
MECHANICAL ENGINEERING EXAMINATIONS SYLLABUS

GROUP A COMPULSORY EXAMINATIONS (6 REQUIRED)

98-Mec-A1 Applied Thermodynamics and Heat Transfer

Applied Thermodynamics: Review of fundamental laws and their applications to closed and open systems. Vapour cycles for power and refrigeration; cycle modifications including reheat, regeneration. Gas cycles; spark ignition and compression ignition cycles. Gas turbine cycles, including modifications such as regeneration and intercooling; effects of component efficiency on performance.

Heat Transfer: Conduction in one and two-dimensional systems; steady state and transient regimes. Natural- and forced-convection problems. Radiation heat exchange between black, gray, and real surfaces. Thermal design of heat exchangers.

98-Mec-A2 Fluid Mechanics and Applications

Review of basic concepts; elementary two-dimensional potential flow, vorticity and circulation, one-dimensional compressible flow of an inviscid perfect gas, isentropic flow through nozzles, shock waves, frictional compressible flow in conduits, equations of viscous flow, laminar and turbulent boundary layers. Bernoulli's equation and Navier-Stokes equations. Dimensional analysis and similitude. Application to pumps, fans, compressors, hydraulic turbines; pump system matching, pump/turbine similarity analysis, and idealized velocity diagrams and head calculations; limitations due to unsteady flow, stalling, and cavitation.

98-Mec-A3 Kinematics and Dynamics of Machines

Kinematic and Dynamic Analysis: Graphical and analytical methods for kinematic analysis of space mechanisms and elementary body motion in space, static and dynamic force analyses of mechanisms, gyroscopic forces, dynamics of reciprocating and rotating machinery, cam and gear mechanisms and specifications.

Vibration Analysis: Free and forced vibration of underdamped lumped systems with multidegrees of freedom, analytical and numerical techniques of solution, viscous damping, vibrational isolation, vibration measurement and control.

98-Mec-A4 Advanced Strength of Materials

Stress-Strain Analysis: Stress and strain, graphical representation by Mohr's circles of biaxial and triaxial cases, generalized Hooke's law, equations of equilibrium and compatibility, plane strain and plane stress problems. Euler critical loads for columns, shear flow in beams with thin sections, torsion of non-circular members, shear centre, membrane analogy, thick-walled cylinders and rotating discs, curved beams, contact stresses, strain gauges and application, stress concentrations. Failure theories and limit analysis.

Energy Methods: Strain energy principles, virtual work, Castigliano's theorem. Applications to cases in axial, bending, and torsional loadings. Applications to statically indeterminate problems.

98-Mec-A5 Design and Manufacture of Machine Elements

Stress, strain and material properties. Fundamentals of machining, metal forming, plastic moulding, and powdered metallurgy processes; non-traditional material removal processes: electric discharge machining, laser beam cutting and machining. Load analysis, static body stresses, elastic strain, deflection, and stability. Failure theories, safety factors, and reliability. Fatigue of machine elements, effect of surface treatments, notches, holes, cracks, and other stress raisers. Applications to the design of: threaded fasteners, power screws, bolted connections, welded joints, springs, roller bearings, gears, rotating shafts.

98-Mec-A6 Electrical and Electronics Engineering

Steady state and transient analysis of electric circuits. Time domain and frequency domain analyses. Single phase and polyphase circuits. 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. Protection of electrical apparatus and systems. Electrical safety. Practical approach to electronic instrumentation, measurement systems and transducers. Magnetic circuits and transformers, DC machines: motors and generators. AC machines: induction motors, synchronous motors, and alternators. Power factor correction.

GROUP B
ELECTIVE EXAMINATIONS (3 REQUIRED)

98-Mec-B1 Advanced Machine Design

Stress analysis and design of machine elements under conditions of: shock, impact, inertial forces, initial and residual stresses, corrosion environments, wear, elevated temperatures (creep), and low temperatures (brittle fracture). Hydrodynamic lubrication. Applications to the design of: journal bearings, clutches, brakes, couplings, and linkages. Introduction to probabilistic methods in mechanical design.

98-Mec-B2 Environmental Control in Buildings

Heating, ventilating, and air conditioning: Psychrometrics, heating load, cooling load, comfort, ventilation, and room air distribution. Humidifying and dehumidifying, duct and fan design, piping and pump design. Heating, ventilating and cooling systems, and components. Refrigeration.

Noise control: Sound wave characteristics, measurement instruments. Sources of noise, absorption, and transmission. Free field and reverberant conditions. Noise control techniques in buildings.

Energy management technology: Energy usage in buildings, control systems and instrumentation, lighting systems operation, engineering/economic analysis principles, energy audit procedures.

98-Mec-B3 Energy Conversion and Power Generation

Fuel sources and characteristics: hydrocarbon fuels, nuclear fission and fusion fuels. Fuel reserves. Applications of steam and gas cycles for large scale commercial power generation; theory and practice of fossil boilers, nuclear reactors, steam and gas turbines and hydroturbines. Methods of improving conversion efficiency of power generation systems. Energy storage methods and limitations. Renewable energy methods: wind, solar heating and photovoltaics, hydroelectric, geothermal, ocean thermal energy conversion, waves.

98-Mec-B4 System Analysis and Control

Open-loop and feedback control. Laws governing mechanical, electrical, fluid, and thermal control components. Mathematical models of mechanical, hydraulic, pneumatic, electric and electronic processes, and control devices. Block diagrams, transfer functions, response of servomechanisms to typical input signals (step function, impulse, harmonic), stability analysis, and stability criteria.

Improvement of system response by introduction of simple elements in the control circuit. Regulation of physical process: proportional, integral, and derivative control. Theory of linear controller design.

98-Mec-B5 Production Planning and Manufacturing

Production Engineering: Production engineering and its role in the management function, product

design development and value engineering, planning and control of production. Economic decision models, breakeven and minimum cost analysis, allocation and scheduling of resources. Analysis of plant layout and material handling systems, product range and mix and the effect on plant layout and materials handling, and techniques for facility layout. Types of inspection and inspection procedures.

Design for Manufacturability: Control of quality, principles of design, and measurement of gauges. Analysis of design, use of metrology equipment for testing of flatness, roundness, and concentricity. Measurement of angular surfaces, use of autocollimator and alignment telescope. Analysis of errors, quality assurance, statistical quality control, acceptance sampling. Concepts of reliability: life, sequential, environmental, and accelerated methods of component testing. Use of statistical and probability theory in determining reliability of components and systems.

98-Mec-B6 Fluid Machinery

Review of dimensional analysis and similitude. Performance characteristics. Specific speed and machine selection. System characteristics and operating point and matching. System regulations, momentum and energy transfer, thermodynamic analysis, and efficiency definitions. Two-dimensional cascade analysis and performance. Axial-flow compressors and turbines, impulse and reaction designs, radial-flow machines, secondary flows and losses. Performance limits due to cavitation.

98-Mec-B7 Aerodynamics of Flight

Review of basic equations of incompressible and compressible flow. Atmospheric characteristics relating to flight; measurement of air speed. Prediction of 2-D lift and drag using momentum and pressure methods; boundary layers and friction drags; dimensional analysis and wind tunnel measurements pertaining to lift and drag; induced drag and total airplane drag. Propulsion systems: turbo-fan and propeller/engine combinations; propulsion efficiency; thrust/power characteristics. Airplane performance; climb rate, time of climb, ceiling, generalized power required curve; range-payload characteristics; turns, take off, and landing; flight performance including stall, structural, and gust envelopes. Static stability and control.

98-Mec-B8 Aircraft Materials and Structures

Behaviour of aircraft materials: Testing of aircraft materials. Working properties of steel and aluminum, magnesium, and titanium alloys. Working properties of plastics and fibre-reinforced composites. Selection of materials. High and low temperature problems. Strength theories for triaxial cases, stress concentration, fatigue analysis and endurance limit, plastic behaviour, residual stresses, creep and stress relaxation. Fatigue and crack propagation.

Design and Analysis of Structures: Torsion of shells and box beams. Bending of thin-walled beams with open and closed sections. Flexural axis, shear lag, effects of stringers and booms. Pressure cabin problems, introduction to dynamic loading, normal modes, response to gust and landing loads. Aeroelastic effects, flutter and divergence.

98-Mec-B9 Finite Element Analysis

Shape functions, derivatives, numerical integration, continuity, convergence, numerical solution of simultaneous equations, weighted residual methods, natural coordinates, Jacobian matrix, accuracy, stability, conversion from continuous to nodal variables, generalized coordinates, imposition of boundary conditions, interpolation. Finite-element application to heat transfer, fluid flow, and stress analysis problems.

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

1998 MECHANICAL 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 (All Required)</i>			
98-BS-1	Mathematics		
98-BS-2	Probability and Statistics		
98-BS-3	Statics and Dynamics		
98-BS-6	Mechanics of Materials		
98-BS-7	Mechanics of Fluids		
98-BS-10	Thermodynamics		
<i>Basic Studies (2 required)</i>			
98-BS-4	Electric Circuits and Power		
98-BS-5	Advanced Mathematics		
98-BS-8	Digital Logic Circuits		
98-BS-11	Properties of Materials		
<i>Group A (6 required)</i>			
98-Mec-A1	Applied Thermodynamics and Heat Transfer		
98-Mec-A2	Fluid Mechanics and Applications		
98-Mec-A3	Kinematics and Dynamics of Machines		

98-Mec-A4	Advanced Strength of Materials		
98-Mec-A5	Design and Manufacture of Machine Elements		
98-Mec-A6	Electrical and Electronics Engineering		
Group B (3 Required)			
98-Mec-B1	Advanced Machine Design		
98-Mec-B2	Environmental Control in Buildings		
98-Mec-B3	Energy Conversion and Power Generation		
98-Mec-B4	System Analysis and Control		
98-Mec-B5	Production Planning and Manufacturing		
98-Mec-B6	Fluid Machinery		
98-Mec-B7	Aerodynamics of Flight		
98-Mec-B8	Aircraft Materials and Structures		
98-Mec-B9	Finite Element Analysis		
Complementary Studies (All Required)			
98-CS-1	Engineering Economics		
98-CS-2	Engineering in Society - Health, Safety, and the Environment		
98-CS-3	Management Concepts for Engineers		

Suggested Text 1998 CCPE - Mechanical Syllabus

**** Note to candidates, the listed textbooks below are only suggested. The list does not define or limit the syllabus.**

98-Mec-A1, Applied Thermodynamics & Heat Transfer

F.P. Incropera & David DeWitt, Introduction to Heat Transfer, latest edition, John Wiley & Sons.

Y. Cengel & M. Boles, Thermodynamics An Engineering Approach, 2nd edition, McGraw Hill.

98-Mec-A2, Fluid Mechanics and Applications

F.M. White, Fluid Mechanics, 4th edition, McGraw-Hill, 1998.

98-Mec-A3, Kinematics & Dynamics of Machines

William T. Thomson & Marie Dahleh, Theory of Vibration with Applications, latest edition, Prentice Hall ISBN # 0-13-651-068-X.

A.G. Erdman & G.N. Sandor, Mechanism Design: Analysis & Synthesis, Volume 1, Prentice Hall, 1997.

98-Mec-A4, Advanced Strength of Materials

Ansel Ugural & Saul Fenster, Advanced Strength & Applied Elasticity, Prentice Hall Englewood Cliffs, New Jersey 07632, latest edition, 1995.

R.G. Budynas, Advanced Strength & Applied Stress Analysis, McGraw-Hill, 2nd edition, 1998.

98-Mec-A5, Design & Manufacture of Machine Elements

Kalpajian, Manufacturing Engineering & Technology, 3rd edition, Addison Wesley, ISBN# 1-201-53846-6.

Shigley & Mischke, Mechanical Engineering Design, McGraw-Hill, 5th edition (Metric/English edition) 1993.

98-Mec-A6, Electrical & Electronics Engineering

R.J. Smith & R.C. Dorf, Circuits, Devices & Systems, 5th edition, John Wiley & Sons Inc., 1992.

98-Mec-B1, Advanced Machine Design

Shigley and Mischke, Mechanical Engineering Design, McGraw-Hill, 5th edition (Metric/English edition), ISBN 0-07-056899-5.

98-Mec-B2, Environmental Control in Buildings

F.C. McQuinston & G.D. Parker, Heating, Ventilating, & Air Conditioning – Analysis & Design 4th edition, 1988, John Wiley & Sons, ISBN # 0471-581070

ASHRAE Handbook Fundamentals Atlanta Georgia, American Society of Heating Refrigeration & Air Condition Engineers, 1791 Tullie Circle, N.E. 30329 U.S.A. Tel: 404-636-8400 Fax: 404-321-5478 www.ashrae.org

98-Mec-B3, Energy Conversion & Power Generation

M.M. El-Wakil, Power Plant Technology, McGraw-Hill, 1984, ISBN # 0-07-019288-X

Kam W. Li & A. Paul Priddy, Power Plant System Design, John Wiley & Sons, 1985, TK 1191.L5, ISBN 0-471-88847-8.

Joel Weisman & L.E. Eckart, Modern Power Plant Engineering, Prentice-Hall, 1985, TK 1191.W45, ISBN 0-13-597252-3.

98-Mec-B4, System Analysis & Control

J. Van de Vegte, Feedback Control Systems, Prentice-Hall, 1989, latest edition.

Dorf, Modern Control Systems, 7th edition, Addison-Wesley, 1980.

Raven, Automatic Control Engineering, 4th edition, McGraw-Hill, 1997.

98-Mec-B5, Production Planning & Manufacturing

Juran & Gryna, Quality Planning & Analysis, 3rd edition, McGraw-Hill.

H.T. Amrine, J.A. Ritchey, & C.L. Moodie, Manufacturing Organization and Management, Prentice-Hall, latest edition, 1987. ISBN # 0-135-55814-X

Chase, Aquilano & Jacobs, Operations Management for Comparative Advantage, 9th Edition, ISBN 0-072-59619.

98-Mec-B6, Fluid Machinery

R.L. Dougherty, J.B. Franzini, E.J. Finnemore, Fluid Mechanics with Engineering Applications, 8th edition, McGraw-Hill.

S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, 3rd edition, Pergamon Press.

V.L. Streeter, Y.E.B. Wylie, Fluid Mechanics, 8th edition, McGraw-Hill.

98-Mec-B7, Aerodynamics of Flight

John D. Anderson, Introduction to Flight, 3rd Edition, McGraw Hill. ISBN 0-07-001641-0

John D. Anderson, Fundamentals of Aerodynamics 3rd edition, McGraw Hill, ISBN # 0-07-001679-8

Barnes W. McCormics, Aerodynamics, Aeronautics & Flight Mechanics 2nd Edition, Wiley, 1995.

98-Mec-B8, Aircraft Materials & Structures

T.H.G. Megson, Aircraft Structures for Engineering Students, 2nd edition, Halstead Press, ISBN # 0-470-21653-0

R.Flinn & P.Trojan, Engineering Materials & Their Applications, Houghton Mifflin, ISBN # 0-395-35660-1

98-Mec-B9, Finite Element Analysis

Frank L. Stasa, Applied Finite Elements for Engineers, Holt, Reinhart, 1985, ISBN # 0-030-62737-0

Logan, A First Course in Finite Element Method, P.W.S. Engineering, 2nd edition, 1992.

W. Bickford, A First Course in Finite Element Method, Irwin, 1990

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