ANNEXURE-II

Post of Assistant Director of Industries and Commerce (Technical) included in Tamil Nadu Industries Service

PAPER-I
BASICS OF ENGINEERING (DEGREE STANDARD) Code No.230

UNIT I - MATHEMATICS:

Matrices: Eigen values - Eigenvectors – Cayley–Hamilton theorem –Similar and Orthogonal transformations – Reduction of a quadratic form to Canonical form by orthogonal transformation.

Ordinary differential equations: Order and degree – Types of Equations – Higher order linear ODE with constant coefficients - Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficient.

Functions of several variables : Partial derivatives – Total derivatives – Euler's theorem – Implicit functions–Jacobians– Taylor's theorem – Maxima and Minima.

Integration: Techniques of integration using integration by parts and Bernoulli's formula – Line, Surface and Volume Integrals – Change of order of integration.

Vector Calculus: Vectors and scalars – Directional derivatives – Gradient, Divergence and Curl of vectors – Applications of Green's theorem, Gauss divergence theorem and Stoke's theorem.

Complex variables: Verification of Analyticity – Construction of Analytic functions – Conformal Mappings – Bilinear transformations.

Complex Integration: Cauchy's integral theorem – Cauchy's fundamental theorem – Cauchy's residue theorem – Taylor's theorem – Laurent's series–Contour integration (excluding poles on the real axis)

Laplace transform: Existence of Laplace transform – Laplace transform of elementary functions– Properties – Laplace transform of Periodic functions – Inverse Laplace transform – Convolution theorem – Solution of linear second order ODE by Laplace transform technique

Unit II - ENGINEERING PHYSICS:

Newton's laws of motion – gravitation – work, energy and power - elasticity – moduli of elasticity and their determination-sound intensity level – reverberation – ultrasonics: production and detection - thermal conductivity and expansion - flow of heat-thermodynamics - heat engines – optical interference, anti-reflection coatings - diffraction

and polarization – lasers and types - optical fibres and applications - photoelectric effect - atom models - dual nature of matter and radiation - nuclear models –radioactivity - nuclear fission and fusion - crystal structures - unit cells - packing factor –imperfections – superconductivity - magnetic and dielectric materials – semiconducting materials - nano materials.

UNIT III - ENGINEERING CHEMISTRY:

Fuel –Classification of fuels - Calorific value – Solid fuel – Liquid fuel – Gaseous fuel – Octane number – Cetane Number – Fuel Cells. Lubricants – Classification – Greases – Solid Lubricants. Water – Sources – Classifications – Softening process – Desalination – RO Method – Internal treatment – Treatment of Water for Municipal purposes. Plastics – High polymer – classification – Polymerization techniques – Thermoplastics
– Thermosetting resins – examples. Rubber – Types of Rubber – Vulcanisation – Properties – Unvulcanised and Vulcanised. Natural Rubber – Synthetic Rubber – examples. Refractories – Classification – Manufacture of Refractories – Magnesite – Silica – Zirconia – Chromite. Abrasives – Natural – Artificial–Abrasive paper & cloth. Corrosion: Dry and Wet corrosion – Factors affecting corrosion- Different types of corrosion. Productive coating – Hot dipping- metal cladding, electrodeposition – Organic Coatings – Paints – Varnishes. Cement and lime- setting and hardening. Explosives- classifications- characteristics-requirements for good explosives- nitrocellulose- TNT- TNB-DNB-PETN-RDX. Alloys- purpose of making alloy- types of alloys- Ferrous alloys. Electrochemistry – conductors and non conductors – Kohlrausch law – Electrochemical cell-reversible and irreversible cells – EMF- Concentration cell- polarization – over voltage, decomposition potential.

UNIT IV - ENGLISH :

Grammar: Articles – Prepositions – Tenses (simple present, present continuous, simple past, past continuous, future, & perfect tenses) – Modal verbs – Clauses – Conditional clauses – Subject-Verb agreement – conjunctions – Active & passive voice – Reported speech (Direct to Indirect speech) – Error correction – Combining sentences using connectives – Cause & effect expressions (because, so, due to, on account of, etc.) – Framing questions (converting statements into questions)

Vocabulary: Synonyms & antonyms – Prefixes, suffixes & intensifying prefixes (e.g. Flammable – inflammable) – Phrasal verbs – Idioms – Fixed expressions (e.g. adhere to, lodge a complaint to, etc.) – One word substitution – Collocation – Expansion of compound nouns (e.g. keyboard)

Reading: Reading comprehension passage – Data interpretation (e.g. comprehension questions based on table /chart) – Choosing appropriate title for a given short passage – Inferential questions based on a short reading passage – Reading comprehension questions making use of scanning & skimming strategies – Jumbled Sentences.

Writing: Definitions (instrument & technical terms) – Visual interpretation (picture/photo/chart etc.) – process description – Letter writing (formal / official) – email communication (email etiquette) – essays.

UNIT V - BASICS OF COMPUTER ENGINEERING:

Computer Organization - CPU and Microprocessor [ALU, Control Unit and Bus Structure] – Data Storage [Primary, Secondary and Virtual] – Input and Output Devices

Systems Software – Assembler – Compiler – Loader – Linker – Operating Systems

Programming Languages – Classification of Programming Language, High-Level Languages

Basic Computer Networking – Network Components [Routers, Bridges, Gateways] – ISO-OSI Reference Model – LAN – WAN – Client-Server Architecture – Internet
Applications – Office Tools – Word-processor – Spreadsheet – Powerpoint – Database – E-mail – Browser

IT Enabled Services – E-Government – E-Commerce – Multimedia

UNIT VI - BASICS OF CIVIL AND MECHANICAL ENGINEERING:

Introduction to Engineering mechanics – Units and Dimensions – Laws of Mechanics – Coplanar Forces – Static Equilibrium of Rigid body – Moment of a force – free body diagram – friction – laws of friction – sliding friction – wedge friction – Rolling resistance – Lader friction - Friction in screws – Screw jack – Belt friction – Properties of surfaces and solids – Centroids and centre of mass – line and areas – Rectangular, circular, triangular areas by integration – T-section, I- Section, Angle section, Hollow section – Area moment of inertia of plane areas – Parallel axis theorem – Centroid of the simple solids – Dynamics of particle – Displacement, velocity and acceleration – Different types of motion – Rectilinear , Curvilinear and Projectile motions – Newton's II-law of motion – Work Energy equation – Impulse and momentum principles.

UNIT VII - BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING:

Ohm's law- Kirchoff's laws - Introduction to DC and AC circuits –Power and powerfactor-single phase and three phase circuits Operating principles of moving coil and moving iron instruments (voltmeters and ammeters)- wattmeters and energy meters
Construction and principle of operation: DC motors- DC generators-Transformers-Induction motors Characteristics of PN junction diode-zener diode- half wave and full wave rectifiers-Bipolar junction transistor (CC,CE,CB configurations)-Amplifiers-Operational amplifiers Binary number system- logic gates- Boolean algebra – Half and full adders- Flip-flops – registers and counters- A/D and D/A conversion Types of analog and digital signals-Modulation and Demodulation(amplitude and frequency) Communication systems: Radio-TV- Fax- Microwave-Satellite and optical fibre

UNIT VIII - PRINCIPLES OF MANAGEMENT:

Management- Definition, Evolution- Taylor, Fayol, Elton Mayo, Peter Drucker Planning-Types, Steps, Forecasting, MBO, MBE Organising- Deparmentation- Line and staff, Delegation and Decentralization Staffing- Manpower planning, Recruitment and selection,

Training, Performance Appraisal Directing- Leadership styles, Discipline, Communication in business Controlling- Types, Control Techniques, Budgetary Control, Statistical Control

UNIT IX - TOTAL QUALITY MANAGEMENT:

Quality - vision, mission and policy statement, dimensions of product and service quality, contributions of quality gurus-Deming, Juran, Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Cost of Quality, continuous process improvement- PDCA, Quality Circle, 5S, Kaizen, Statistical Process Control (SPC), 7 QC Tools, new management tools, benchmarking, 6 sigma, Process Quality, Quality Function Deployment(QFD), POKA YOKE, Total Productive Maintenance (TPM), Business Process Reengineering(BPR), ISO 9004: 2000 - QMS, ISO-14000.

UNIT X - ENVIRONMENTAL SCIENCE AND ENGINEERING:

Environment– Global perspective- awareness of environmental pollution- Classification of Pollutants- Air Pollution- Composition of Air – Major sources of air pollution. Gaseous Pollutants- effect of air pollution on weather, climate, atmospheric process, NOX, SO_2, CO, CO_2, Fly ash, Vehicular pollution- automobile emission- prevention- green houseeffect – chlorofluoro carbon- ozone layer -ozone depletion- smog- photochemical smog, acid rain. Water pollution- types of water pollution- Factors affecting surface water – sewage and domestic waste – BOD, COD. Industrial effluent- harmful effects of industrial pollutants- agricultural discharge – detergent and toxic metal – siltation. Thermal pollutants- effect of thermal pollution- radioactive pollutant – inorganic pollutants and its detrimental effects. Soil Pollution- sources of soil pollution- effect of carbon waste- noise pollution- sources of noises of pollution- types of noise pollution- prevention and control

Post of Assistant Superintendent (Chemical Wing) included in Tamil Nadu Industries Service.

PAPER-I

CHEMICAL ENGINEERING (DEGREE STANDARD) CODE NO: 260

UNIT-I: CHEMICAL PROCESS CALCULATIONS AND CHEMICAL ENGINEERING THERMODYNAMICS

Properties of gases liquids and solids, Humidity and saturation, Gas laws, Material and Energy balances- involving recycle, by pass and purge systems, Material and Energy balance with reactions. Thermodynamics functions - Chemical and Phase Equilibrium - Laws of Thermodynamics - Ideal and non-ideal gases and solutions – fugacity, partial molal properties.

UNIT- II: MECHANICAL OPERATIONS AND ENGINEERING MATERIALS

Size Reduction, law, particle size Analysis, Mixing and agitation, Filtration, Sedimentation and Settling, Materials of construction for chemical Industries, Metallic, Non-metallic and Polymeric materials, corrosion. Grinding, Law. Smart materials for Chemical Engineering applications.

UNIT- III: CHEMICAL TECHNOLOGY AND RENEWABLE ENERGY SOURCES

Acids, Fertilizers, marine Chemicals, Cement, Glass, Ceramic and Refractories.Petroleum Refining Products, Fermentation Products, Oils, Soaps and Detergents, Pulp and paper, Dyes, sugar, leather and rubber. Potential for energy resources, energy conversion, solar, thermal, photoelectric, ocean, geothermal, wind energy, bio-energy sources, battery and fuel Cells.

UNIT -IV: TRANSFER OPERATIONS

Momentum: Newtonian and Non-Newtonian fluids, Compressible and in-compressible fluids flow through packed bed, Fluidized bed and closed ducts, Fluid Machinery. Heat transfer: conduction, convection and radiation, Heat transfer with phase change, heat exchangers, Evaporation. Mass transfer: Diffusion, Theories of mass transfer, Inter phase mass transfer, Analogy. Distillation, Extraction, Absorption, Adsorption, Drying.

UNIT - V: CHEMICAL REACTION ENGINEERING

Chemical Kinetics, Rate equations, Interpretation of rate data, Design of reactors, order of reaction, Catalysis, Thermal characteristics of reactors. Isothermal and adiabatic fixed bed reactors, non-isothermal and non-adiabatic fixed bed reactors. Two-phase fluidized bed model, slurry reactors, trickle bed reactor. Experimental determination and evaluation of reaction kinetics for heterogeneous systems.

UNIT - VI: INSTRUMENTATION AND PROCESS CONTROL

Principles of measurements and classification of process instruments, measurement of temperature, pressure, fluid flow, liquid weight and weight flow rate, viscosity, pH, concentration, electrical and thermal conductivity,

humidity of gases. Laplace transformation, application to solve ODEs. Open-loop systems, first order systems, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag. Closed loop control systems, feed-back control systems, BODE diagram, stability criterion, tuning of controller settings, cascade control, feed forward control, Smith predictor controller, control of distillation towers and heat exchangers.

UNIT - VII: NUMERICAL AND COMPUTATIONAL METHODS

Curve fitting, Equations with real and rational Coefficients, Imaginary roots and irrational roots, Transformation of equations. Numerical solutions of linear and non linear algebraic equations- solution of initial value and boundary value ordinary and non-linear differential equations, solution of partial differential equations. Partial Differential equation – finite element, finite difference method. Matrix, determinants and properties – Elementary Row transformations algebraic equations; ordinary differential equations and non homogeneous first order ordinary differential equations rank of Matrix – Eigen value problems, Orthogonal and orthonormal vectors; Gram-Schmidt orthogonalization; Theorem for Eigenvalues and Eigenfunctions.

UNIT - VIII: SEPARATION OPERATIONS

Crystallization, Membrane separation processes. frame, tubular, spiral wound and hollow fibre membrane reactors, dialysis, reverse osmosis, nano/ultra filtration, microfiltration. Ion Exchange chromatography and electrodialysis, Separations involving pervaporation and permeation techniques for solids, liquids and gases, supercritical fluid extraction.

UNIT-IX: ENVIRONMENTAL ENGINEERING AND SAFETY IN CHEMICAL INDUSTRIES

Air, Water and soil pollution, causes, effects and remedies, Nuclear waste disposal, Noise control, Wastewater treatment by various methods: Chemical, biochemical and advanced oxidation process. Industrial hygiene, occupational safety. Industrial safety principles, site selection and plant layout, chemical hazards classification, Safety in operations and processes, hazardous identification techniques.

UNIT - X: DESIGN AND OPTIMIZATION

Problem formulation, degree of freedom analysis, objective functions, Simplex method, Barrier method, sensitivity analysis, Convex and concave functions, unconstrained NLP, Newton"s method, Quasi-Newton"s method, Direct substitution, Quadratic programming, Cost estimation, Plant utilities, Heat exchanger networks, Pinch technology.

PAPER-II

GENERAL STUDIES (DEGREE STANDARD)

Objective Type

UNIT-I : GENERAL SCIENCE

(i) Scientific Knowledge and Scientific temper - Power of Reasoning - Rote Learning Vs Conceptual Learning - Science as a tool to understand the past, present and future.

(ii) Nature of Universe - General Scientific Laws – Mechanics - Properties of Matter, Force, Motion and Energy - Everyday application of the basic principles of Mechanics, Electricity and Magnetism, Light, Sound, Heat, Nuclear Physics, Laser, Electronics and Communications.

(iii) Elements and Compounds, Acids, Bases, Salts, Petroleum Products, Fertilizers, Pesticides.

(iv) Main concepts of Life Science, Classification of Living Organisms, Evolution, Genetics, Physiology, Nutrition, Health and Hygiene, Human diseases.

(v) Environment and Ecology.

UNIT-II: CURRENT EVENTS

(i) History - Latest diary of events - National symbols - Profile of States - Eminent personalities and places in news – Sports - Books and authors.

(ii) Polity - Political parties and political system in India - Public awareness and General administration - Welfare oriented Government schemes and their utility, Problems in Public Delivery Systems.

(iii) Geography - Geographical landmarks.

(iv) Economics - Current socio - economic issues.

(v) Science - Latest inventions in Science and Technology.

UNIT- III: GEOGRAPHY OF INDIA

(i) Location – Physical features - Monsoon, rainfall, weather and climate - Water resources - Rivers in India - Soil, minerals and natural resources - Forest and wildlife - Agricultural pattern.

(ii) Transport - Communication.

(iii) Social geography – Population density and distribution - Racial, linguistic groups and major tribes.

(iv) Natural calamity – Disaster Management – Environmental pollution: Reasons and preventive measures – Climate change – Green energy.

UNIT – IV: HISTORY AND CULTURE OF INDIA

(i) Indus valley civilization - Guptas, Delhi Sultans, Mughals and Marathas - Age of Vijayanagaram and Bahmani Kingdoms - South Indian history.

(ii) Change and Continuity in the Socio - Cultural History of India.

(iii) Characteristics of Indian culture, Unity in diversity – Race, language, custom.

(iv) India as a Secular State, Social Harmony.

UNIT-V: INDIAN POLITY

(i) Constitution of India - Preamble to the Constitution - Salient features of the Constitution - Union, State and Union Territory.

(ii) Citizenship, Fundamental rights, Fundamental duties, Directive Principles of State Policy.

(iii) Union Executive, Union legislature – State Executive, State Legislature – Local governments, Panchayat Raj.

(iv) Spirit of Federalism: Centre - State Relationships.

(v) Election - Judiciary in India – Rule of law.

(vi) Corruption in public life – Anti-corruption measures – Lokpal and LokAyukta - Right to Information - Empowerment of women - Consumer protection forums, Human rights charter.

UNIT-VI: INDIAN ECONOMY

(i) Nature of Indian economy – Five year plan models - an assessment – Planning Commission and Niti Ayog.

(ii) Sources of revenue – Reserve Bank of India – Fiscal Policy and Monetary Policy - Finance Commission – Resource sharing between Union and State Governments - Goods and Services Tax.

(iii) Structure of Indian Economy and Employment Generation, Land reforms and Agriculture - Application of Science and Technology in agriculture - Industrial growth - Rural welfare oriented programmes – Social problems – Population, education, health, employment, poverty.

UNIT-VII: INDIAN NATIONAL MOVEMENT

(i) National renaissance – Early uprising against British rule - Indian National Congress - Emergence of leaders – B.R.Ambedkar, Bhagat Singh, Bharathiar, V.O.Chidambaranar, Jawaharlal Nehru, Kamarajar, Mahatma Gandhi, Maulana Abul Kalam Azad, Thanthai Periyar, Rajaji, Subash Chandra Bose and others.

(ii) Different modes of Agitation: Growth of Satyagraha and Militant movements.

(iii) Communalism and partition.

UNIT- VIII : History, Culture, Heritage and Socio - Political Movements in Tamil Nadu

(i) History of Tamil Society, related Archaeological discoveries, Tamil Literature from Sangam age till contemporary times.

(ii) Thirukkural :
- (a) Significance as a Secular literature
- (b) Relevance to Everyday Life
- (c) Impact of Thirukkural on Humanity
- (d) Thirukkural and Universal Values - Equality, Humanism, etc
- (e) Relevance to Socio - Politico - Economic affairs
- (f) Philosophical content in Thirukkural

(iii) Role of Tamil Nadu in freedom struggle - Early agitations against British Rule - Role of women in freedom struggle.

(iv) Evolution of 19th and 20th Century Socio-Political movements in Tamil Nadu - Justice Party, Growth of Rationalism - Self Respect Movement, Dravidian movement and Principles underlying both these movements, Contributions of Thanthai Periyar and Perarignar Anna.

UNIT – IX : Development Administration in Tamil Nadu

(i) Human Development Indicators in Tamil Nadu and a comparative assessment across the Country – Impact of Social Reform movements in the Socio - Economic Development of Tamil Nadu.

(ii) Political parties and Welfare schemes for various sections of people – Rationale behind Reservation Policy and access to Social Resources - Economic trends in Tamil Nadu – Role and impact of social welfare schemes in the Socio - economic development of Tamil Nadu.

(iii) Social Justice and Social Harmony as the Cornerstones of Socio - Economic development.

(iv) Education and Health systems in Tamil Nadu.

(v) Geography of Tamil Nadu and its impact on Economic growth.

(vi) Achievements of Tamil Nadu in various fields.

(vii) e-governance in Tamil Nadu.

UNIT-X: APTITUDE AND MENTAL ABILITY

(i) Simplification – Percentage - Highest Common Factor (HCF) - Lowest Common Multiple (LCM).

(ii) Ratio and Proportion.

(iii) Simple interest - Compound interest - Area - Volume - Time and Work.

(iv) Logical Reasoning - Puzzles-Dice - Visual Reasoning - Alpha numeric Reasoning – Number Series.