, including identification of technical, economic, social, human components and characteristics in the system. Forecasting techniques. Inventories, including role, measuring service level, inventory models and their application in distribution and manufacturing. Aggregate planning of production levels and inventories, including master plan, materials requirements planning (MRP), detailed scheduling and sequencing, assembly line balancing. Information and control systems for production operations. Project planning and control.

## **98-Ind-A5    Quality Planning, Control, and Assurance**

Basic concepts: planning, measurement, control, and improvement of quality. Economics of quality. Strategic planning of quality. Total quality management. Quality function organization. Motivation for quality. Statistical tools: tests, regression analysis, design and analysis of planned experiments, Taguchi methods, control charts for variables and attributes, capability analysis, acceptance sampling: single, multiple, sequential, MILSTD105 E, MILSTD 414, elements of reliability. Quality assurance: ISO/QS 9000, suppliers, audits, quality manual, certification.

## **98-Ind-A6    Systems Simulation**

Computer simulation of systems. Design of simulation models of discrete systems. Statistical foundations and methodology. Generation of random variates. Design of simulation experiments. Simulation programming languages. Applications: the analysis and design of systems for production, and distribution. Model validation. Simulation output analysis. Use of software.

**GROUP B**  
**ELECTIVE EXAMINATIONS (3 REQUIRED)**

**98-Ind-B1    Applied Probability and Statistics**

Basic concepts of probability, transformations of random variables and moment generating functions. Joint and conditional distributions for discrete and continuous random variables, correlation and expectation of a function of several random variables. Sums of random variables, convolutions and central limit theorem. Reliability, maintenance and repair, replacement, inventory, etc. Statistical methods: hypothesis testing, T and F tests, and nonparametric tests. Estimation of parameters. Analysis of variance in one way classifications with fixed effects. Linear regression with one or two independent variables. Goodness of fit tests.

**98-Ind-B2    Manufacturing Processes**

Fabricating characteristics of metals and plastics. Molding, forging, welding principles and operations, jigs and fixtures. Cold-forming and stamping, turning and related operations, other machining operations and related jigs and fixtures. Metrology. Numerical control machines and applications. Process quality control.

**98-Ind-B3    Computer Aided Design and Computer-Assisted Manufacturing**

Fundamental concepts in design and manufacturing automation strategies, high volume discrete parts production systems, numerical control manufacturing systems, computer aided manufacturing (CAM), support systems for manufacturing, group technology, and flexible manufacturing systems.

**98-Ind-B4    Design of Information Systems**

Analysis of existing systems and general design. The role of information for the control and management of integrated production systems. Concepts of information, humans as information processors, nature and value of information for decision-making, economics of sampling, structure of management information systems, hardware, software and control environments of information processing systems, transaction processing systems, data-base sub-systems, organizational structure and management information systems, development and evaluation of management information systems, distributed systems, local area networks, data communications. Data acquisition and transmission. Economic evaluation.

## **98-Ind-B5    Ergonomics**

Basic human abilities and characteristics, including vision and hearing. Psychomotor characteristics. Anthropometry: static and dynamic human body dimensions and muscle strength. Environmental factors, including illumination, atmospheric conditions, noise, and vibration. Ergonomic work design, including layout of equipment, manual work aids, design of seating, and person-machine interfaces: instruments, controls, and software.

## **98-Ind-B6    Workplace Design**

System and human engineering analysis, the human as a system component, visual presentation of information, auditory and other sensory forms of information presentation, speech communication. Human machine dynamics, including data entry devices and procedures, design of the multi human machine dynamics. Layout of work places in order to maximize productivity, comfort, health and safety of employees, locating controls and displays, design for maintainability, training system design, training device design, human engineering tests and evaluation.

## **98-Ind-B7    Financial and Managerial Accounting**

A study of financial and managerial accounting, including basic accounting concepts, measurements of income and balance sheet presentation. Accounting records and systems, including financial statement analysis, chartered accountant reports, and funds flow. Cost and management accounting, including standard cost and variance analysis, allocation and control of costs. Accounting in business decisions, including budgeting, cash flow forecasting, and planning.

## **98-Ind-B8    Computer Integrated Manufacturing (CIM)**

Computerization in manufacturing. Manufacturing information systems. Hierarchical control. Just-in-time in the context of CIM. CIM Architecture: Networking OSI, LANS, WANS, MAP. Current technologies: operating systems, case technologies, artificial intelligence, databases. Product Information Management: CAD positioning; Design File Management; Hardware & software; Product Data Models; component, specifications, symbols. Typical Product Information Standards: PDES, IGES, EDIF; Data For Human Consumption. Case Studies.

## **98-Ind-B9    Logistics: Transportation Aspects**

Introduction to transportation engineering, and transport planning and economics. Modeling of transportation and warehousing problems. Characteristics of transportation systems: rail, highway, airway, waterway, and pipeline. The rural and intercity transport system in Canada; cost and tariffs. Network analysis; the transport planning process. Logistics and competitiveness: evaluation of transportation projects and systems, urban transportation analysis and prediction, traffic studies, highway and intercity capacity, characteristics of traffic flow, traffic control principles, and economics.

## **98-Ind-B10 Industrial Safety and Health**

Fundamentals of systems safety. Safety and accident prevention — causes and models. Safety in product and process design. Fault-tree analysis and risk assessment. Occupational diseases, stress, fatigue. Health, safety and the physical environment. Engineering methods of controlling chemical hazards, safety and the physical environment: engineering methods of controlling chemical and physical hazards. Code and regulations for worker safety and health.

**The Association of  
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS  
of British Columbia**

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1998 INDUSTRIAL ENGINEERING SYLLABUS  
Checklist for Self Evaluation  
(Not required for candidates who are assigned  
confirmatory exams)

Name: \_\_\_\_\_

Exam Number	Exam Name	Applicant's Self-Evaluation - Course Equivalent	For Office Use Only
<i>Basic Studies (6 Required)</i>			
04-BS-1	Mathematics		
04-BS-2	Probability and Statistics		
04-BS-3	Statics and Dynamics		
04-BS-6	Mechanics of Materials		
04-BS-7	Mechanics of Fluids		
04-BS-10	Thermodynamics		
<i>Basic Studies (2 required)</i>			
04-BS-4	Electric Circuits and Power		
04-BS-5	Advanced Mathematics		
04-BS-8	Digital Logic Circuits		
04-BS-11	Properties of Materials		
<i>Group A (6 required)</i>			
98-Ind-A1	Operations Research		
98-Ind-A2	Analysis and Design of Work		
98-Ind-A3	Facilities Planning		
98-Ind-A4	Production Management		

98-Ind-A5	Quality Planning, Control and Assurance		
98-Ind-A6	Systems Simulation		
<b><i>Group B (3 Required)</i></b>			
98-Ind-B1	Applied Probability and Statistics		
98-Ind-B2	Manufacturing Processes		
98-Ind-B3	Computer Aided Design and Computer-Assisted Manufacturing		
98-Ind-B4	Design of Information Systems		
98-Ind-B5	Ergonomics		
98-Ind-B6	Workplace Design		
98-Ind-B7	Financial and Managerial Accounting		
98-Ind-B8	Computer Integrated Manufacturing (CIM)		
98-Ind-B9	Logistics: Transportation Aspects		
98-Ind-B10	Industrial Safety and Health		
<b><i>Complementary Studies (All Required)</i></b>			
11-CS-1	Engineering Economics		
11-CS-2	Engineering in Society – Health and Safety		
11-CS-3	Sustainability, Engineering and the Environment		
11-CS-4	Engineering Management		

## **Professional Industrial Text Listing**

**\*\* NOTE TO CANDIDATES, THE LISTED TEXTBOOKS BELOW ARE ONLY SUGGESTED. THE LIST DOES NOT DEFINE OR LIMIT THE SYLLABUS.**

### **98-Ind-A1- Operation Research**

Winston, Operations Research Applications and Algorithms, latest edition. Duxbury Press, Belmont, Calif. Hillier and Lieberman, Introduction to Operations Research, latest edition. McGraw-Hill.

### **98-Ind-A2- Analysis and Design of Work**

Ralph M. Barnes, Motion and Time Study Design and Measurement of Work, 7<sup>th</sup> Edition. John Wiley and Sons Inc.

### **98-Ind-A3- Facilities Planning**

S. Heragu, Facilities Design, PWS Publishing Company (20 Park Plaza; Boston MA 02116-4324), 1997. ISBN # 0-534-95183-X

D.R. Sule, Manufacturing Facilities. PWS-Kent Publishing, Boston.

J.A. Tompkins and J.A. White, Facilities Planning. John Wiley and Sons Inc.

### **98-Ind-A4 - Production Management**

Stephenson, J. Williams, Production Operations Management, 6<sup>th</sup> Ed., CD Rom On-Line Card, McGraw Hill. ISBN 007 2359587

### **98-Ind-A5 - Quality Planning, Control, and Assurance**

J.M. Juran and F.M. Gryna, Quality Planning and Analysis, latest edition. McGraw-Hill.

D.C. Montgomery, Introduction to Statistical Quality Control, latest edition. John Wiley and Sons (NOTE: Exclude Chapters 10 and 15.)

### **98-Ind-A6 - Systems Simulation**

A.M. Low and W.D. Kelton, Simulation, Modelling and Analysis, 2<sup>nd</sup> edition. McGraw-Hill Inc., 1991.

C.D. Pegden, R.E. Shannon, and R.P. Sadowski, Instruction to Simulation Using Siman. McGraw-Hill Inc., 1990.

### **98-Ind-B1 - Applied Probability and Statistics**

D.C. Montgomery and G.C. Runger, Applied Statistics and Probability for Engineers. John Wiley. ISBN # 0-471-54041-2.

### **98-Ind-B2 - Manufacturing Processes**

Kalpakjian, Serope, Manufacturing Processes for Engineering Materials, 3<sup>rd</sup> Edition, Addison Wesley Longman Inc., 1997. ISBN # 0-201-82370-5

E.P. DeGarmo, J.T. Black, and R.A. Kohser, Materials and Processes in Manufacturing, 6<sup>th</sup> edition. MacMillan, 1984.

### **98-Ind-B3 - Computer Aided Design and Computer-Assisted Manufacturing**

M.P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, latest edition. Prentice-Hall, 1987. ISBN # 0-13-054652-6025.

**98-Ind-B4 - Design of Information Systems**

Laudon & Laudon, Management Information Systems: A Contemporary Perspective, latest edition. MacMillan, 1991.

R. McLeod, Management Information Systems: A Study of Computer Based Information Systems, latest edition. MacMillan, 1990.

**98-Ind-B5 - Ergonomics**

R.S. Bridger, Introduction to Ergonomic. McGraw-Hill, ISBN 0-07-007741-X.

Kodak Ergonomics Group, Ergonomic Design for People at Work, Volumes I and II. Van Nostrand Reinhold Co. Ltd.

**98-Ind-B6 - Workplace Design**

M.S. Sanders, Human Factors in Engineering and Design, 7<sup>th</sup> Edition. McGraw-Hill, 1993.

ISBN # 054-901.

E. Granjean, Fitting the Task in the Man, 4<sup>th</sup> edition. Taylor and Francis Publishers, 1988.

**98-Ind-B7 - Financial and Managerial Accounting**

Meigs, Meigs, and Lam, Accounting: The Basis for Business Decisions, 6<sup>th</sup> Edition (Canadian). McGraw-Hill.

R.M. Mallouk, Problems Plus Solutions In Financial Accounting. McGraw-Hill.

**98-Ind-B8 - Computer Integrated Manufacturing (CIM)**

Reinhold, Blume, Djllmann, Computer Integrated Manufacturing Technology and Systems, latest edition. Marcel Dekker, Inc. ISBN # 0-8247-7403-5.

**98-Ind-B9 - Logistics: Aspects**

Not available at this time.

**98-Ind-B10 - Industrial Safety and Health**

Occupational Health and Safety Act Regulation for Industrial Establishment. 880 Bay St. Toronto, Ontario. M7B 1N8. Tel.: 416-326-5300, 1-800 668-9938.

Willie Harruner, Occupational Safety Management and Engineering, latest edition. Prentice-Hall. ISBN 0-13-629437-5.

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