C.No: 989/SS/2007

SCHEME AND SYLLABUS FOR RECRUITMENT TO THE POST OF INSPECTOR OF FACTORIES IN A.P. FACTORY SERVICE
(Degree Standard)

SCHEME

PART – A: WRITTEN (Objective Type) EXAMINATION				
i)	General Studies and Mental ability	150 Marks	150 Questions.	150 Minutes
ii)	Subject: MECH **or** ELE **or** CHEM **or** INDUSTRIAL ENGINEERING.	300 Marks	150 Questions.	150 Minutes
PART – B:	INTERVIEW (ORAL TEST)	50 Marks		

SYLLABUS

GENERAL STUDIES AND MENTAL ABILITY

1. General Science – Contemporary developments in Science and Technology and their implications 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 scientific discipline.

2. Current events of national and international importance.

3. History of India – emphasis will be on broad general understanding of the subject in its social, economic, cultural and political aspects with a focus on AP Indian National Movement.

4. World Geography and Geography of India with a focus on AP.

5. Indian polity and Economy – including the country's political system- rural development – Planning and economic reforms in India.

6. Mental ability – reasoning and inferences.

MECHANICAL ENGINEERING

1. **Theory of Machines:** Kinematic and dynamic analysis of planar mechanisms, Cams, Gears and gear trains, Flywheels, Governors, Balancing of rigid rotors, Balancing of single and multi cylinder engines, Linear vibration analysis of mechanical systems (single degree and two degrees of freedom), Critical speeds and whirling of shafts, Automatic Controls, belts and chain drives. Hydrodynamic bearings.

2. **Mechanics of Solids:** Stress and strain in two dimensions. Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and an isotropy, stress-strain relations, unilaxial loading, thermal stresses. Beams: Banding moment and shear force diagrams, bending stresses and deflection of beams, Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Thick and thin walled pressure vessels. Struls and columns, strain energy concepts and theories of failure. Rotating discs. Shrink fits.

3. **Engineering Materials:** Basic concepts on structure of solids, Crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials, Heat treatment of steels, Plastics, Ceramics and composite Materials, common applications of various materials.

4. **Manufacturing Science:** Merchant's force analysis, Taylor's tool life equation, machine ability and machining economics, Rigid, small and flexible automation, NC, CNC. Recent machining methods-EDM, ECM and ultra sonics, Application of lasers and plasmas, analysis of forming processes. High energy rate forming, Jigs, fixtures, tools and gauges, inspection of length, position, profile and surface finish.

5. **Manufacturing Management**: Production Planning and Control, Forecasting-Moving average, exponential smoothing. Operations sheduling; assembly line balancing. Product development Breakeven analysis, Capacity planning. PERT and CPM.

Control Operations: Inventory control-ABC analysis. EOQ model, Materials requirement planning. Job design, job standards, work measurement, quality management quality control. Operations Research: Linear programming-Graphical and Simplex methods. Transportation and assignment models. Single server queuing model. Value Engineering: Value analysis, for cost/value, Total quality management and forecasting techniques. Project management.

6. **Elements of Computation:** Computer Organisation, Flow-charting. Features of Common Computer Languages-FORTRAN d Base III, Lotus 1-2-3 C and Elementary Programming.

7. **THERMODYNAMICS:** Basic Concept. Open and closed systems, Applications of thermo-dynamic Laws, Gas equations, Clapeyron equation, Availability, Irreversibility and Tds relations.

8. **I.C. Engines, Fuels and Combustion:** Spark ignition and compression ignition engines, Four stroke engine and Two stroke engines, mechanical, thermal and volumetric efficiency, Heat balance.

Combustion process in S.I. and C.I. engines, preignition detonation in S.I. engine Diesel knock in C.I. engine, Choice of engine fuels, Octane and Cetane retings. Alternate fuels Carburration and Fuel injection, Engine emissions and control, solid, liquid and gaseous fuels, stoichometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

9. Heat Transfer, Refrigeration and Air Conditioning: One and two dimensional heat conduction. Heat transfer from extended surfaces, heat transfer by forced and free convection. Heat exchangers. Fundamentals for diffusive and connective mass transfer, Radiation laws, heat exchange between black and non black surfaces, Network Analysis, Heat pump refrigeration cycles and systems, Condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling loading calculations, solar refrigeration.

10. **Turbo-Machines and Power Plants**: Continuity, momentum and Energy Equations, Adiabatic and isentropic flow, fanno lines, Raylegh lines. Theory and design of axial flow turbines and compressors Flow through turbo-machine blade, cascades, and centrifugal compressor. Dimensional analysis and modeling. Selection of site for steam, hydro, nuclear and stand-by power plants, Selection base and peak load power plants, Modern High pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

ELECTRICAL ENGINEERING

Circuits, Instruments and Mechines:

1. Basic Electric Circuits: Active and passive network elements, dependent and independent sources – response of passive elements to arbitrary excitations – energy store in inductance and capacitance – Kirchoff Laws – formation of mesh and nodal integro differential equations – their solution by classical and Laplace transform methods – Transient and steady state response of RL and C elements to impulse, step, ramp and sinusoidal inputs – Single phase A.C. circuits – methods of solution – Polyphase circuits – analysis of balanced and unbalanced circuits – measurement of polyphase power.
2. Electrical measurements and instruments: Objectives of measurements – fundamental and derived units – absolute measurement of electrical quantities – voltage, resistance, capacitance and inductance standards. – Instruments – secondary and absolute instrument types – principles of operation of different types of instruments – extension of instrument ranges – Measurement of current, voltage, power and energy – testing of meters – Localisation of cable faults – Murray loop and Varley loop tests – high voltage meassurements – high frequency tests – surge or impulse tests – testing of insulating oils. Electronic instruments – electronic voltmeters – D.C. and A.C. volt-meters – electronic galvenometers – R.F. and A.F. power measurement – R.F. voltage measurement – cathods ray oncilloscope.
3. D.C. generators and motors: Principles of electromechanical energy conversion – basic ideas of electromagnetic torque – generator action constructional details of D.C. machines – methods of excitation characteristics of series, shunt and compound generators and their application. D.C. motors – principle of operation – back emf – torque equation – characteristics of different types of motors – applications – speed control – d.c. starters – Testing of d.c. machines.
4. Transformers: Principles of operation – constructional details of single and polyphase transformers – core, tank and other auxiliaries – operation on no load and load – phasor diagram – regulation and efficiency – All-day efficiency 3 Phase to two phase conversion – Choice of insulation – testing of transformers as per I.S.I.
5. A.C. Generators and motors: Generation of 3-phase power – types of a.c. generators – steady performance – parallel operation of a.c. generators – excitation and governing systems – testing of a.c. generators – Synchoronous motors – principle of operation – power factor control – applications.
6. Induction motors – Principle of operation of 3 phase motors – mechanism of torque production – types of induction motors – slip torque-slip characteristics – speed control by conventional methods and solid state controllers – applications and testing – Single phase motors – Principle of operation of shaded pole, capacitor motors – Single phase series motors – phasor diagrams – fractional h.p. motors – applications and testing.

Power generation, transmission, distribution and utilisation:

1. Generation: Types of power stations – Selection of site for steam, hydro, diesel and nuclear power stations economic choice of different types of stations – base load and peak load stations – pumped hydrostations – layout of power stations.
2. Choice of aerial lines: Types of conductors – mechanical contrution – sag calculations – resistance inductance and capacitance of lines – bundled conductors – transposition – line calculations – voltage regulation and efficiency voltage control – corona on overhead lines.
3. Insulators: Types of insulators – string efficiency – methods of improving string efficiency – thermal and short circuit testing of insulators and bushings – dielectric tests and impulse tests as per ISI standards – synthetic testing.
4. Underground cables: Advantages of cables – Insulation of cables – grading of cables – capacitance measurement in cables – types of testing of cables – mechanical, thermal duty, dielectric, power factor tests power frequency with stand tests etc.
5. Fault calculations and reactors: Per unit system – Choice of base values symmetrical components and application to symmetrical and unsymmetrical faults – reactors and their methods of usage – testing of reactors.
6. Relay and circuit breaker applications: General philosophy of relaying – basic relay elements – types of relays protective schemes of apparatus, bus and line protection, types of circuit breakers – low, medium and high voltage breakers – standard ratings of circuit breakers – testing of circuit breakers.
7. Distribution systems: Types of distribution systems – primary and secondary distribution systems – banking – general layout of substations – factors affecting the design of substations – lampt flicker and remedial measures.
8. Power system earthing: Tolerance limits of body shock – soil resistivity – earth resistance – driven rods, buried horizontal wires – earthing gold – touch voltage – design of earthing grid-tower footing resistance measurement of soil resistivity – neutral earthing – grounding transformer.
9. Utilisation of electric energy: Industrial drives – motors for various drives – estimation and rating – mbranking methods – Heating and welding – Types of electric heating design of the heating element – different types of furnaces – welding practices – Economic of supply – Factors affecting plant design – load factor, diversity factor, demand factor, use factor and loss factor – economic choice of equipment – Illumunation – Types of lamps – factory and domestic lighting – flood lighting – design considerations – Earth pits – methods of testing wiring installations as per ISI specifications.

CHEMICAL ENGINEERING

(a) Fluid and Particle Dynamics: Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equition Bernoulli's theorem. Flow meters. Fluid drag and pressure drop due to friction. Reynolds's Number and friction factor effect of pipe roughness. Economic pipe diameter, pumps, water, air/steam jet ejectors, compressors, blowers and fans. Agitation and mixing of liquids. Mixing of solids and pastes. Crushing and Grinding – principles and equipment. Rittinger's and Bond's Laws. Filtration and filtration equipment. Fluid-particle mechanics – free and hindered setting. Fluidisation and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of solids.

(b) Mass Transfer: Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates: Liquid-liquid equilibria. Extraction theory and practice; Design of gas-absorption columns. Drying, Humidification, dehumidification. Crystallisation. Design of equipment.

(c) Heat Transfer: Conduction, thermal conductivity, extended surface heat transfer. Convection – free and forced. Heat transfer coefficients – Nusselt number. LMTD and effectiveness. NTU methods for the design of Double Pipe and Shell & Tube heat Exchangers. Analogy between heat and momentum transfer. Boiling and condensation heat transfer. Single and multiple-effect evaporators. Rediation – Stefan Boltzman law, emissivity and absorptivity. Calculation of heat load of a furnace. Solar heaters.

(d) Novel Separation Process: Equilibrium separation processes – ion-exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. Super critical fluid extraction.

(e) Process Equipment Design: Fractors affecting vessel design criteria – Cost considerations. Design of storage vessels-vertical, horizontal spherical, underground tanks for atmospheric and higher pressure, Design of closures flat and eliptical head. Design of supports. Materials of construction-characteristics and selection.

(f) Process Dynamics and Control: Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/ pneumatic/analog/digital signal forms. Control variable, manipulative variable and load variables. Linear control theory-Laplace, transforms. PID controllers. Block diagram representation. Transient and frequency response, stability of closed loop system. Advanced control strategies. Computer based process control.

(g) Material and Energy balances : Material and energy balance calculations in processes with recycle/bypass/purge. Combustion of solid/liquid/gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.

(h**) Chemical Engineering Thermodynamics:** Laws of thermodynamics. PVT relationships for pure components and mixtures. Energy functions and inter-relationships – Maxwell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria, for ideal/non-ideal, single and multi component systems. Criteria for chemical reaction equilibrium, equilibrium constant and equilibrium conversions. Thermodynamic cycles – refrigeration and power.

(i) Chemical Reaction Engineering: Batch reactors – kinetics of homogeneous reactions and interpretation of kinetic data, ideal flow reactors – CSTR, plug flow reactors and their performance equations. Temperature effects and run-away reactions. Heterogeneous reactions – catalytic and non-catalytic and gas-solid and gas-liquid reactions. Intrinsic kinetics and global rate concept. Importance of interphase and intraparticle mass transfer on performance. Effectiveness factor. Isothermal and non-isothermal reactors and reactor stability.

(j) Chemical Technology: Natural organic products – wood and wood based chemicals, pulp and paper, Agro Industries – Sugar – Edible oils extraction (including tree based seeds), Soaps and detergents. Essential oils – Biomass gasification (including biogas). Coal and coal chemical. Petroleum and Natural gas – Petroleum refining (Atmospheric distillation/cracking/reforming) – Petrochemical industries – Polyethylene's (LDPE/HDPE/LLDPE), Polyvinyl Chloride Polystyrene. Ammonia manufacture. Cement and lime industries. Paints and varnishes. Glass and ceramics. Fermentation – Alcohol and antibiotics.

(k) Environmental Engineering and Safety: Ecology and Environment. Sources of pollutants in air and water. Green House effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazards rating – HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislation's – water, air environment protection Acts. Forest (Conservation) Act.

(l) Process Engineering Economics: Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR, Depreciation, taxes and insurance. Breakeven point analysis. Project scheduling – PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

INDUSTRIAL ENGINEERING

1. **Theory of Machines:**

Kinematic and dynamic analysis of planar mechanisms, Gams, Gears and gear trains, Flywheels, Governors, Balancing of rigid motors, Balancing of single and multi cylinder engines, Linear vibration analysis of mechanical systems (single degree and two degrees of freedom), Critical speeds and whirling of shafts, Automatic Controls, Belts and chain drives. Hydrodynamic bearings.

2. **Mechanics of Solids**

Stress and strain in two dimensions. Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and an isotropy, Stress-strain relations, unilaxial loading, thermal stresses. Beams: banding moment and shear force diagrams, bending stresses and deflection of beams, shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Thick and thin walled pressure vessels. Struls and columns, strain energy concepts and theories of failure. Rotating discs, Shrink fits,

3. **Engineering Materials**

Basic concepts on structure of solids, Crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials, Heat treatment of steels, Plastics, Ceramics and composite Materials, common applications of various materials.

4. **Manufacturing Science**

Merchant's force analysis, Taylor's tool life equation, machine ability and machining economics, Rigid small and flexible automation, NC, CNC, Recent machining methods – EDM, ECM and ultra sonics. Application of lasers and plasmas, analysis of forming processes. High-energy rate forming jigs, fixtures, tools and gauges, inspection of length, position, profile and surface finish.

5. **METROLOGY AND INSTRUMENTATION**

Limits and fits, ISO System: Types of inter changeability. Slip gauges and end bars. Different types of micrometers. Height gauges. Tomlinson gauges. Precision polygon. Sine bar, Auto collimator. Dial indicator, Sigma and mechanical comparator, Free Flow and back pressure type pneumatic comparator. Application of single, double and triple set jet gauge heads.

Optical projector, Chart gauges, Micro gauges, Micro gauge bridge lines. Tool maker's microscope. Floating carriage diameter measuring machine and coordinate measuring machine. Measurement of straightness and flatness. Roundness measurement with bench centers and Talyrond.

Taylor's principle for plain limit gauges. Use of plug, Ring and Snap gauges. Indicating type limit gauges. Gauge material and step in gauge manufacture. General geometric tests for testing machine tools.

Elements of instrumentation system. Static and dynamic characteristics. Dynamic response of first order and second order instruments. Types of error. Displacement transducers LVDT.

6. **Production Management:**

Production planning and control, Forecasting Moving average, exponential smoothing, Operations scheduling; assembly line balancing. Product development Breakeven analysis, Capacity planning PERT and CPM.

7. **Operations Research:**

Linear programming – graphical method, Simplex, Revised Simplex and Dual Simplex methods. Duality and economic interpretation of dual variables.

Post optimal sensitivity analysis. Integer programming. Transportation, Transshipment, Assignment and Travelling salesman problems.

Dynamic programming – capital budgeting problem. Game theory. Waiting lines – single server and multiple server models based on Poisson's arrivals.

8. **Material Management:** Role of material planning. EOQ inventory, control (deterministic and probabilistic models) MRP – 1 (Inputs& Outputs) MRP-2 Material handling equipment (Selection, Classification, types) ABC analysis. Industrial Robots.

9. **Work Study:** Procedure of method study, various charts used in method study principals of motion of economy. Work place design, egronomics.

Time Study: Calculation of standard time. Performance rating types of ratings, work sampling, types of incentive financial and non-financial. Different wage payment plans.

10. **Inspection and Quality Control:** Types and objectives of inspection, SQC and its principals. Acceptance sampling, inspection, OC curves, process control charts, Zero defect concept, Quality development function, TQM (principals) Taguchi method of total quality, ISO – 9000 series. Reliability – failure concepts. Bath tub curves explanation, use of Weibul distribution.

Costing: Elements of costs. Types over heads and overhead distribution. Break even analysis and its calculation. Description and its methods.

11. **Plant maintenance (objective importance).** Types of maintenance (break down, preventive, scheduled, predictive) plant maintenance schedule. Recent development in plant maintenance techniques, conditioning monitoring.

Replacement analysis (Reasons and factors considered for equipment replacement) methods like MAPI.

12. **Computers in Industrial Engineering:** Flow charts, dBase-IV, Lotus 1-2-3 & Elementary Programming.

Sd- Secretary,
13/05/2008