COURSE SYLLABUS

FUNDAMENTALS OF ENGINEERING

INSTRUCTOR & EMAIL:	David K Hurd – dhurd@times2.org
ROOM:	Engineering Lab – Room 129
OFFICE HOURS:	2:45-3:45 MWR

COURSE DESCRIPTION/OVERVIEW: This is an introductory engineering course designed to introduce students to many of the concepts they will learn in a college engineering program as well as the engineering design process. Study will focus on the following areas.

- **Engineering Mathematics:** Indirect measurement techniques. SI and English Unit conversions. Accuracy, Precision & Significant Figures. Vector Algebra.
- **Statics & Mechanics of Materials:** Resultants of force systems. Concurrent force systems. Reaction forces. Equilibrium of rigid bodies. Frames and Trusses (method of joints). Inertia. Stress-strain diagrams. Stress types. Mohr's circle. Stress and strain caused by axial loads.
- **Dynamics, Kinematics, and Vibrations:** Kinematics of particles (rectilinear, projectile, rotational, curvilinear). Kinetic friction. Newton's 2nd law. Work-Energy Theorem. Impulse & Momentum. Free and forced vibrations. Simple Machines, Efficiency, Mechanical Advantage. Satellite motion. Rotational dynamics. Conservation of Momentum (linear and rotational). Conservation of energy (Linear, rotational, and vibratory). Elastic and Inelastic Collisions
- **Heat Transfer & Thermodynamics:** Temp scales. Heat transfer modes - Convection/conduction/radiation. Thermal Conductivity/Heat transfer rate. Boiling and condensation (latent and specific heat). Linear & volumetric expansion of solids and fluids. Properties of ideal gases. Energy, heat, and work. Laws of thermodynamics. Power cycles, thermal efficiency. P-V diagrams - Adiabatic/isothermal/isochoric/isotropic. Heat Engines & Carnot efficiency.
- **Electricity and Magnetism:** Charge, current, voltage, power, and energy. Ohm's law and Basic Hardware. Kirchoff's rules. Equivalent circuits (series and parallel). Short circuits. Electromagnetic forces (right-hand rule). Induced EMF. Electromagnetic Torque. Electric Motors and generators.
- **Challenge Project Options:** Tower/bridge construction. Catapults. Rube Goldberg Devices. Impact absorption competition. Robot obstacle courses. Solar heaters. Self-propelled vehicles.

GOALS: This course will introduce students to many of the concepts covered in the Fundamentals of Engineering Exam and to provide a broad survey of the types of engineering careers available to students. The Fundamentals of Engineering (FE) exam, also referred to as the Engineer in Training (EIT) exam, and formerly in some states as the Engineering Intern (EI) exam, is the first of two examinations that engineers must pass in order to be licensed as a Professional Engineer in the United States.

COMMON CORE STANDARDS OVERVIEW: The engineering design process is embedded throughout the next generation. Specific subject matter will reinforce and extend the physical science standards while preparing the student for the potential rigors of a college engineering program.

CLASSROOM RULES/PROCEDURES: As per the Times2 STEM Academy handbook.

GRADING POLICY: The final exam is cumulative and will count for 20% of the final grade. Each quarter will count for 40% of the cumulative grade and is scored as follows:

- Category I: Unit tests 40%
- Category II: Lab Reports 20%
- Category III: Assignments 20%
- Category IV: Projects 10%
- Category V: Science Fair 10%

COURSE SYLLABUS

Scope & Sequence

Semester I		
Sequence	**TOPIC**	**ASSIGNMENTS**
Unit 1	Mechanics of Materials	Activity – Course Policies and outline Mechanics of Elastic Solids - stress and strain Strength of Materials - Young's Modulus Mechanics of Elastic Solids – Advanced Problems Mohr's Circle – Shear and Normal Stresses. Activity – Modulus of Elasticity & Hooke's Law
Unit 2	Static Equilibrium	Activity – Indirect Measurement with Sextant Vector Algebra Translational Equilibrium Torque & Rotational Equilibrium (moment of force) Static Equilibrium Activity – Translational Equilibrium
Unit 3	Structures (Frames & Trusses)	Activity – Rotational Equilibrium Structures: Stability of Trusses Structures: Method of Sections Structures: Method of Joints Truss analysis Activity – Resultant Force vectors
Unit 4	Kinematics	Activity – Free Fall Speed, Velocity and Acceleration Rectilinear motion (Galilean equations) Free Fall Projectile Motion (Parabolic Motion) Activity –Projectile Motion
Unit 5	Dynamics	Activity – Friction Newton's Laws of motion Dynamics with Friction Impulse and Momentum Work, Energy and Power Activity – Law of Acceleration
Unit 6	Conservative Systems	Activity – Mechanical Advantage in Simple Machines Simple Machines: Efficiency & Mechanical Advantage Work-Energy Theorem Conservation of Momentum Conservation of energy Activity – Conservation of Mechanical Energy I
Unit 7	Rotational and Circular Motion	Activity – Centripetal Force Centripetal acceleration and Centripetal force, Satellite Motion and Gravitation Rotational Kinematics (angular speed) Rotational Kinematics (angular acceleration) Activity – Loop the loop
Unit 8	Rotational Dynamics	Activity – Rotational Inertia Moment of Inertia Rotational Dynamics (Newton's Laws) Conservation of Energy Conservation of Momentum Activity – Conservation of mechanical Energy II
Start-End Sem1	Engineering Challenge Project 1	Evaluation - Tower Challenge: Design, construct, and load test a balsawood tower.

COURSE SYLLABUS

Semester II		
Sequence	**TOPIC**	**ASSIGNMENTS**
Unit 9	Vibratory Systems	Activity – Simple Harmonic Motion Periodic and simple harmonic motion The Sinusoidal Nature of SHM Energy Conservation in Vibrating Systems Fundamental Frequencies & Resonance Activity –Forced Vibration/Resonance
Unit 10	Thermal Energy	Activity – Linear expansion of solids Temp scales, Linear & volumetric expansion Thermal Stress. Internal Energy, Latent Heat, Specific Heat Calorimetry & Thermal Equilibrium Activity – Calorimetry
Unit 11	Heat and Mass Transfer	Activity – SAM Heat Transfer Heat transfer - Convection. Heat transfer - Conduction Heat transfer - Radiation. Heat Engines & Carnot efficiency Activity – Computer simulation http://mw2.concord.org/public/part2/heat/index.cml
Unit 12	Thermodynamics	Activity – SAM Heat and Temperature The Ideal Gas Law Molecular Kinetic theory (Adiabatic/isothermal/isochoric/isotropic expansions P-V diagrams (Thermodynamic cycles) Activity – RI-ITEST (SAM) Gas Laws
Unit 13	Electric Fields & Potential	Activity – SAM Electrostatics Investigation Electrostatic Charge & Force Electric Fields and Lines Electric Potential Difference Capacitance Activity – Equipotential lines investigation.
Unit 14	Electrical Engineering	Activity – Series and Parallel Resistance Current, Power, Ohm's law and Basic Hardware (resistor, capacitor, inductor) Basic Circuit Analysis. (Series and Parallel RC circuits) Capacitance & Complex Circuit Analysis RC Circuits & Kirchoff's rules Activity – Kirchoff's Rules for circuits
Unit 15	Power Systems/E&M	Activity – Magnetic Fields and Flux Electromagnetism. Electric & Magnetic Fields. Electromagnetic forces / Right Hand Rule Induced EMF/Generators Electromagnetic Torque, Electric Motors & Back EMF Activity – Generator/Induced EMF
Start-End Sem2	Engineering Challenge Project 2	Evaluation - Vehicle Challenge: Design, construct, and test a self-propelled vehicle.