SCHEME AND SYLLABUS FOR THE POST OF INSPECTOR OF LEGAL METROLOGY IN A.P. WEIGHTS AND MEASURES SUB-SERVICE.

SCHEME

PART – A: WRITTEN (Objective Type) EXAMINATION			
I) General Studies (Degree standard)	150 Marks	150 Qns.	150 Minutes
II) Concerned Subject: (Physics OR Electrical OR Mechanical Engineering).	150 Marks	150 Qns.	150 Minutes
PART – B: INTERVIEW (ORAL TEST)	30 Marks		

NOTE: For subject Physics in Degree standard for Engineering subjects in Diploma standard.

SYLLABUS

General Science

Current Events of National and International Importance.

History of India and Indian National Movement. India and World Geography.

General Mental Ability.

Questions on General Science will cover General appreciation and understanding of science including matters of every day observation and experience, as may be expected of a well educated person who has not made a special study of any particular scientific discipline. In current events, knowledge of significant national and international events will be tested. In History of India, emphasis will be on broad general understanding of the subject in its social, economic and political aspects. Questions on Indian National Movement will relate to the nature and character of the nineteenth century resurgence, growth of Nationalism and attainment of independence. In geography emphasis will be on geography of India. Questions on geography of India will relate to physical, social and economic geography of the country, including the main features of the Indian agricultural and natural resources. On general mental ability, the candidates will be tested on reasoning and analytical abilities.

CONCERNED SUBJECTS

PHYSICS

1. Mechanics and Waves: Dimensional analysis. Newton's laws of motion and applications, variable mass systems, projectiles. Rotational dynamics-kinetic energy, angular momentum, theorems of moment of inertia and calculations in simple cases. Conservative forces, frictional forces. Gravitational potential and intensity due to spherical objects. Central forces, Kepler's problem, escape velocity and artificial satellites (including GPS). Streamline motion, viscosity, Poiseuille's equation. Applications of Bernoulli's equation and Stokes' law.
Special relativity and Lorentz transformation-length contraction, time dilation, mass-energy relation.
Simple harmonic motion, Lissajous figures. Damped oscillation, forced oscillation and resonance. Beats, Phase and group velocities. Stationary waves, vibration of strings and air columns, longitudinal waves in solids. Doppler effect. Ultrasonics and applications.

2. **Geometrical and Physical Optics**: Laws of reflection and refraction from Fermat's principle. Matrix method in paraxial optics- thin lens formula, nodal planes, system of two thin lenses. Chromatic and spherical aberrations. Simple optical instruments- magnifier, eyepieces, telescopes and microscopes.
Huygen's principle-reflection and refraction of waves. Interference of light – Young's experiment, Newton's rings, interference by thin films, Michelson interferometer. Fraunhofer diffraction-single slit, double slit, diffraction grating, resolving power. Fresnel diffraction- half-period zones and zone plate. Production and detection of linearly, circularly and elliptically polarized light. Double refraction, quarter-waves plates and half-wave plates. Polarizing sheets. Optical activity and applications. Raman & Rayleigh scattering and applications.
Elements of fibre optics-attenuation; pulse dispersion in step index and parabolic index fibres; material dispersion. Lasers, characteristics of laser light-spatial and temporal coherence. Focusing of laser beams and applications.

3. Heat and Thermodynamics: Thermal equilibrium and temperature. The zeroth law of thermodynamics. Heat and the first law of thermodynamics. Efficiency of Carnot engines. Entropy and the second law of thermodynamics. Kinetic theory and the equation of state of an ideal gas. Mean free path, distribution of molecular speeds and energies. Trasport phenomena. Andrew's experiments-van der Waals equation and applications. Joule-Kelvin effect and applications. Bronian motion. Thermodynamic potentials-Maxwell relations. Phase transitions. Kirchhoff's laws. Black-body radiation – Stefan-Boltzmann law, spectral radiancy, Wien displacement law, application to the cosmic microwave background radiation, Planck radiation law.

4. Electricity and Magnetism: Electric charge, Coulomb's law, electric field, Gauss' law. Electric potential, van de Graff accelerator. Capacitors, dielectrics and polarization. Ohm's law, Kirchhoff's first and second rules, resistors in series and parallel, applications to two-loop circuits. Magnetic field-Gauss' law for magnetism, atomic and nuclear magnetism, magnetic susceptibility, classification of magnetic materials. Cirulating charges, cyclotron, synchrotron. Hall effect. Biot-Savart law, Ampere's law, Faraday's law of induction – Lenz's law. Inductance. Alternating current circuits – RC, LR, single-loop LRC circuits, impedance, resonance, power in AC circuits. Displacement current, Maxwell's equations (MKS Units), electromagnetic waves, energy transport and Poynting vector.

5. Atomic and Nuclear Physics: Photoelectric effect, Einstein's photon theory. Bohr's theory of hydrogen atom. Stern Gerlach experiment, quantisation of angular momentum, electron spin. Pauli exclusion principle and applications. Zeeman effect. X-ray spectrum, Bragg's law, Bohr's theory of the Mosley plot. Compton effect, Compton wavelength. Wave nature of matter, de Broglie wavelength, wave-particle duality. Heisenberg's uncertainty relationships. Schroedinger's equation-eigenvalues and eigenfunctions of (i) particle in a box, (ii) simple harmonic oscillator and (iii) hydrogen atom. Potential step and barrier penetration. Natural and artificial radioactivity. Binding energy of nuclei, nuclear fission and fusion. Classification of elementary particles and their interactions.

6. Electronics.: Diodes in half-waves and full-wave rectification, qualitative ideas of semiconductors p type and n type semiconductors, junction diode, Zener diode, transistors, binary numbers, Logic gates and truth tables, Elements of microprocessors and computers.

ELECTRICAL ENGINEERING

Electrical Circuits – Theory and Applications: Circuit components, network graphs, KCL, KVL; circuit analysis methods; nodal analysis, mesh analysis; basic network theorems and applications; transient analysis; RL. RC and RLC circuits; sinusoidal steady state analysis; resonant circuits and applications; coupled circuits and applications; balanced 3-phase circuits. Two port networks, driving point and transfer functions; poles and zeros of network functions.

Signals & Systems: Representation of continuous-time and discrete-time signals & system's; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform, Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals.

Control Systems: Elements of control systems; block-diagram representations; open-loop & closed-loop systems; principles and applications of feed-back. LTI systems: time domain and transform domain analysis. Stability: Routh Hurwitz criterion, root-loci, Nyquist's criterion. Bode-plots, Design of lead-lag compensators; Proportional, PI, PID controllers.

E.M. Theory: Electro-static and magneto-static fields; Maxwell's equations; e.m. waves and wave equations; wave propagation and antennas; transmission lines; micro-wave resonators, cavities and wave guides.

Electrical Engineering Materials: Electrical/electronic behaviour of materials: conductivity; free-electrons and band-theory; intrinsic and extrinsic semi-conductor, p-n junction; solar cells, super-conductivity. Dielectric behaviour of materials: polarization phenomena; piezo-electric phenomena. Magnetic materials: behaviour and application.

Analog Electronics: Diode circuits: rectifiers filters, clipping and clamping, zener diode and voltage regulation, Bipolar and field effect transistors (BJT, JFET and MOSFET): Characteristics, biasing and small signal equivalent circuits. Basic amplifier circuits; differential amplifier circuits. Amplifiers: analysis, frequency response. Principles of feedback; OPAMP circuits; filters; oscillators.

Digital Electronics: Boolean algebra; minimisation of Boolean function; logic gates, digital IC families (DTL, TTL, ECL, MOS, CMOS). Combination circuits: arithmetic circuits, code converters, multiplexers and decoder's. Sequential circuits: latches and flip-flops, counters and shift-registers. Comparators, timers, multi-vibrators. Sample and hold circuits; ADCs and DACs. Semiconductor memories.

Communication Systems: Fourier analysis of signals: amplitude, phase and power spectrum, auto-correlation and cross-correlation and their Fourier transforms. Analog modulation systems: amplitude and angle modulation and demodulation systems, spectral analysis; super heterodyne receivers. Pulse code modulation (PCM), differential PCM, delta modulation. Digital modulation schemes : amplitude, phase and frequency shift keying schemes (ASK,PSK,FSK). Multiplexing: time-division, frequency-division. Additive Gaussian noise; characterization using correlation, probability density function, power spectral density, Signal-to-noise ratio calculations for AM and FM. Elements of digital communication systems; source coding, channel coding; digital modulation & demodulation. Elements of information theory, channel capacity. Elements of satellite and mobile communication; principles of television engineering; radar engineering and radio aids to navigation.

Computers and Microprocessors: Computer organization; number representation and arithmetic, functional organization machine instructions, addressing modes, ALU hardwire and micro programmed control, memory organization. Elements of microprocessors; 8-bit microprocessors-architecture, instruction set, assembly level programming, memory, I/O interfacing, micro controllers and applications.

Measurement and Instrumentation: Error analysis; measurement of current voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurements. Electronic measuring instruments; multimeter, CRO, digital volt meter, frequency counter, Q-meter, spectrum analyser, distortion-meter. Transducers; thermocouple, thermistor, LVDT, strain-guages, piezo-electric crystal. Use of transducers in measurement of non-electrical quantities. Data-acquisition systems.

Energy Conversion: Single-phase transformer; equivalent circuit, phasor-diagram, tests, regulation and efficiency; three-phase transformer; auto transformer. Principles of energy conversion-d.c. generators and motors: Performers characteristics, starting and speed control armature reaction and commutation; three-phase induction motor; performance characteristics, starting and speed control. Single-phase induction motor. Synchronous generators; performance characteristics, regulation, paralel operation. Synchronous motors; starting characteristics, applications; synchronous condensor, FHP motors, permanent magnet and stepper motors, brushiess d.c. motors, single-phase motors.

Power Systems: Electric power generation; thermal, hydro, nuclear. Transmission line parameters; steady-state performance of overhead transmission lines and cables. Distribution systems; insulators, bundle conductors, corona and radio interference effects; per-unit quantities; bus admittance and impedance matrices; load flow; voltage control and power factor correction. Economic operation. Principles of over current, differential and distance protection; solid state relays, circuit breakers, concept of system stability, HVDC transmission.

Power Electronics and Electric Drives: Semiconductor power devices; diode, transistor, thyristor, triac, GTO and MOSFET, static characteristics, principles of operation; triggering circuits; phase controlled rectifiers; bridge converters-fully controlled and half controlled; principles of thristor chopper and inverter. Basic concept of speed control of DC and AC motor drives.

Elements of IC Fabrication Technology: Overview of IC Technology. Unit steps used in IC fabrication; wafer cleaning, photo-lithography, wet and dry etching, oxidation, diffusion, ion-implantation, CVD and LPCVD techniques for deposition of poly-silicon, silicon, silicon-pnitride and silicon dioxide; metallisation and passivation.

MECHANICAL ENGINEERING

STATICS: Simple applications of equilibrium equations.

DYNAMICS: Simple applications of equations of motion, work, energy and power.

THEORY OF MACHINES: Simple examples of kinematic chains and their inversions.
Different types of gears, bearings, governors, flywheels and their functions.
Static and dynamic balancing of rigid rotors.
Simple vibration analysis of bars and shafts.
Linear automatic control systems.

MECHANICS OF SOLIDS: Stress, strain and Hookes Law. Shear and bending moments in beams. Simple bending and torsion of beams, springs and thin walled cylinders. Elementary concepts of elastic stability, mechanical properties and material testing.

MANUFACTURING SCIENCE: Mechanics of metal cutting, tool life, economics of machining, cutting tool materials. Basic types of machine tool and their processes. Automatic machine tools, transfer lines. Metal forming processes and machines-shearing, drawing, spinning, rolling, forging, extrusion. Types of casting and welding methods. Power metallurgy and processing of plastics.

MANUFACTURING MANAGEMENT: Methods and time study, motion economy and work space design, operation and flow process charts. Cost estimation, break-even analysis. Location and layout of plants, material handling. Capital budgeting, job shop and mass production, scheduling, dispatching, Routing, Inventory.

THERMODYNAMICS: Basic concepts, definitions and laws heat, work and temperature, Zeroth law, temperature scales, behaviour of pure substances, equations of state, first law and its corollaries, second law and its corollaries. Analysis of air standard power cycles, carnot, otto, diesel, brayton cycles. Vapour power cycles, Rankine reheat and regenerative cycles, Refrigeration cycles-Bell Coleman, Vapour absorption and Vapour compression cycle analysis, open and closed cycle gas turbine with inter-cooling, reheating.

ENERGY CONVERSION: Flow of steam through nozzles, critical pressure ratio, shock formation and its effect. Steam generators, mountings and accessories. Impulse and reaction turbines elements and layout of thermal power plants.
Hydraulic turbines and pumps, specific speed, layout of hydraulic power plants.
Introduction to nuclear reactors and power plants, handling of nuclear waste.

REFRIGERATION AND AIR CONDITIONING: Refrigeration equipment and operation and maintenance, refrigerants, principles of air conditioning, psychrometric chart, comfort zones, humidification and dehumidification.

FLUID MECHANICS: Hydrostatics, continuity equation, Bernoulli's theorem, flow through pipes, discharge measurement, laminar and turbulent flow, boundary layer concept.

Sd/- Secretary,
01/07/2008