ELECTRICAL/ELECTRONICS ENGINEERING TECHNOLOGY

(EET)

BODY OF KNOWLEDGE

RUBRIC			DESCRIPTION
1			**Basic Concepts of Electricity**
	1.1		Systems of Units and Notation
		1.1.1	Units Systems and Fundamental Units
	.	1.1.2	Standard Notation
		1.1.3	Significant digits and rounding
	1.2		Voltage and Current Concepts
		1.2.1	Voltage
		1.2.2	Current
	1.3		Conductors and Insulators
		1.3.1	Free and bound electronics
		1.3.2	Barriers and hindrances to charge movement
		1.3.3	Relative conductivity – conductors vs. insulators vs. semiconductors
		1.3.4	Breakdown Voltage
	1.4		Resistivity, Resistance and Color Codes
		1.4.1	Resistivity as a material property
		1.4.2	Resistance/conductance as device properties
		1.4.3	Resistance combinations
		1.4.4	Color codes
		1.4.5	Resistor types
	1.5		Ohm's Law
		1.5.1	Linear V-I relationships
		1.5.2	Non-linear V-I relationships
		1.5.3	"DC" and "AC" resistance
	1.6		Capacitance, Capacitors and Markings
		1.6.1	Charge separation and storage
		1.6.2	Definition of capacitance
		1.6.3	Device capacitance
		1.6.4	Parallel and series capacitance combinations
		1.6.5	Capacitor types
		1.6.6	Markings and standard values
	1.7		Inductance, inductors and markings
		1.7.1	Current and magnetic flux
		1.7.2	Definition of inductance
		1.7.3	Device Inductance
		1.7.4	Parallel and series inductance combinations
		1.7.5	Inductor types and usage
		1.7.6	Markings and standard values
	1.8		Power and Energy
		1.8.1	Units
		1.8.2	Power dissipation/calculation in resistors
		1.8.3	Energy storage in capacitors and inductors
	1.9		Usage of Basic Electrical/Electronic Test Equipment
		1.9.1	Voltmeters and ammeters
		1.9.2	Power supplies
		1.9.3	Oscilloscopes
2			**Alternating Current (AC) Circuit Concepts**
	2.1		Sinusoidal Concepts
		2.1.1	Basics of periodic signals (amplitude, frequency, period, phase shift)
		2.1.2	Special nature of sinewaves and single-frequency sinewave systems
		2.1.3	Key trigonometric relationships
		2.1.4	Average and 'effective (rms)' values
		2.1.5	Standard symbols
	2.2		Capacitance and Capacitors

RUBRIC			DESCRIPTION
		2.2.1	Fundamentals
		2.2.2	Frequency effects on operation
	2.3		Inductance and Inductors
		2.3.1	Fundamentals
		2.3.2	Frequency effects on operation
	2.4		Energy Consumption and Storage
		2.4.1	Power consumption in resistors
		2.4.2	Energy storage/release in capacitors and inductors
	2.5		Capacitive and Inductive Reactance
		2.5.1	vc(t) - vL(t) - iL(t) relationships in single-frequency sinusoidal circuits
		2.5.2	AC reactance/susceptance definitions
		2.5.3	Reactance equations for Ls and Cs
		2.5.4	Series and parallels reactance combinations
	2.6		AC impedance/admittance
		2.6.1	Standard symbols
		2.6.2	Relationships: Z to Y; X to B; R to G
		2.6.3	Complex impedance concepts
		2.6.4	Equivalent Z/Y for series, parallel and series-parallel mixed impedances
	2.7		Phase Relationships
		2.7.1	Fundamental v(t) – i(t) phase shift for Rs, Ls, and Cs
		2.7.2	“Lead/Lag” terminology and conventions
		2.7.3	v(t) – i(t) phase relationship and complex impedance angle
	2.8		Simplified RC and RL Transients
		2.8.1	Generalized exponential response
		2.8.2	Constraining equations
		2.8.3	Circuit time constants
		2.8.4	Equations
		2.8.5	Time to steady-state
		2.8.6	Rise-time
	2.9		Complex Numbers and Phasors
		2.9.1	Plotting AC impedance on a complex plane
		2.9.2	Relationship of complex operation “j” and phase angle
		2.9.3	Basic math operations with complex numbers
		2.9.4	Relationship between complex plane and phasors
		2.9.5	Application of KVL and KCL to phasor diagrams
		2.9.6	Choice of “reference” phasor
		2.9.7	“Graphical” additions/subtraction of phasors
	2.10		AC Power, Power Factor and Power Triangle
		2.10.1	Generalized instantaneous AC power equation
		2.10.2	Definition of real, reactive and apparent power terms
		2.10.3	Reactive power sign conventions& general equation for apparent power
		2.10.4	General complex-number equation for apparent power
		2.10.5	Power triangle representation of P, Q and S
	2.11		Maximum Power Transfer
		2.11.1	Maximum power in purely resistive circuits
		2.11.2	Maximum power circuits with complex impedances
		2.11.3	Relationship to circuit efficiency
	2.12		Series and Parallel Resonance
		2.12.1	Basic definitions
		2.12.2	Resonance requirement – QC and QL
		2.12.3	Series resonant circuits
		2.12.4	Parallel resonant circuits
3			**Basic Circuit Analysis Methods**

RUBRIC			DESCRIPTION
		3.1	Series, Parallel and Series-Parallel Circuits
		3.2	Ideal and Practical Source Models
		3.3	Kirchhoff's Laws
		3.4	Voltage and Current Divider Rules
		3.5	Mesh Current Analysis
		3.6	Node Voltage Analysis
		3.7	Thevenin and Norton Theorems
		3.8	Source Conversions
		3.9	Superposition
		3.1	Bridge and Ladder Networks
		3.11	Y-Δand Δ-Y Conversions
		3.12	Schematic Entry and Simulation
4			**Digital Electronics**
	4.1		Numbering Systems and Codes
		4.1.1	Binary-to-Decimal Conversions
		4.1.2	Decimal-to-Binary Conversions
		4.1.3	Hexadecimal Number System Conversions
		4.1.4	BCD Code
		4.1.5	Gray Code
		4.1.6	Byte, Nibble, and Word
		4.1.7	ASCII Code
		4.1.8	Parity—Odd, Even, None, Error Detection
	4.2		Boolean Algebra and Logic Operations
		4.2.1	Boolean Math
		4.2.2	Constants
		4.2.3	Variables
		4.2.4	Logic Operators
		4.2.5	Equations
	4.3		Logic Gates and Standard Symbols
		4.3.1	AND Gate
		4.3.2	OR Gate
		4.3.3	NOT Gate
		4.3.4	Exclusive OR (XOR)
		4.3.5	NAND
		4.3.6	NOR
	4.4		Combinational Logic
		4.4.1	Sum-Of-Products Form (SOP)
		4.4.2	Product-Of-Sum Form (POS)
		4.4.3	Designing Combinatorial Logic Circuits
		4.4.4	Exclusive OR Circuits
		4.4.5	Karnaugh Maps
		4.4.6	Circuits<to>Equations<to>Truth Tables
	4.5		Latches and Flip-Flops
		4.5.1	Gate Based (Truth Table and Waveform Responses)
		4.5.2	D Latch
		4.5.3	Flip-Flop Timing
		4.5.4	Monostable
		4.5.5	Astable
	4.6		Clocked Circuits and Sequential Logic
		4.6.1	Clock Signals, Edge Triggered
	4.7		Counters and Registers
		4.7.1	Asynchronous counters (ripple)
		4.7.2	Synchronous Counters

RUBRIC			DESCRIPTION
		4.7.3	Simple IC Counter Chips
		4.7.4	Cascade Counters
		4.7.5	Parallel Shift Registers (schematics, timing, truth tables, waveforms)
		4.7.6	Serial Shift Registers (schematics, timing, truth tables, waveforms)
		4.7.7	Bi-Directional Shift Registers
		4.7.8	?
		4.7.9	Modulo Counters
	4.8		Arithmetic Operations and Circuits
		4.8.1	Binary Math Operations
		4.8.2	Implementation of Adders
		4.8.3	ALUs
		4.8.4	Comparators: =< >
	4.9		Analog-Digital Interfaces (A-D and D-A Circuits)
		4.9.1	Digital-to-Analog Conversion
		4.9.2	Analog-to-Digital Conversion
		4.9.3	ADC Specs
		4.9.4	Enhanced Types
		4.10	Programmable Devices (PLDs, FPGAs, etc.)
		4.10.1	PLD Architectures
		4.10.2	GALs (16V8)
		4.10.3	CPLDs
		4.10.4	FPGA
		4.10.5	JTAG Interfacing
	4.11		Encoders, Decoders and Multiplexers
		4.11.1	Decoders
		4.11.2	Encoders
		4.11.3	Multiplexers: IC
		4.11.4	De-Multiplexers
	4.12		IC Families
		4.12.1	Key Parameters
		4.12.2	Major Families
	4.13		Descriptive Languages and Programming
		4.13.1	VHDL vs AHDL
		4.13.2	VHDL vs Programming Languages
	4.14		RTL Simulation
	4.15		HDL Synthesis
		4.15.1	Syntax
		4.15.2	Functions
		4.15.3	Simulations
	4.16		FPGA and ASIC Processes
	4.17		FPGA Core/Base and ASIC Specialty/Advanced
	4.18		Signal Condition
		4.18.1	Op Amps
		4.18.2	Inverting and Non-Inverting
		4.18.3	Follower
		4.18.4	Opto-Isolators
		4.18.5	Filters: Bandpass, Low Pass
		4.18.6	Sampling
	4.19		Schematic Capture/Layout
		4.19.1	Schematics
		4.19.2	Simulation
		4.19.3	Net lists
		4.19.4	PCB Layout

RUBRIC			DESCRIPTION
	4.20		Memory
		4.20.1	Memory characteristics
5			**Analog Electronics**
	5.1		Semiconductor Theory
		5.1.1	Atomic Structure and Covalent Bonding
		5.1.2	Doping
		5.1.3	The P-N Junction
	5.2		The Semiconductor Diode
		5.2.1	Biasing the P-N Junction
		5.2.2	Diode Characteristics (including Zeners and LEDs)
	5.3		Voltage Rectification and Regulation Concepts
		5.3.1	Rectifier Circuits
		5.3.2	Filters
		5.3.3	Semiconductor (IC) Voltage Regulators
	5.4		The Bipolar Junction Transistor
		5.4.1	NPN and PNP Structures
		5.4.2	Biasing the BJT
		5.4.3	Basic BJT Linear Amplifiers
		5.4.4	The BJT as a switch
		5.4.5	The BJT as a simple current amplifier
	5.5		The Field Effect Transistor
		5.5.1	JFET structure and characteristics
		5.5.2	MOSFET structures and characteristics
		5.5.3	FET biasing
		5.5.4	FET linear amplifiers
		5.5.5	FET switching circuits
	5.6		Discrete-Device Amplifier Concepts, Design and Operation
		5.6.1	Gain
		5.6.2	Loading
		5.6.3	Frequency Considerations
		5.6.4	Coupling
		5.6.5	Amplifier Classes
	5.7		Differential Amplifiers
		5.7.1	Gain
		5.7.2	Input impedance
	5.8		Ideal Operational Amplifiers
		5.8.1	Basic characteristics
		5.8.2	Open loop response
		5.8.3	Closed loop response
		5.8.4	Feedback concepts
	5.9		Actual Operational Amplifiers
		5.9.1	Op-Amp Characteristics
		5.9.2	Specifications
		5.9.3	Limitations
	5.10		Basic Operational Amplifier Circuits
		5.10.1	Inverting and Non-Inverting Configurations
		5.10.2	Basic Comparators
		5.10.3	Summing Amplifiers
	5.11		Advanced Operational Amplifier Circuits
		5.11.1	Integrators
		5.11.2	Differentiators
		5.11.3	Feedback Oscillators
		5.11.4	Active Filters

RUBRIC			DESCRIPTION
		5.11.5	A-D and D-A Converters
	5.12		Special Purpose Amplifiers
		5.12.1	Instrumentation Amplifiers
		5.12.2	Isolation Amplifiers
		5.12.3	Transconductance Amplifiers
	5.13		Frequency Response
		5.13.1	Midband Gain
		5.13.2	Critical Frequencies and Bandwith
		5.13.3	Logarithms and Decibels
		5.13.4	Bode Plots
		5.13.5	Stability
		5.13.6	Internal and External Compensation
	5.14		Precision Diode Circuits
		5.14.1	Clippers
		5.14.2	Clampers
		5.14.3	Limiters
		5.14.4	Peak detectors
		5.14.5	Rectifiers
		5.14.6	Wave shaping circuits
	5.15		Advanced Devices
		5.15.1	SCR and SCR Circuits
		5.15.2	Diac and Triac Circuits
		5.15.3	The UJT
	5.16		Advanced Linear Amplifier Concepts
		5.16.1	The Current Mirror
		5.16.2	Active Loading
	5.17		Power Supply and Regulator Circuits
		5.17.1	Series Voltage Regulation
		5.17.2	Shunt Voltage Regulation
		5.17.3	Switching Regulators
	5.18		Timers and Relaxation Oscillators
		5.18.1	Astable Circuits
		5.18.2	Monostable Circuits
6			**Microcontrollers and Microprocessors**
	6.1		*Data representation*
		6.1.1	Binary number system
		6.1.2	Hexadecimal number system
		6.1.3	Hex/Decimal/Binary conversions
	6.2		Computer Arithmetic Functions
		6.2.1	Binary addition
		6.2.2	Binary subtraction
		6.2.3	Binary multiplication
		6.2.4	Binary division
		6.2.5	Hexadecimal division
	6.3		CISC/RISC architectures
	6.4		Basic Machine Architectures
		6.4.1	ALU
		6.4.2	Instruction Pointer
		6.4.3	Control unit
		6.4.4	Address bus
		6.4.5	Data bus
		6.4.6	Register sets
	6.5		CPU execution cycle

RUBRIC			DESCRIPTION
		6.5.1	Instruction fetch
		6.5.2	Instruction decode
		6.5.3	Execute
		6.5.4	Pipelining
	6.6		Stack based architectures
		6.6.1	Stack registers
		6.6.2	Stack frame
	6.7		Device Architecture, Memory and I/O
		6.7.1	Read only memory
		6.7.2	Random access memory
		6.7.3	IO Ports
		6.7.4	Memory hierarchy (speed vs. cost)
	6.8		Programming Basics
		6.8.1	Interpreted vs. compiled programs
		6.8.2	Assembly language
		6.8.3	Hi-Level languages
	6.9		Loops, Branching, Jumps and Subroutines
		6.9.1	IF-THEN-ELSE constructs
		6.9.2	For and While loops
		6.9.3	Do-While loops
		6.9.4	Stack manipulation
		6.9.5	Subroutines
	6.1		Timing, Control, Polling and Sensing
	6.11		Basic Math Programming
		6.11.1	Number formats and representation
	6.12		Serial and Parallel Ports and I/O
		6.12.1	Data transmission rates
		6.12.2	UARTs
		6.12.3	Data transmission and handshaking
		6.12.4	Modems
	6.13		Interrupts
		6.13.1	Interrupt architecture
		6.13.2	Interrupt service routines
		6.13.3	Exceptions
		6.13.4	Exception handlers
	6.14		Assembly Language
		6.14.1	Instruction set architectures
	6.15		Bus Cycle Analysis
		6.15.1	Instruction fetch cycle
		6.15.2	Memory access
	6.16		Bus-Level Timing Analysis
		6.16.1	Data/Address multiplexing
		6.16.2	Basic control signals
		6.16.3	Direct Memory Access (DMA)
	6.17		Cache Architecture Analysis
		6.17.1	Principle of temporal and spatial locality
		6.17.2	Instruction and Data cache
		6.17.3	Multi-Level cache memory
		6.17.4	Cache lookup strategies
		6.17.5	Cache update policies
	6.18		System Performance (CMA, Bus Size, FIFO)
	6.19		8/16/32 Bit Addressing and Data Storage
		6.19.1	Addressing Concepts and Modes

RUBRIC			DESCRIPTION
		6.19.2	Machine word sizes and formats
	6.20		Advanced Programming Topics
		6.20.1	Data Structures
		6.20.2	Advanced Topics (recursion, sorting/searching, multitasking, communications, bus structures, etc.)
7			Instrumentation and Measurements
	7.1		Measurement Parameters
		7.1.1	Accuracy
		7.1.2	Precision
		7.1.3	Difference between accuracy and precision and the significance
		7.1.4	Percent error
	7.2		Errors
		7.2.1	Systematic or bias errors
		7.2.2	Random errors
		7.2.3	Reduction of random errors by averaging
	7.3		Roundoff Strategies
		7.3.1	Significant digits
		7.3.2	Addition and subtraction rules for significant digits
		7.3.3	Multiplication and division rules for significant digits
	7.4		Statistical Measures of Data
		7.4.1	Mean
		7.4.2	Mean-square
		7.4.3	Root-mean-square (rms)
		7.4.4	Variance
		7.4.5	Standard deviation
	7.5		Basic Passive DC Instruments
		7.5.1	D'Arsonval galvanometer dc ammeter
		7.5.2	DC voltmeter derived from dc ammeter
		7.5.3	Ohmmeter derived from dc ammeter
	7.6		Alternating Current (AC) Instruments
		7.6.1	Rectifier type AC instruments
		7.6.2	Peak and Peak-to-Peak AC instruments
		7.6.3	True RMS instruments
	7.7		Multimeters
		7.7.1	Analog types
		7.7.2	Digital types
	7.8		Important Specifications of All Instruments
		7.8.1	Accuracy and Precision
		7.8.2	Frequency Response
		7.8.3	Input Impedance of Voltmeters
	7.9		Oscilloscopes
		7.9.1	Classifications
	7.10		Oscilloscope Specifications and Measurements
		7.10.1	Rise time and bandwidth
		7.10.2	DC coupling and AC coupling and their applications
		7.10.3	Probes and their compensation circuits
		7.10.4	Rise-time & propagation delay measurements
	7.11		Frequency Response Measurements
		7.11.1	Amplitude response measurement
		7.11.2	Phase response measurement
	7.12		Spectrum Measurements
		7.12.1	Fourier series and spectral displays
		7.12.2	Frequency selective voltmeters (analog forms)

RUBRIC			DESCRIPTION
		7.12.3	Spectrum analyzers (including FFT digital forms)
		7.12.4	Relationship between record length, sampling time, and resolution
	7.13		Miscellaneous Electrical/Electronic Instruments
		7.13.1	Bridge circuits
		7.13.2	Capacitance and inductance measurement circuits
		7.13.3	Frequency and phase measurements
		7.13.4	Q-Meters
		7.13.5	Time domain reflectometers
		7.13.6	Wattmeters
		7.13.7	Stroboscopes
	7.14		Miscellaneous Measurement Devices and Systems
		7.14.1	Temperature measuring systems
		7.14.2	Pressure measurement systems
		7.14.3	Flow measurement systems
		7.14.4	Strain/force measurement systems
8			**Practical Laboratory Skills**
	8.1		Circuit Prototyping
		8.1.1	Breadboards
		8.1.2	Layout
		8.1.3	Component Concerns
	8.2		Basic Soldering
		8.2.1	Tools
		8.2.2	Safety
		8.2.3	Concerns
		8.2.4	Advanced
	8.3		Use of Basic Analog and Digital Meters
		8.3.1	Resistance Measurements
		8.3.2	Voltage Measurements
		8.3.3	Current Measurements
		8.3.4	AC Measurements: RMS, Vp, Vpp
		8.3.5	Frequency Measurements
		8.3.6	LCR Measurements
		8.3.7	Bridge Circuit Basics
		8.3.8	Capacitors
		8.3.9	Inductor
		8.3.10	Digital Logic Probes
		8.3.11	Power Measurements
		8.3.12	Wattmeter
		8.3.13	KwHr meter
		8.3.14	Power Factor
	8.4		Use of Digital Oscilloscope
		8.4.1	Waveform measurements: Oscilloscope
	8.5		Use of Spectrum Analyzer
	8.6		Use of Digital Circuit Analyzer

RUBRIC			DESCRIPTION
	8.7		Use of Electronic Data Acquisition Devices