

# Industrial engineering syllabus

## Industrial engineering examinations

### Group A - Compulsory examinations (six required)

#### 23-Ind-A1 Operations Research

Formulation and solution of mathematical models of allocation, production and inventory control, scheduling, queuing, replacement, and routing; 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; elementary stochastic processes; heuristics for combinatorial optimization problems.

*Textbooks (most recent edition is recommended):*

- W.L. Winston, Operations Research Applications and Algorithms, Duxbury Press.
- F. Hillier, Introduction to Operations Research, McGraw-Hill.

#### 23-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.

*Textbooks (most recent edition is recommended):*

- A. Freivalds, B. Niebel, Niebel's Methods, Standards, & Work Design, McGraw-Hill.

#### 23-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. Safety and relevant environmental considerations

*Textbooks (most recent edition is recommended):*

- M. P. Stephens, F. E. Myers, Manufacturing Facilities Design and Material Handling, Purdue University Press.
- J.A. Tompkins, J.A. White, Y.A. Bozer, and J.M.A. Tanchoco, Facilities Planning, John Wiley and Sons Inc.

#### 23-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.

*Textbooks (most recent edition is recommended):*

- F. Robert, Jacobs, Berry, William, Whybark, David, Manufacturing Planning and Control for Supply Chain Management, McGraw-Hill Education.
- W. J. Stevenson, M. Hojatii, J. Cao, Operation management, McGraw-Hill Education.
- Stevenson, W. J., et Benedetti, C., La gestion des opérations : produits et services, Chenelière McGraw-Hill.

### **23-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, elements of reliability. Quality standards, supplier-producer relations, quality certification.

*Textbooks (most recent edition is recommended):*

- F.M. Gryna, Quality Planning and Analysis, McGraw-Hill.
- D.C. Montgomery, Introduction to Statistical Quality Control, John Wiley and Sons.

### **23-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 verification and validation. Simulation output analysis. Selection and use of software.

*Textbooks (most recent edition is recommended):*

- A.M. Law, Simulation Modeling and Analysis, McGraw-Hill.
- J. Banks, J. S. Carson II, B. L. Nelson, D. M. Nicol, Discrete-Event System Simulation, Pearson.

## **Group B - Optional examinations (three required)**

### **23-Ind-B1 Reliability and Maintainability**

Reliability functions and distributions, analysis of failure, reliability of equipment and systems, failure predictive modelling, reliability block diagrams, fault tree analysis, time-to-repair and maintainability function, age and block replacement policies for components, Time Value of Money to equipment replacement decisions, maintenance program and management, availability analysis.

*Textbooks (most recent edition is recommended):*

- A. K. S. Jardine, A. H. C. Tsang, Maintenance, Replacement and Reliability Theory and Applications, CRC Press.
- C. E. Ebeling, An Introduction to Reliability and Maintainability Engineering, Waveland PR Inc.

### **23-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.

*Textbooks (most recent edition is recommended):*

- J.T. Black, and R.A. Kohser, DeGarmo's Materials and Processes in Manufacturing, Wiley.
- M.P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley.

### 23-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 of manufacturing systems, computer aided manufacturing (CAM), support systems for manufacturing, group technology, and flexible manufacturing systems. Effect of the use of computerized design aids and numerically or robotically controlled machines.

*Textbooks (most recent edition is recommended):*

- M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall.

### 23-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 systems, organizational structure and management information systems, development and evaluation of management information systems, distributed systems, computer networks, data communications. Data acquisition and transmission. Economic evaluation.

*Textbooks (most recent edition is recommended):*

- Laudon & Laudon, Management Information Systems: A Contemporary Perspective, MacMillan.

### 23-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 workplace design, including layout of equipment, manual work aids, design of seating, and person-machine interfaces: instruments, controls, and software. Regulated standards for work, safety and schedules.

*Textbooks (most recent edition is recommended):*

- R.S. Bridger, Introduction to Ergonomics, CRC Press.
- Kodak Ergonomics Group, Ergonomic Design for People at Work, Volumes I and II, Van Nostrand Reinhold Co. Ltd.

### 23-Ind-B6 Human Factor in 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 workplaces 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.

*Textbooks (most recent edition is recommended):*

- M.S. Sanders, E. McCormick, Human Factors in Engineering and Design, McGraw-Hill.
- E. Grandjean, Fitting The Task To The Human: A Textbook Of Occupational Ergonomics, CRC Press.

### 23-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.

*Textbooks (most recent edition is recommended):*

- Rich, Jones, Mowen, Hansen, Jones, Tassone, Cornerstones of Financial Accounting, Nelson Education.
- Meigs, Meigs, and Lam, Accounting: The Basis for Business Decisions, McGraw-Hill.
- Roy C., Garrison R. H., Libby T., Webb R. A., Bergeron H., Fondements de la comptabilité de gestion, Chenelière McGraw- Hill.

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

Computerization in manufacturing. Manufacturing information systems. Hierarchical control. Just-in-time in the context of CIM. CIM Architecture. Technologies: operating systems, case technologies, robots and artificial intelligence, databases. Product Information Management: CAD positioning; Design File Management; Hardware & software; Product Data Models. Product Information Standards: PDES, IGES, EDIF.

*Textbooks (most recent edition is recommended):*

- U. Rembold, Computer Integrated Manufacturing Technology and Systems, Marcel Dekker Inc.
- M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson.

### **23-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.

*Textbooks (most recent edition is recommended):*

- G. Ghiani, G. Laporte, R. Musmanno, Introduction to Logistics Systems Management, Wiley.
- S. Chopra and P. Meindl, Supply Chain Management: Strategy, Planning, and Operation, Pearson.

### **23-Ind-B10 Workplace Health and Safety**

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.

*Textbooks (most recent edition is recommended):*

- 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, Prentice Hall.