Syllabus for written examination of TGT (Work Experience)
(Electrical Gadget and Electronics)

Unit: I

a.	**CIRCUIT FUNDAMENTALS**
b.	**RESISTIVE CIRCUITS**
c.	**KIRCHHOFF'S LAW**
d.	**NETWORK THEOREMS**
e.	**PASSIVE CIRCUITS ELEMENTS**
f.	**ENERGY SOURCES**
g.	**MAGNETISM AND ELECTROMAGNETISM**

(a) Circuit Fundamentals

Zero Reference Level - Chassis Ground - Ohm's Law - Formula Variations of Ohm's Law - Graphical Representation of Ohm's Law - Linear Resistor - Non-linear Resistor - Cells in Series and Parallel - Conventional Problems

(b) Resistive Circuits

Series Circuit - Characteristics of a Series Circuit - The Case of Zero IR Drop - Polarity of IR Drops - Total Power - Series Aiding and Series Opposing Voltages - Proportional Voltage Formula in a Series Circuit Series Voltage Dividers - 'Opens' in a Series Circuit - 'Shorts' in a Series Circuit - Parallel Circuits - Laws of Parallel Circuits - Special Case of Equal Resistances in all Branches - Special Case of Only Two Branches Any Branch Resistance -Proportional Current Formula - 'Opens' in a Parallel Circuit - 'Shorts' in a Parallel Circuit - Series-Parallel Circuits Analysing Series Parallel Circuits - 'Opens' in Series-Parallel Circuits 'Shorts' in Series-Parallel Circuits - Voltage Division in a Complex Series-Parallel Circuit - Conventional Problems

(c) Kirchhoff's Laws

General - Kirchhoff's Current Law - Kirchhoff's Voltage Law - Determination of Algebraic Sign - Assumed Direction of Current Flow - Conventional Problems.

(d) Network Theorems

General - Superposition Theorem - Ideal Constant-Voltage Source - Ideal Constant-current Source - Thevenin's Theorem - How to Thevenize a Circuit? - Norton's Theorem - How to Nortonise a Given Circuit - Maximum Power Transfer Theorem - Conventional Problems

(e) Passive Circuit Elements

General - Resistors - Resistor Types - Wire-wound Resistors - Carbon Composition Resistors - Carbon Film Resistors - Cermet Film Resistors .Metal Film Resistors - Power Rating - Value Tolerance - Variable Resistors - Potentiometers and Rheostats - Fusible Resistors - Resistor Colour Code - Resistance Colour Bands - Resistors under Ten Ohm - Resistor Troubles - Checking Resistors with an Ohmmeter - Inductor - Comparison of Different Cores - Inductance of an Inductor - Another Definition of Inductance - Mutual Inductance - Coefficient of Coupling - Variable Inductors - Inductors in Series or Parallel without M - Series Combination with M - Stray Inductance - Energy Inductance - Energy Stored in a Magnetic Field - DC Resistance of a Coil - Troubles in Coils - Reactance Offered by a Coil - Impedance Offered by a Coil - Q-Factor of a Coil - Capacitors - Capacitor Connected to a Battery - Capacitance -Factors Controlling Capacitance - Types of Capacitors - Fixed Capacitors - Variable Capacitors - Voltage Rating of Capacitors - Stray Circuit Capacitance Leakage Resistance - Capacitors in Series - Two Capacitors in Series Capacitors in Parallel - Two Capacitors in Parallel - Energy stored in a Capacitor - Troubles in Capacitors - Checking Capacitors with Ohmmeter - Charging of a Capacitor - Capacitor Connected Across an AC Source Capacitive Reactance

(f) Energy Sources

Primary and Secondary Cells - Cell and Battery - Voltage and Current of a Cells - Cell life - Different Types of Dry Cells - Carbon Zinc Cell Alkaline Cell - Manganese Alkaline Cell - Nickel Cadmium Cell - Mercury Cell - Silver Oxide Cell - Lead Cells - Battery Rating - Testing Dry Cells - Photoelectric Devices - Photovoltaic Cell - Solar Cell Conventional Problems

(g) Magnetism and Electromagnetism

Magnetic Materials- Ferrites - Types of Magnets - Demagnetising or Degaussing -Magnetic Shielding - Magnetic Terms and Units - Ohm's Law for Magnetic Circuit - Transformer - Transformer Working - Transformer Impedance - Can a Transformer Operate on DC ? - RF Shielding - Autotransformer - Impedance Matching - Conventional Problems.

Unit – II:

a)	A.C. FUNDAMEMTALS
b)	SERIES A.C. CIRCUITS
c)	TIME CONSTANTS
d)	TUNING CIRCUITS AND FILTERS
e)	SOLID STATE PHYSICS
f)	THE P-N JUNCTION
g)	P-N JUNCTION DIODE

(a) A.C. Fundamentals

Introduction – Types of Alternating Waveforms - The Basic AC Generator -Some Definitions - Characteristics of a Sine Wave - Audio and ,Radio Frequencies - Different Values of Sinusoidal Voltage and Current – Phase of an AC - Phase Difference - Vector Representation of an Alternating Quantity - AC Through Pure Resistance Only - AC Through Pure Inductance Only - AC Through Pure Capacitance Only - Non-sinusoidal Waveforms - Harmonics -Conventional Problems

(b)Series A.C. Circuits

R-L Circuit - Q Factor of a Coil - Skin Effect - R-C Circuit - Coupling Capacitor - R-L-C Circuit - Resonance in an R-L-C Circuit - Resonance Curve - Main Characteristics of Series Resonance - Bandwidth of a Tuned Circuit - Sharpness of Resonance - Tuning - Tuning Ratio - RaGio Tuning Dial - Parallel Resonance -Conventional Problem

(c) Time Constant

Rise and Fall of Current in Pure Resistance - Time Constant at an R-L Circuit - Circuit Conditions - Inductive Kick - Time Constant of an RC Circuit - Charging and Discharging of a Capacitor - Decreasing Time Constant - Flasher - Pulse Response of an RC Circuit - Effect of Long and Short Time Constants - Square Voltage Wave Applied to Short A RC Circuit - Square Voltage Wave Applied to Long A,'E.C Circuit - Conventional Problems

(d) Timing Circuits and Filters

What-is. a Tuning Circuit ? - Tuned Circuit - Operating Characteristics of a Tuning Circuit - Resonance - Actual Series Resonance - Is it Series or Parallel Resonance ? - Tuned Transformers - Double Tuned Transformers - Parallel Circuit - Coupled Circuits - Simple Coupled Circuits - Coefficient of Coupling - Filters + Filter Definitions - Types of Filter Circuits - Low-pass Filter - Highpass Filter - Bandpass Filter - Bandstop Filter - Multisection Filter Circuits - Uses of Filters - Conventional Problems

(e) Solid State Physics

Definition of Matter - Crystalline Solids - Unit Cell - Forms of Matter - Atom and Molecule - Atomic Structure - Atomic Number (Z) - Atomic Mass Number (A) - Electron Orbits or Shells - Electron Distribution of Different Atoms - Electron Sub orbits or Subshells - Valence Electrons Orbital Energy. - Normal, Excited and Ionised Atom. - Orbital Energies in Hyrogen Atom - Energy Levels in an Isolated Atom - Energy Bands in Solids - Bonds in Solids - Valence and Conduction Bands - Conduction in Solids - Hole Formation and its Movement - Conductors, Semiconductors and Insulators - Types of Semiconductors - Intrinsic Semiconductors Extrinsic Semicon'ductors - Majority and Minority Charge Carriers - Mobile Charge Carriers and Immobile Ions - Drift Current in Good Conductors Drift Current in Intrinsic Semiconductors - Intrinsic Conduction -Conventional Problems

(f) The P-N Junction

The P-N Junction - Formation of Depletion Layer - Junction or Barrier Voltage (V B) - Effect of Temperature on Barrier Voltage - Forward Biased P-N Junction - Forward VfI Characteristics -Reverse Biased P-N Junction - Reverse Saturation Current (Is or 1_0) - Reverse V/ I Characteristic Combined Forward and Reverse VII Characteristics - Junction Breakdown - Junction Capacitance

(g) P-N Junction Diode

P-N Junction Diode - Diode Ratings or Specifications - Diode Testing The Ideal Diode - The Real Diode - Diode Circuits with DC and AC Voltage Sources - Diode Fabrication - Grown Junction - Alloy Junction _ Diffused Junction - Epitaxial Junction - Point Contact Junction - Clippers and Clampers - Clippers - Some Clipping Circuits - Clampers -,- Summary of Clamping Circuits - Conventional Problems , Questions.

Unit – III

a)	**SPECIAL DIODE**
b)	**OPTOELECTRONIC DEVICES**
c)	**D.C POWER SUPPLIES**
d)	**THE BASIC TRANSISTOR**
e)	**TRANSISTOR CHARACTERISTICS AND APPROXIMATION**
f)	**LOAD LINES AND DC BIAS CIRCUITS**
g)	**TRANSISTOR EQUIBALENT CIRCUITS AND MODELS**

(a) Special Diodes

Zener Diode - Voltage Regulation - Zener Diode as Peak Clipper - Meter Protection - Tunneling Effect - Tunnel Diode - Tunnel Diode Oscillator - Varactor - PIN Diode - Schottky Diode - Step Recovery Diode Thermistors -Conventional Problems

(b) Optoelectronic Devices

Introduction - Spectral Response of Human Eye - Light Emitting Diode (LED) - Photoemissive Devices - Photomultiplier Tube - Photovoltaic Devices - Bulk Type Photoconductive Cells - Photodiodes -P-N Junction Photodiode - PIN Photodiode - Avalanche Photodiode -

(c) DC Power Supplies

Introduction - Unregulated Power Supply - Regulated Power Supply Steady and Pulsating DC Voltages - Rectifiers - Half-wave Rectifier Full-wave Rectifier - Full-wave Bridge Rectifier - Filters - Series Inductor Filter - Shunt Capacitor Filter - Effect of Increasing Filter Capacitance - LC Filter - The CLC or Pi Filter - Bleeder Resistor - Voltage Regulation Zener Diode Shunt Regulator - Transistor Series Voltage Regulator - Controlled Transistor Series Regulator - Transistor Shunt Voltage Regulator Transistor Current Regulator - Voltage Dividers - Complete Power Supply - Voltage Multipliers - Half-wave Voltage Doubler - Full-wave Voltage Doubler - Voltage Tripler and Quadrupler Circuits - Troubleshooting Power Supplies - Controlled Rectification - Output Waveforms for Different Firing Angles - Output Voltage and Current Values in Controlled Rectifiers Average Values for FW Controlled Rectifier - Silicon Controlled Rectifier (SCR) - Pulse Control of SCR - 90^0 Phas~ Control of SCR - 180^0 Phase Contr,gi of SCR - SCR Controlled Circuit - UJT Controlled Circuit Conventional Problems

(d) The Basic Transistor

The Bipolar Junction Transistor - Transistor Biasing -Important Biasing Rule - Transistor Currents - Summing Up - Transistor Circuit Configurations - CB Configuration - CE Configuration -Relations between α and β - CC Configuration - Relations between Transistor Currents - Leakage Currents in a Transistor - Thermal Runaway - Conventional Problems

(e) Transistor Characteristics and Approximations

Transistor Static Characteristics - Common Base Test Circuit - Common Base Static Characteristics – Common

Emitter Test Circuit - Common Emitter Static Characteristics - Common Collector Static Characteristics –

Different Ways of Drawing Transistor Circuits - Common Base Formulas Common Emitter Formulas –

Common Collector Formulas - The Beta Rule - Importance of V_{CE}- Cut-off and Saturation Points - Normal DC

Voltage Transistor Indications - Transistor Fault Location - Solving Universal Stabilization Circuit

- Notation for Voltages and Currents - Increase / Decrease Notation - Applying AC to a DC Biased Transistor

- Transistor *AC/DC*

Analysis –Conventional problems

(f) Load Lines and DC Bias Circuits

DC Load Line - Q-point and Maximum Undistorted Output - Need for Biasing a Transistor - Factors Affecting

Bias Variations - Stability Factor - Beta Sensitivity - Stability Factor for CB and CE Circuits - Different

Methods for Transistor Biasing - Base Bias - Base Bias with Emitter Feedback - Base Bias with Collector

Feedback - Base Bias with Collector and Emitter Feedbacks - Voltage Divider Bias - Load Line and Output

Characteristics - AC Lmid Line - Conventional Problems'

(g) Transistor Equivalent Circuits and Mode

General - DC Equivalent Circuit - AC Equivalent Circuit - Equivalent Circuit of a CB Amplifier - Effect of Source Resistance RS on Voltage Gain - Equivalent Circuit of a CE Amplifier - Effect of Source Resistance RS - Equivalent Circuit of a CC Amplifier - Small-Signal Low-frequency Model or Representation - General - T-Model - Formulas for T-Equivalent of a CB Circuit - T-Equivalent of a CE Circuit - T-Equivalent of a CC Circuit - What are h-parameters ? - The h-parameter Formulas for Notation for Transistors - The h-parameters of an Ideal Transistor -, The h-parameters of an Ideal CB Transistor - The h-parameters of an Ideal CE Transistor - Approximate Hybrid Equivalent Circuits - Typical Values of Transistor h-parameters - Hybrid Formulas for Transistor Amplifier - Approximate Hybrid Formulas -Conventional Problems

Unit – IV

a)	SINGLE STAGE TRANSISTOR AMPLIFIER
b)	MULTISTAGE AMPLIFIER
c)	DECIBELS AND FREQUENCY RESPONSE
d)	FEEDBACK AMPLIFIERS
e)	FIELD EFFECT TRANSISTORS
f)	BREAKDOWN DEVICES
g)	SINUSOIDAL OSCILLATORS
h)	NON SINUSOIDAL OSCILLATORS

(a) Single-Stage Transistor Amplifiers

Classification of Amplifiers - Common Base (CB) Amplifier - Various Gains of a CB Amplifier - Characteristics of a CB Amplifier - Common Emitter (CE) Amplifier - Various Gains of a CE Amplifier - Characteristics of a CE Amplifier - Common Collector (CC) Amplifier - Various Gains of a CC Amplifier - Characteristics of a CC Amplifier - Uses - Comparison of Amplifier Configurations - Amplifier Classification Based on Biasing Condition - Graphic Representation - Class-A Amplifiers - Power Distribution in a Class-A Amplifier - Power Rectangle - Power Efficiency Maximum AC Power in Load - Transformer-coupled Class-A Amplifier Class-B Amplifier - Power Relations for Class-B Operation - Maximum Values - Class-B Push-Pull Amplifier - Crossover Distortion - Power Efficiency of Push-Pull Amplifiers - Complementary Symmetry Push-Pull Class-B Amplifier - Class-C Amplifier - Tuned Amplifier - Distortion in Amplifier - Non-linear Distortion - Intermodulation Distortion - Frequency Distortion - Phase or Delay Distortion - Noise

(b) Multistage Amplifiers

General '--- Amplifier Coupling - RC-coupled Two-stage Amplifier - Advantages of RC Coupling ~ Impedance-coupled Two-stage Amplifier -Advantages of Impedance Coupling - .Transformer-coupled Two Stage Amplifier - Advantages of Transformer Coupling - Frequency Response - Applications - Direct-coupled Two-stage Amplifier Using Similar Transistors - Direct-coupled Amplifier Using Complementary Symmetry of Two Transistors - Darlington Pair - Advantages of Darlington Pair - Comparison between Darlington Pair and Emitter Follower - Special Features of a Differential Amplifier - Common Model Input - Differential Amplifier -Conventional Problems

(c) Decibels and Frequency Response

The Decibel System - Other Expressions for Power Gain - Voltage and Current Levels - Characteristics of the Decibel System - Value of 1 dB Zero Decibel Reference Level - Variations in Amplifier Gain with Frequency - Changes in Voltage and Power Levels - Causes of Gain Variations Miller Effect - Cut-off Frequencies of Cascaded Amplifiers - Transistor Cut-off Frequencies - Alpha Cut-off Frequency - Beta Cut-off Frequency - The f_t of a Transistor - Relation Between f_{α},f_{β} and f_T - Gain-Bandwidth Product - Conventional Problems

(d) Feedback Amplifier

Feedback Amplifiers - Principle of Feedback Amplifiers - Advantages of Negative Feedback - Gain Stability - Decreased Distortion - Increased Bandwidth - Forms of Negative Feedback - Shunt-derived Series-fed Voltage Feedback - Current-series Feedback Amplifier - Voltage-shunt Negative Feedback Amplifier - Current-shunt Negative Feedback Amplifier -Conventional Problems

(e) Field Effect Transistor

What is a FET ? - Junction FET (JFET) - Static Characteristics of a JFET - JFET Drain Characteristic with $V_{GS} = 0$ - JFET Characteristic with External Bias - Transfer Characteristic - Small Signal JFET Parameters DC Biasing of a JFET - DC Load Line - Common Source JFET

Amplifier - JEFT on an IC Chip - Advantages of FETs - MOSFET or IGFET DE MOSFET - Schematic Symbols for a DE MOSFET - Static Characteristics of a DE MOSFET - Enhancement-only N-channel MOSFET Transfer Characteristic - FETs as Switches - FET Applications - MOS-FET Handling

(f) Breakdown Devices

What are Breakdown Devices ? - Unijunction Transistor - UJT Relaxation Oscillator - Silicon Controlled Rectifier - 90° Phase Control - Theft Alarm - Triac -Diac - Silicon Controlled Switch (SCS) -

(g) Sinusoidal Oscillators

What is an Oscillator? - Comparison between an Amplifier and an Oscillator - Classification of Oscillators - Damped and Undamped Oscillations - The Oscillatory Circuit - Frequency of Oscillatory Current - Frequency Stability of an Oscillator - Essentials of a Feedback LC Oscillator - Tuned Base Oscillator - Tuned Collector Oscillator - Tuned Drain Oscillator (FET) - Hartley Oscillator - FET Hartley Oscillator - Colpitts Oscillator - Clapp Oscillator - FETCo]pitts Oscillator - Crystals - Crystal Controlled Oscillator - Transistor Pierce Crystal Oscillator - FET Pierce Oscillator - Phase Shift Principle - Phase Shift Oscillator - Wien Bridge Oscillator

(h) Noninusoidal Oscillators

Nonsinusoidal Waveforms -Classification of Nonsinusoidal Oscillators Pulse Definitions - Basic Requirements of a Sawtooth Generator -UJT Sawtooth Generator - Multivibrators (MV) - Uses of Multivibrators - Astable Multivibrator - Monostable Multivibrator (MMV) - Bistable Multivibrator (BMV) - Schmitt Trigger -Transistor Blocking Oscillator

Unit – V

a)	MODULATION AND DEMODULATION
b)	INTEGRATED CIRCUITS
c)	NUMBER SYSTEMS
d)	LOGIC GATES
e)	BOOLEAN ALGEBRA
f)	LOGIC FAMILIES
g)	TRANSDUCERS
h)	ELECTRONIC INSTRUMENTS

(a) Modulation and Demodulation

Introduction - What is a Carrier Wave? - Radio Frequency Spectrum Sound - Need for Modulation - Radio Broadcasting - Modulation Methods of Modulation - Amplitude Modulation - Per cent Modulation Upper and Lower Side Frequencies - Upper and Lower Sidebands - Mathematical Analysis of a Modulated Carrier Wave - Power Relations in an AM Wave - Forms of Amplitude Modulation – Generation of SSB - Methods of Amplitude Modulation - Block Diagram of an AM Transmitter - Modulating Amplifier Circuit - Frequency Modulation - Frequency Deviation and Carrier Swing - Modulation Index'-Deviation Ratio - Per cent Modulation - FM Sidebands ;- Modulation Index and Number of Sidebands - Mathematical Expression for FM Wave - Demodulation or Detection - Essentials of AM Detection - Diode Detector for AM Signals - Transistor Detectors for AM Signals - FM Detection - Quadrature Detector - Frequency Conversion - Superheterodyne AM Receiver - FM Receiver - Comparison between AM and FM - The Four Fields of FM - Conventional Problems

(b) Integrated Circuits

Introduction - What is an Integrated Circuit? - Advantages of ICs - Drawbacks of ICs - Scale of Integration - Classification of ICs by Structure Comparison between Different ICs - Classification of ICs by Function Linear Integrated Circuits (UCs) - Digital Integrated Circuits - IC Terminology - How Monolithic ICs are Made? - Ie Symbols - Fabrication of IC Components - Complete Monolithic Integrated Circuits - Popular Applications of ICs - MOS Integrated Circuits - What is an OP-AMP ? OP-AMP Symbol - Polarity Conventions - Ideal Operational Amplifier - Virtual Ground and Summing Point - Why Vi Is Reduced to almost Zero ? - OP-AMP Applications - Linear Amplifier - Unity Follower - Adder or Summer - Subtractor - Integrator - Differentiator – Comparator

(c) Number Systems

Number of Systems -The Decimal Number System - !3inary System Binary to Decimal Conversion - Binary Fractions - Double-Dadd Method - Decimal to Binary Conversion - Shifting the Place Point - Binary Operations - Binary Addition - Binary Subtraction - Complement of a Number - 1 's Complemental Subtraction - 2's Complemental Subtraction - Binary Multiplication - Binary Division - Shifting a Number to Left or Right - Representation of Binary Numbers as Electrical Signals - Octal Number System - Octal to Decimal Conversion -

Decimal to Octal Conversion - Binary to Octal Conversion -Octal to Binary Conversion - Advantages of Octal Number System - Hexadecimal Number System - How to Count beyond F in Hex Number System? ---, Binary to Hexadecimal Conversion - Hexadecimal to Binary Conversion -Conventional Problems

(d) Logic Gates

Definition - Positive and Negative Logic - The OR Gate - Equivalent Relay Circuit of an OR Gate - Diode OR Gate - Transistor OR Gate OR Gate Symbolizes Logic Addition - Three Input OR Gate - Exclusive OR Gate - The AND Gate - Equivalent Relay Circuit of an AND Gate. Diode AND Gate ~ Transistor AND Circuit - AND Gate Symbolizes Logic Multiplication - The NOT Gate - Equivalent Circuits for a NOT Gate The NOT Operation - Bubbled Gates -. The NOR Gate - NOR Gate is a Universal Gate - The NAND Gate - NAND Gate is a Universal Gate The XNOR Gate - Logic Gates at a Glance - Adders and Subtractors Half Adder - Full Adder - Parallel Binary Adder -Half Subtractor - Full Subtractor -Conventional Problems

(e) Boolean Algebra

Introduction - Unique Feature of Boolean Algebra - Laws of Boolean Algebra - Equivalent Switching Circuits - De Morgan's Theorems - Duals - Conventional Problems

(f) Logic Families

Main Logic Families - Saturated and Non-saturated Logic Circuits - Characteristics of Logic Families - RTL Circuit - DTL Circuit ---'- TTL Circuits - TTL Subfamilies -ECL Circuit $-I^2L$ Circuit - MOS Family - PMOS Circuit - NMOS Circuit - CMOS Circuit

(g) Transducer

What is a Transducer? - Classification of Transducers - Classification based on Electrical Principle Involved - Resistive Position Transducer - Resistive Pressure Transducer ---;- I~ductive Pressure Transducer - Capacitive Pressure Transducer - Self-generating Inductive Transducers - Linear Variable Differential Transformer (LVDT) - Piezoelectric Transducer - Strain Gauge Temperature Transducers - Resistance Temperature Detectors - Thermistor - Thermocouples - Ultrasonic Temperature Transducers - Photoelectric Transducers - Various Types of Microphones - Carbon Microphone Ribbon Microphone - Moving-Coil (Me) Microphone - Crystal Microphone - Ceramic Microphone - Capacitor Microphone - The Electret Microphone - The Loudspeaker

(h) Electronic Instruments

Introduction - Analog and Digital Instruments - Functions of Instruments - Electronic versus Electrical Instruments - Essentials of an Electronic Instrument - Measurement Standards - The Basic Meter Movement - Characteristics of Moving Coil Meter Movement - Variations of Basic Meter Movement - Converting Basic Meter to DC Ammeter - Multirange Meter - Measurement of Current - Converting Basic Meter to DC Voltmeter Multirange DC Voltmeter -Loading Effect of a Voltmeter - Ohmmeter The Multimeter - Rectifier Type AC Meter - Electronic Voltmeters - The Direct Current VTVM - Comparison of VOM and VTVM - Direct Current FET VM - Electronic Voltmeter for Alternating Currents - The Digital Voltmeter (DVM) -Cathode Ray Oscilloscope (CRO) - Cathode Ray Tube (CRT) - Deflection Sensitivity of a CRT - Normal Operation of a CRO Triggered and Non-triggered Scopes - Dual Trace CRO - Dual Beam CRO - Storage Oscilloscope - Sampling CRO - Digital Readout CRO - Lissajous Figures - Frequency Determination with Lissajous Figures - Applications of a CRO