WWW.WES.ORG/CA

2 Carlton Street, Suite 1400
Toronto, ON M5B 1J3
CANADA
Tel: 800-361-6106 Fax: 416-972-9004
Email: supportca@wes.org

12-Dec-2017

Asso of Professional Eng and Geos of Saskat APEGS
300-4581 Parliament Avenue
Regina, SK S4W 0G3
CANADA

Reference#:
Name: A. Patel

Updated Evaluation Report (Original Completed on 11/12/2014)

The enclosed evaluation report is sent to you at the request of the applicant named above.

WES is prepared to answer any questions that you may have regarding the evaluation. Please contact our Academic Services staff by e-mail at supportca@wes.org or by phone at 800-361-6106.

WES evaluations can be accessed online via *AccessWES*. Please visit https://applications.wes.org/accesswes/Pages/Logon.aspx for more information.

Sincerely,

World Education Services

Cc:

Attachments

1137089

CREDENTIAL EVALUATION AND AUTHENTICATION REPORT

Name: [redacted]

Date : December 12, 2017

Date of Birth: [redacted]

Ref #:

CANADIAN EQUIVALENCY SUMMARY

Bachelor's degree (four years)

CREDENTIAL ANALYSIS

1. **Name on Credential:** [redacted]

Credential Authentication:	*Documents were sent directly by the institution*
Country:	India
Credential:	Bachelor of Engineering
Year:	2008
Awarded By:	University of Mumbai
Status:	Recognized Institution
Admission Requirements:	Secondary school graduation
Length of Program:	Four years
Major/Specialization:	Mechanical Engineering
Canadian Equivalency:	Bachelor's degree (four years)
Remarks:	The course-by-course analysis is based on the attached transcript and a sample evaluation in our database*

COURSE-BY-COURSE ANALYSIS

Name: [redacted]

Date of Birth: [redacted]

Date : December 12, 2017

Ref #:

INSTITUTIONS - DATES - SUBJECTS	Credits	Grades
University of Mumbai		
2004-2005		
✓ Applied Mathematics I*	2.0	B
Complex Variables, Vector Analysis and Calculus		
✓ Applied Sciences I	2.5	C
✓ Engineering Mechanics	2.5	C
Basic Electrical and Electronics Engineering I	2.5	C
Computer Programming I	2.5	C
✓ Applied Mathematics II*	2.0	B
Differential Equations and Integral Calculus		
✓ Applied Sciences II	2.5	C
Communication Skills	2.5	C
✓ Engineering Drawing	1.0	B
Computer Programming II	2.5	C
PASCAL		
Basic Workshop Practice I	1.0	A
2005-2006		
✓ Applied Mathematics III*	2.0	B
Complex Variables, Fourier Series and Integrals, Laplace Transforms and Matrices		
✓ Strength of Materials	2.5	C
Industrial Electronics	2.5	B
✓ Machine Drawing	1.0	B
✓ Production Processes I	2.5	B
✓ Applied Thermodynamics I	2.5	B
✓ Machine Shop Practice	1.0	A
✓ Applied Mathematics IV*	2.0	A
Computational Mathematics		
✓ Kinematics of Machinery	3.5	B
Thermal Engineering II	3.5	C
Production Processes II	3.5	C
Materials Technology	3.5	C
Graphical User Interfaces and Database Management	3.5	A
Machine Shop Practice II	1.0	A
2006-2007		
Mechanical Engineering Measurements	2.5	B

(Continued on next page)

COURSE-BY-COURSE ANALYSIS

Name: **Date :** December 12, 2017

Date of Birth: **Ref #:**

INSTITUTIONS - DATES - SUBJECTS	Credits	Grades
Dynamics of Machinery I	2.5	B
Fluid Mechanics	2.5	A
Heat and Mass Transfer	2.5	B
Data Structures	2.5	C
Presentation and Communication Techniques	1.0	A
Elements of Machine Design I	3.5	B
Mechatronics	3.5	B
Hydraulic Machinery	3.5	B
Dynamics of Machinery II	3.5	B
Power Plant Engineering	3.5	A
Internal Combustion Engines	3.5	B
2007-2008		
Elements of Machine Design II *with Lab*	4.0	B
CAD/CAM and Finite Element Analysis *with Lab*	4.0	B
Manufacturing Planning and Control	3.5	B
E-Commerce and Industrial Finance	3.5	B
Automobile Engineering I	4.0	B
Project I	1.0	B
Design of Mechanical Systems *with Lab*	4.0	B
Refrigeration and Air Conditioning *with Lab*	3.5	B
Industrial Engineering and Enterprise Resources Planning *with Lab*	3.5	B
Automobile Engineering II *with Lab*	3.5	B
Project II	2.5	B

SUMMARY

Total Undergraduate Semester Credits: 129.5 GPA: 2.86

Academic Assessment Form

Instructions for Applicants

General:

1. You must use your WES course-by-course assessment to complete this form.
2. You must fill out only the self-assessment column C2. Do not enter any information in C3 or C4. If you do it will be deleted.
3. Enter the year, course name, credits and grade from the course-by-course analysis in your WES assessment (see example on website).
4. Both the Basic Studies Syllabus Table and the Discipline Specific Syllabus Table contain compulsory subjects and elective subjects. Include courses that cover any part of the syllabus even if you have more than the minimum number in the elective sections.
5. Colour code the content of the APEGS syllabus in column C1 by highlighting it the same colour as the course name from WES assessment in column C2.
6. Once you have completed column C2, submit the Word form through the Contact Us page on the APEGS website.

Program Syllabus (when required):

7. Provide the program syllabus in a PDF document and submit through the Contact Us page on the APEGS website.
8. If the course names in the program syllabus are different than those in your WES assessment you must provide an explanation of how they correlate, in the program syllabus column of the form.
9. Use the page number of the PDF document of the program syllabus (not the original page number).

By submitting this self-assessment, I declare that I have read and followed the instructions and that this self-assessment is accurate and complete, to the best of my knowledge and ability, and that I have provided all the relevant information that I have available to me. I understand that if information is incorrect or missing, that it may delay my application and may result in the assignment of examinations to satisfy any academic deficiencies.

Assessment Form – Mechanical Engineering

Applicant Name:	**A. Patel**
APEGS File #	**12345**
Institution Attended:	**University of Mumbai**
Years Attended:	**2004-2008**
Year Degree Awarded:	**2008**
Degree (full name):	**Bachelor of Engineering in Mechanical Engineering**

BASIC STUDIES SYLLABUS TABLE

C1 APEGS Syllabus	C2 Self-Assessment (by applicant)		C3 for Staff only	C4 for ARC only
COMPULSORY SUBJECTS (all required)	**WES assessment: year, course name, credits and grade.**	**Program Syllabus: page number, course name**	**Preliminary Review**	**Final Review**
04-BS-1 Mathematics (calculus, vector, linear algebra): Applications involving matrix algebra, determinants, eigenvalues; first and second order linear ordinary differential equations, Laplace transforms. Vector algebra; vector functions and operations; orthogonal curvilinear coordinates; applications of partial derivatives, Lagrange multipliers, multiple integrals, line and surface integrals; integral theorems (Gauss, Green, Stokes). Power series.	2004-2005: Applied Mathematics I, 2 credits. Grade: B 2004-2005: Applied Mathematics II, 2 credits. Grade: B 2005-2006: Applied Mathematics III, 2 credits. Grade: B	Not required		
04-BS-2 Probability and Statistics: Concepts of probability, events and populations, probability theorems, concept of a random variable, continuous and discrete random variables, probability distributions, distributions of functions of a random variable, sampling and statistical estimation theory, hypothesis testing, simple regression analysis.	2005-2006: Applied Mathematics IV, 2 credits. Grade: A	Not required		
04-BS-3 Statics and Dynamics: Force vectors in two- and three-dimensions, equilibrium of a particle in two- and three-dimensions; moments and	2004-2005: Engineering Mechanics, 2.5 credits. Grade: C	Not required		

couples; equilibrium of rigid bodies in two- and three-dimensions; centroids, centres of gravity; second moment of area, moment of inertia; truss, frame and cable static analysis; friction. Planar kinematics of particles and rigid bodies; planar kinetics of particles and rigid bodies; work and energy, impulse, and momentum of particles and rigid bodies.				
04-BS-6 Mechanics of Materials: Definitions of normal stress, shearing stress, normal strain, shearing strain; shear force and bending moment diagrams; members subjected to axial loading; members subjected to torsional loading; compound stresses, Mohr's circle; deformation of flexural and torsional members; failure theories; elastic and inelastic strength criteria; columns.	2005-2006: Strength of Materials, 2.5 credits. Grade: C	Not required		
04-BS-7 Mechanics of Fluids: Fluid characteristics, dimensions and units, flow properties, and fluid properties; the fundamentals of fluid statics, engineering applications of fluid statics; the one-dimensional equations of continuity, momentum, and energy; laminar and turbulent flow, flow separation, drag and lift on immersed objects; wall friction and minor losses in closed conduit flow; flow of incompressible and compressible fluids in pipes; dimensional analysis and similitude; flow measurement methods.	2006-2007: Fluid Mechanics, 2.5 credits. Grade: A	Not required		
04-BS-10 Thermodynamics: Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; equation of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, Gibbs phase rule, gas-vapour mixtures.	2005-2006: Applied Thermodynamics I, 2.5 credits. Grade: B	Not required		

04-BS-11 Properties of Materials: Properties of materials for mechanical, thermal and electrical applications. Atomic bonding, solid solutions, crystallisation. Equilibrium phase diagrams, applications to steel and aluminium alloys, heat treatments. Structure and special properties of polymers and ceramic materials. General characteristics of metallic composites, polymeric composites and concrete. Introduction to materials in hostile environments: corrosion, creep at high temperature, refractory materials, subnormal temperature brittle fracture.	2005-2006: Materials Technology, 3.5 credits. Grade: C	Not required		
04-BS-15 Engineering Graphic and Design Process: Engineering drawing: Orthographic sketching. Standard orthographic projection. Principal views, selection and positioning of views. Visualization. Conventions and practices. First and second auxiliary views. Basic descriptive geometry. Section views, types, hatching conventions. Basic dimensioning requirements. Tolerance for fits and geometry control. Detail drawings and assembly drawings, other drawings and documents used in an engineering organization. Bill of materials. Fasteners and welds. Design process and methods: Project management & teamwork. Requirements and function analysis in design. Conceptual design and testing. Concept evaluation design factors such as: cost, quality, manufacturability, safety, etc. Systems modeling & design detail.	2004-2005: Engineeering Drawing, 1.0 credits. Grade B 2005-2006: Machine Drawing, 1.0 credits. Grade B 2007-2008: Project I, 1.0 credits. Grade B 2007-2008: Project II, 2.5 credits. Grade B	Not required		
C1 **APEGS Syllabus**	**C2** **Self-Assessment (by applicant)**		**C3** **for Staff only**	**C4** **for ARC only**
ELECTIVE SUBJECTS (**none required, but include them if you have them**)	**WES assessment: year, course name, credits and grade.**	**Program Syllabus: page number, course name**	**Preliminary Review**	**Final Review**

04-BS-4 Electric Circuits and Power: Basic laws, current, voltage, power; DC circuits, network theorems, network analysis; simple transients, AC circuits. Impedance concept, resonance; use and application of phasors and complex algebra in steady-state response; simple magnetic circuits; basic concepts and performance characteristics of transformers; an introduction to diodes and transistors; rectification and filtering; simple logic circuits.	2004-2005: Basic Electrical and Electronics Engineering I 2.5 credits. Grade C 2005-2006: Industrial Electronics 2.5 credits. Grade B	**Not required**		
04-BS-5 Advanced Mathematics: Series Solutions of Differential Equations: Series solutions of ordinary differential equations, boundary value problems and orthogonal functions, Fourier series. Numerical Methods: Use of computers for numerical solution of engineering problems, including techniques involving library subroutines and spreadsheets. Approximations and errors, interpolation, systems of linear and non-linear algebraic equations, curve fitting, numerical integration and differentiation, and ordinary differential equations.	2005-2006: Applied Mathematics III, 2 credits. Grade: B 2005-2006: Applied Mathematics IV, 2 credits. Grade: A	Not required		
04-BS-8 Digital Logic Circuits: Boolean algebra, encoders, decoders, shift registers, and asynchronous and synchronous counters together with timing considerations. Design of asynchronous circuits, synchronous sequential circuits, and finite state machines. Karnaugh mapping techniques, and state tables and diagrams. Introduction to programmable logic.				
04-BS-9 Basic Electromagnetics: Introduction to the basic electromagnetic principles upon which electrical engineering is based (laws in both integral and differential form). Classical development of electrostatics and magnetostatics leading to Maxwell's				

equations. Application of electromagnetic theory to calculation of d-c circuit parameters, study of plane wave transmission in various media.				
04-BS-12 Organic Chemistry: Principles of organic chemistry developed around the concepts of structure and functional groups. The main classes of organic compounds. Properties of pure substances. Introduction to molecular structure, bond types, properties, synthesis and reactions, reaction mechanisms, as a means of systematizing organic reactions.				
04-BS-16 Discrete Mathematics: Logic: propositional equivalences, predicates and quantifiers, sets, set operations, functions, sequences and summations, the growth of functions. Algorithms: complexity of algorithms, the integers and division, matrices. Methods of proof: mathematical induction, recursive definition. Basics of counting: pigeonhole principle, permutations and combinations, discrete probability. Recurrence relations: inclusion-exclusion. Relations and their properties: representing relations, equivalence relations. Introduction to graphs: graph terminology, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths. Introduction to sorting.				

DISCIPINE SPECIFIC SYLLABUS TABLE

C1 APEGS Syllabus	C2 Self-Assessment (by applicant)		C3 for Staff only	C4 for ARC only
COMPULSORY SUBJECTS (SIX REQUIRED, A1-A5 and one of A6 & A7)	**WES assessment: year, course name, credits and grade.**	**Program Syllabus: page number, course name**	**Preliminary Review**	**Final Review**
16-Mec-A1 Applied Thermodynamics and Heat Transfer : Thermodynamics: Review of the fundamental laws of	2005-2006: Thermal Engineering II 3.5 credits. Grade C	**Not required**		

thermodynamics, introductory psychrometry and analysis of the ideal gas compressor cycle, Rankine cycle, Otto cycle, Diesel cycle, Brayton cycle and the vapour compression refrigeration cycle. Heat Transfer: Application of the principles of steady and transient conduction heat transfer, natural and forced convection heat transfer and radiation heat transfer. Thermal analysis of heat exchangers.	2006-2007: Heat and Mass Transfer 2.5 credits. Grade B			
16-Mec-A2 Kinematics and Dynamics of Machines: Kinematic and Dynamic Analysis: Graphical and analytical methods for kinematic analysis of planar and spatial mechanisms and elementary body motion in space, static and dynamic force analyses of mechanisms, gyroscopic forces, dynamics of rotating machinery, cam and gear mechanisms and specifications. Vibration Analysis: Free and forced vibration of undamped and damped lumped single and multi degrees of freedom systems with, analytical and numerical techniques of solution, viscous damping, vibrational isolation, vibration measurement and control.	2005-2006: Kinematics of Machinery 3.5 credits. Grade B 2006-2007: Dynamics of Machinery II 3.5 credits. Grade B	Not required		
16-Mec-A3 System Analysis and Control: Open-loop and feedback control. Laws governing mechanical, electrical, fluid, and thermal control components. Mathematical models of mechanical, hydraulic, pneumatic, electrical and control devices. Block diagrams, transfer functions, response of servomechanisms to typical input signals (step function, impulse, harmonic), frequency response, Bode diagram, stability analysis, and stability criteria. Improvement of system response by introduction of simple elements in the control circuit. Regulation of physical	2006-2007: Mechatronics 3.5 credits. Grade B	Not required		

process: proportional, integral, and derivative control. Theory of linear controller design.				
16-Mec-A4 Design and Manufacture of Machine Elements: 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.	2006-2007: Elements of Machine Design I 3.5 credits. Grade B 2005-2006: Production Processes I 2.5 credits. Grade: B 2005-2006: Production Processes II 3.5 credits. Grade: C	Not required		
16-Mec-A5 Electrical and Electronics Engineering: 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,	2004-2005: Basic Electrical and Electronics Engineering I 2.5 credits. Grade C 2005-2006: Industrial Electronics 2.5 credits. Grade B	**Not required**		

synchronous motors, and alternators. Power factor correction.				
16-Mec-A6 Fluid Machinery: 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.	2006-2007: Hydraulic Machinery 3.5 credits. Grade B 2006-2007: Fluid Mechanics, 2.5 credits. Grade: A	Not required		
16-Mec-A7 Advanced Strength of Materials: Stress-Strain Analysis: Stress and strain, transformations, principal stresses, graphical representation by Mohr's circles of biaxial and triaxial cases, generalized Hooke's law including thermal strains, equations of equilibrium and compatibility, plane strain and plane stress problems. Failure theories and limit analysis. Euler critical loads for columns, curved beams, thick-walled cylinders and rotating disks, contact stresses, strain gauges and their application, stress concentrations, introductory fracture mechanics. Energy Methods: Strain energy principles, virtual work, Castigliano's theorem. Applications to cases of axial, bending, and torsional loadings. Applications to statically indeterminate problems.				
C1 **APEGS Syllabus**	**C2** **Self-Assessment (by applicant)**		**C3** **for Staff only**	**C4** **for ARC only**
ELECTIVE SUBJECTS (minimum of three required)	**WES assessment: year, course name, credits and grade.**	**Program Syllabus: page number, course name**	**Preliminary Review**	**Final Review**
16-Mec-B1 Advanced Machine Design: Stress analysis and design of	2007-2008: Elements of Machine Design II (w/ lab)	Not required		

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, power screws, clutches, brakes, couplings, and linkages. Introduction to probabilistic methods in mechanical design.	4.0 credits. Grade B 2007-2008: Automobile Engineering I 4.0 credits. Grade B			
16-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.				
16-Mec-B3 Energy Conversion and Power Generation: Fuel sources and characteristics: hydrocarbon fuels, nuclear fission, fusion fuels and fuel cells. 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, hydroturbines, and fuel cells. Methods of improving conversion efficiency of power generation systems. Energy storage methods and limitations. Renewable	2006-2007: Power Plant Engineering 3.5 credits. Grade A	Not required		

energy methods: wind, solar heating and photovoltaics, hydroelectric, geothermal, ocean thermal energy conversion, waves. Safety, environmental and emissions, economic, and social issues.				
16-Mec-B4 Integrated Manufacturing Systems: Production automation and the role of the computer in modern manufacturing systems via an comprehensive overview of applications of advanced technologies in manufacturing and their business impact on the competitive dimensions of cost, flexibility, quality and deliverability. Particular topics include: facility layout; cellular manufacturing; fundamentals of automation, numerical control programming, material handling and storage, automatically-guided vehicles, flexible manufacturing systems, group technology, programmable logic controllers, concurrent engineering, production planning and control, production activity control systems, automatic identification and data collection, lean and agile manufacturing, computer-aided process planning, forecasting, inventory management and control, quality control and inspection and inspection technologies.	2007-2008: Manufacturing Planning and Control 3.5 credits. Grade: B 2007-2008: Industrial Engineering and Enterprise Resource Planning 3.5 credits. Grade: B 2006-2007: Mechatronics 3.5 credits. Grade: B	Not required		
16-Mec-B5 Product Design and Development: 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.				
16-Mec-B6 Advanced Fluid Mechanics: 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.				
16-Mec-B7 Aero and Space Flight: 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. Re-entry and launch issues for space flight.				
16-Mec-B8 Engineering Materials: 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.				
16-Mec-B9 Advanced Engineering Structures: Materials and mechanics issues. Constitutive models for macroscale representation of the material response to mechanical load, temperature changes, electric field, etc. 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.	2007-2008: Design of Mechanical Systems 4.0 credits. Grade: B	Not required		
16-Mec-B10 Finite Element Analysis: Linear static analysis: basic concepts, shape functions, bar and beam	2007-2008: CAD/CAM and Finite Element Analysis (w/ lab) 4.0 credits. Grade B	Not required		

elements, direct and energy-based formulations, simple coordinate transformations, element assembly, boundary conditions, equation solution. Planar model formulations, work equivalent loads. Isoparametric element formulation: Jacobian matrix, numerical integration, stress averaging. Modeling, common errors, convergence, and accuracy issues. Introductory 3D solids, solids of revolution, plates and shells. Thermal analysis: matrix formulation, steady state and transient response. Introductory nonlinear modeling and procedures: simple material nonlinearity, stress stiffening, contact interfaces.				
16-Mec-B11 Acoustics and Noise Control: Function of hearing system, acquired deafness, acoustics standards and recommendations. Basic principles and calculations of acoustics phenomenon. Instrumentation about noise measurement, frequency-analysis sound meter. Acoustics reflection and transmission, characterization and selection of acoustics materials. Room acoustics, preventive calculation of noise level in rooms. Sound propagation in conduits, muffler design. Noise analysis and application of noise reduction techniques.				
16-Mec-B12 Robotics: 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.				
16-Mec- B13 Biomechanics (04-Bio-A4): The musculoskeletal system; general characteristics and classification of tissues and joints. Elastic and viscoelastic mechanical characterization of biological tissues including bone, cartilage, ligament and tendon. Principles of viscoelastic and the rate sensitivity of biological materials. The stress-strain-time or constitutive equations for soft connective tissue components. Biomechanics and clinical problems in orthopaedics. Modelling and force analysis of musculoskeletal systems. Passive and active kinematics. Mechanical properties of biological and commonly used biomedical engineering materials.				