TOTAL EXAMINATION PROGRAM

PEO Syllabus of Examinations, 2008 Edition

MANUFACTURING ENGINEERING

PROFESSIONAL EXAMS – SPECIFIC TO MANUFACTURING ENGINEERING

GROUP A

08-Mfg-A1 Design and Manufacture of Machine Elements (22-MEC-A4)

Theory and methodology related to conceptual design; review of the methods used in stress analysis; simple design factor approach; variable loads; stress concentrations; bolts and bolted joints; welded joints; springs; shaft and bearing design; clutches, brakes, and braking systems.

The role and characterization of manufacturing technology within the manufacturing enterprise is also examined. Topics include an overview of the deformation process, joining processes, consolidation processes, material removal processes, material alteration processes; composites manufacturing, nano-and-microfabrication technologies rubber processing, glass working, coating processes, mechanical assembly, electronics packaging and assembly, and production lines; and process selection and planning; quality control systems.

08-Mfg-A2 Manufacturing Processes (23-IND-B2)

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.

08-Mfg-A3 Production Management (23-IND-A4)

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.

08-Mfg-A4 Analysis and Design of Work (23-IND-A2)

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.

08-Mfg-A5 Facilities Planning (23-IND-A3)

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.

08-Mfg-A6 Quality Planning, Control, and Assurance (23-IND-A5)

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, MIL STD105 E, MIL STD 414, elements of reliability. Quality assurance: ISO/QS 9000, suppliers, audits, quality manual, certification.

08-Mfg-A7 Electrical and Electronics Engineering (22-MEC-A5)

Introduction to analogue and digital semiconductor devices. Transistor amplifiers and switches. Power semiconductor devices, rectifiers, dc power supplies and voltage regulation. Operational amplifiers and application circuits. Combinational and sequential digital logic circuits. Practical approach to electronic instrumentation, measurement systems and transducers. DC circuits, Single phase and polyphase circuits Magnetic circuits and transformers (ideal and practical), DC machines: motors and generators. AC machines: induction motors, synchronous motors, and alternators. Power factor correction.

GROUP B

08-Mfg-B1 Computer Aided Design and Computer-Assisted Manufacturing (23-IND-B3)

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.

08-Mfg-B2 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.

08-Mfg-B3 Systems Simulation (23-IND-A6)

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.

08-Mfg-B4 Product Design and Development (22-MEC-B5)

Modern tools and methods for creative product design and development involving product research, establishment of design parameters, experimentation, development of conceptual alternatives, visualization, evaluation, revision, optimization and presentation. Particular topics include: The engineering design process, development processes and organizations, product planning, identifying customers needs, product specifications, concept generation, concept selection, prototyping, robust design, concept testing, product architecture, industrial design, design for manufacturing, patents and intellectual property, product development economics, and managing projects.

08-Mfg-B5 Engineering Materials (22-MEC-B8)

Working properties of steel, aluminum, magnesium, and titanium light alloys, superalloys and metal matrix composites. High temperature materials, metallic foams and other cellular materials, precursor-derived ceramics, corrosion of materials, intermetallics, multicomponent alloys, biomedical materials, polymeric composites as structural materials, ultrafine and nano structured materials. Microscale and nanoscale mechanisms responsible for their unique properties, such as molecular mobility and phase transitions. Working properties of polymers, shape memory alloys, piezoelectric materials, electro-rheological fluids, magnetostrictive materials, and fibre-reinforced composites. Selection of materials.

Testing of engineering materials. Emphasis on those used in aircraft, high-speed ground transportation vehicles, underwater, and space applications.

08-Mfg-B6 Metrology

The language and systems of measurement. Standards and measuring units system. Calibration and traceability and . Optical, pneumatic, electronic and mechanical measuring instruments and related methods. Coordinate metrology and mathematical concepts of dimensional metrology. Measuring errors analysis, their sources and propagation. Uncertainty in physical measurements. Precision and surface engineering. Applications of computers in metrological work and the interfacing of digital measuring equipment.

08-Mfg-B7 Logistics: Transportation Aspects (23-IND-B9)

Introduction to transportation engineering, and transport planning and economics. Modelling 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 competitivity: 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.

08-Mfg-B8 Robot Mechanics (22-MEC-B12)

Robot components (sensors, actuators, and end effectors, and their selection criteria); basic categories of robots (serial and parallel manipulators, mobile robots); mobility/constraint analysis; workspace analysis; rigid body kinematics (homogeneous transformation, angle and axis of rotation, Euler angles, cylindrical and spherical coordinates); manipulator kinematics and motion trajectories (displacement and velocity analyses, differential relations, Jacobian matrix); non-redundant and redundant sensing/actuation of manipulators; manipulator statics (force and stiffness); singularities; and manipulator dynamics.

08-Mfg-B9 Industrial Safety and Health (23-IND-B10)

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.

08-Mfg-B10 Tooling, Jigs and Fixture Design

Types of jigs and fixtures and their applications. Concepts of referencing, locating and planes of movement. Design characteristics for locating, clamping, assembling, machining and operational devices. Templates, vices, angle-plate, boxes and channels, Designing around the human element. Modular work holding, welding fixtures and manipulators, machining and assembly fixtures. Tooling for conventional machining and numerically controlled machines, setup devices. Tooling, jigs and fixtures for high quality production. Tool materials. Considerations for design economics.

08-Mfg-B11 Fluid Machinery (22-MEC-A6)

Dimensional analysis and similitude. Performance characteristics. Specific speed and machine selection, idealized velocity diagram. System characteristics and operating point and matching a pump to a piping system. System regulation, momentum and energy transfer, thermodynamic analysis, and efficiency definitions. Two-dimensional cascade analysis and performance. Application to pumps, fans, compressors, and turbines. Performance limits due to unsteady flow stalling and cavitation.

08-Mfg-B12 Ergonomics (23-IND-B5)

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.

08-Mfg-A1 Design and Manufacture of Machine Elements

Juvinall, Robert C., and Kurt M. Mershek, Fundamentals of Machine Component Design, 4th Edition. Wiley, 2005. ISBN: 0-471-66177-5.

Groover, Mikell P., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 3rd Edition. Wiley, 2006. ISBN: 0-471-74485-9.

08-Mfg-A2 - Manufacturing Processes

Kalpakjian, Serope, Manufacturing Processes for Engineering Materials, 3rd 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, 6th edition. MacMillan, 1984.

08-Mfg-A3 - Production Management

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

Stevenson & Hojati, Operations Management, 2nd Edition, McGraw-Hill Publishing Co. ISBN# 0-07-091189-4, 2004

08-Mfg-A4- Analysis and Design of Work

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

08-Mfg-A5- Facilities Planning

Meyers, F.E. & Stephens, M,P, Manufacturing Facilities Design and Material Handling, Edition 3, 2005, ISBN 0-13-112535-4

Muther,R,J & Wheeler,J,D, Simplified Systematic Layout Planning, ISBN 0-933684-09-6

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.

08-Mfg-A6 - 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.)

08-Mfg-A7 Electrical and Electronics Engineering

Edminister, J. A., and M. Nahvi, Electric Circuits, 4th Edition. Schaum's Outlines, 2003. Nasar, S., Electric

Machines and Electromechanics, 2nd Edition. Schaum's Outlines, 1998

Rizzoni, G., Principles and Applications of Electrical Engineering, 5th edition. McGraw Hill, 2007.

08-Mfg-B1 - 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.

08-Mfg-B2 - Computer Integrated Manufacturing (CIM)

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

08-Mfg-B3 - Systems Simulation

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

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

08-Mfg-B4 Product Design and Development

Prime Texts:

Collier, D.A. & Evans,J.R., Operations Management, Goods, Services and Value Chains, Edition 2, Illustrated, Thomson-Delmar Publishing, 2007 ISBN 0-324-36077-0

Ulrich, Karl T. & Steven D. Eppinger, Product Design and Development, 4th Edition. McGraw Hill, 2008. ISBN: 13 9780073101422.

Boothroyd, G., W.A. Knight & Peter Dewhurst, Product Design for Manufacture and Assembly, 2nd Edition. Marcel Dekker Inc. 2002. ISBN-10: 082470584X.

Supplementary Texts:

Ullman, David G., The Mechanical Design Process, 3rd Edition. McGraw Hill, 2003. ISBN: 0072373385.

08-Mfg-B5 Engineering Materials

Prime Text:

Ashby, Michael and D.R.H. Jones, Engineering Materials 1: An Introduction to Properties, Applications and Design, 3rd Edition. Butterworth-Heinemann, 2005. ISBN-10: 0750663804.

Ashby, Michael and D.R.H. Jones, Engineering Materials 2:An Introduction to Microstructures, Processing and Design, 3rd Edition. Butterworth-Heinemann, 2005. ISBN-10: 0750663812.

Supplementary Texts:

Courtney, Thomas H., Mechanical Behavior of Materials, 2nd Edition. Waveland Pr. Inc., 2005. I S B N-10: 1577664256.

Ashby, Michael, Materials Selection in Mechanical Design, 3rd Edition. Butterworth-Heinemann, 2005. ISBN-10: 0750661682.

08-Mfg-B6 Metrology

Dotson, Connie, Fundamentals of Dimensional Metrology, Edition 5, Illustrated, Thomson-Delmar Publishing, 2006, ISBN13 - 978-1-4180-2062-0

08-Mfg-B8 Robot Mechanics

Paul, R.P., Robot Manipulators - Mathematics, Programming and Control. MIT Press, 1981. ISBN 026216082X (out of print, but could be borrowed from libraries)

Craig, J.J., Introduction to Robotics: Mechanism and Control. Addison-Wesley Publishing Co., 2005. ISBN 0201543613

08-Mfg-B9 - 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.

08-Mfg-B10 Tooling, Jigs, and Fixture Design

Edward G. Hoffman, Jig and Fixture Design, Edition 5, Illustrated, Cengage Learning, 2003, ISBN 1401811078, 9781401811075

08-Mfg-B11 Fluid Machinery

Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbomachinery, 5th Edition. Butterworth-Heinemann, 2005.

Finnemore, E.J. & J.B. Franzini, Fluid Mechanics with Engineering Applications, 10th Edition. McGraw-Hill, 2002.

08-Mfg-B12 - 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.

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