FURTHER DETAILS REGARDING MAIN TOPICS OF PROGRAMME NO. 02/2015 (Item No. 3)

LECTURER IN CHEMICAL ENGINEERING (POLYTECHNICS)

TECHNICAL EDUCATION

(CATEGORY No. 507/2013)

Part I: General Knowledge, Current Affairs and Renaissance in Kerala

Salient Features of Indian Constitution

Salient features of the Constitution - Preamble- Its significance and its place in the interpretation of the Constitution.

Fundamental Rights - Directive Principles of State Policy - Relation between Fundamental Rights and Directive Principles - Fundamental Duties.

Executive - Legislature - Judiciary - Both at Union and State Level. - Other Constitutional Authorities.

Centre-State Relations - Legislative - Administrative and Financial.

Services under the Union and the States.

Emergency Provisions.

Amendment Provisions of the Constitution.

Social Welfare Legislations and Programmes

Social Service Legislations like Right to Information Act, Prevention of atrocities against

Women & Children, Food Security Act, Environmental Acts etc. and Social Welfare Programmes like Employment Guarantee Programme, Organ and Blood Donation etc.

RENAISSANCE IN KERALA

Towards A New Society

Introduction to English education - various missionary organisations and their functioning- founding of educational institutions, factories.printing press etc.

Efforts To Reform The Society

(A) Socio-Religious reform Movements

SNDP Yogam, Nair Service Society, Yogakshema Sabha, Sadhu Jana Paripalana Sangham, Vaala Samudaya Parishkarani Sabha, Samathwa Samajam, Islam Dharma Paripalana Sangham, Prathyaksha Raksha Daiva Sabha, Sahodara Prasthanam etc.

(B) Struggles and Social Revolts

Upper cloth revolts.Channar agitation, Vaikom Sathyagraha, Guruvayoor Sathyagraha, Paliyam Sathyagraha. Kuttamkulam Sathyagraha, Temple Entry Proclamation, Temple Entry Act .Malyalee Memorial, Ezhava Memorial etc.

Malabar riots, Civil Disobedience Movement, Abstention movement etc.

Role Of Press In Renaissance
Malayalee, Swadeshabhimani, Vivekodayam, Mithavadi, Swaraj, Malayala Manorama, Bhashaposhini, Mathnubhoomi, Kerala Kaumudi, Samadarsi, Kesari, AI-Ameen, Prabhatham, Yukthivadi, etc

Awakening Through Literature
Novel, Drama, Poetry, *Purogamana Sahithya Prasthanam, Nataka Prashtanam,* Library movement etc

Women And Social Change
Parvathi Nenmenimangalam, Arya Pallam, A V Kuttimalu Amma, Lalitha Prabhu.Akkamma Cheriyan, Anna Chandi, Lalithambika Antharjanam and others

Leaders Of Renaissance
Thycaud Ayya Vaikundar, Sree Narayana Guru, Ayyan Kali.Chattampi Swamikal, Brahmananda Sivayogi, Vagbhadananda, Poikayil Yohannan(Kumara Guru) Dr Palpu, Palakkunnath Abraham Malpan, Mampuram Thangal, Sahodaran Ayyappan, Pandit K P Karuppan, Pampadi John Joseph, Mannathu Padmanabhan, V T Bhattathirippad, Vakkom Abdul Khadar Maulavi, Makthi Thangal, Blessed Elias Kuriakose Chaavra, Barrister G P Pillai, TK Madhavan, Moorkoth Kumaran, C. Krishnan, K P Kesava Menon, Dr.Ayyathan Gopalan, C V Kunjuraman, Kuroor Neelakantan Namboothiripad,
Velukkutty Arayan, K P Vellon, P K Chathan Master, K Kelappan, P. Krishna Pillai, A K Gopalan, T R Krishnaswami Iyer, C Kesavan. Swami Ananda Theerthan , M C Joseph, Kuttippuzha Krishnapillai and others

Literary Figures
Kodungallur Kunhikkuttan Thampuran, KeralaVarma Valiyakoyi Thampuran, Kandathil Varghese Mappila. Kumaran Asan, Vallathol Narayana Menon, Ulloor S Parameswara Iyer, G Sankara Kurup, Changampuzha Krishna Pillai, Chandu Menon, Vaikom Muhammad Basheer. Kesav Dev, Thakazhi Sivasankara Pillai, Ponkunnam Varky, S K Pottakkad and others

GENERAL KNOWLEDGE AND CURRENT AFFAIRS
General Knowledge and Current Affairs

Part II a: Technical Mathematics

I. Matrices – Identification of Matrices, matrix operations, adjoint and inverse.

II. Determinants – Evaluation of second and third order, minors and cofactors, solutions of simultaneous linear equation in three unknown using Cramer's rule.

III. Binomial Series – Expansions using Binomial theorem.

IV. Trigonometric functions – Signs of functions in each quadrant. Trigonometric values of angles, properties of trigonometric functions, applications of the identities sin (A ± B), cos (A ± B) and tan (A ± B).

V. Coordinate geometry – Equations to a straight line – slope-intercept form, intercept form, Angle between two lines, condition for two lines to be perpendicular, parallel.

VI. Differentiation – Limits and continuity, derivatives of functions, equation to tangents and normals. Maxima and minima of functions of one variable.

VII. Integration of functions – Integration of different types of functions.

VIII. Applications of integration – Area bounded by a curve and X or Y axis, solutions of differential equations using the method of variable separable, solutions of linear differential equations of first order.

Part II b: Basic Civil Engineering

Materials: Brick – varieties and strength, characteristics of good brick. Cement – varieties and grade of cement and its uses. Steel – types of steel for reinforcement bars, steel structural sections. Aggregates – types & requirements of good aggregates. Concrete – grades of concrete as per IS code, water cement ratio. Workability, mixing, batching, compaction and curing.

Construction: Parts of building – foundation – types of foundations – spread footing, isolated footing, combined footing, Raft, pile and well foundations. Masonry – types rubble masonry, brick masonry, English bond and Flemish bond. (One brick wall).

Surveying: Chain surveying – principles, instruments, ranging, and chaining survey lines, field work and field book, selection of survey stations, units of land area.

Levelling: Levelling instruments, different types, bench mark, reduced level of points, booking of field notes, reduction of levels by height of collimation method (simple problem). Modern survey – instruments – Total station, Electronics theodolite, Distomat.

Part II c: Basic Mechanical Engineering

The importance of IC Engines: Definition, classification – two stroke engines, four stroke engines, working of two stroke engines and four stroke engines with the help of line sketches, comparison between two stroke and four stroke engines, comparison between petrol and diesel engines, function of fly wheel, clutch, gearbox, propeller shaft and differential in power transmission, explain with sketch the working of differential, briefly explain power transmission of 4 wheel vehicle with line diagram.

The importance of Power Plants: Introduction, classification of power plants – working of hydroelectric power plant with schematic sketches – working of thermal (Steam and Diesel) power plant with schematic sketches – working of nuclear power plant with schematic sketches.

Part II d: Basic Electrical Engineering

Review with discussion of electric current, potential difference, power, EMF, resistance and its laws, Ohms law and series parallel circuit, electromagnetism, generation of AC and DC supply.

Idea of Basic electrical circuit: Electrical supply and load and its functioning, division of voltage and current in a parallel and series circuit – simple problems, units of power and energy, solution of DC circuit with calculation of energy consumption in an installation.

Circuit parameters: Resistance, Capacitance and inductance. AC circuit with R, L, C. Simple solution of typical AC circuit with resistance, impedance, power and power factor.

Electrical circuit of an installation: Earthing, lightning protection.

Part II e: Essentials of Electronics Engineering

Active and passive devices – review only. LED – working, applications, comparison of LED lighting and CFL lighting. Full wave rectifier – diagram and explanation, 5 V power supply – with bridge rectifier and 7805. SMPS – block diagram and advantages. Integrated circuits. SMDs – advantages. Static electricity – precautions in handling electronic circuits.

Switches: ON / OFF, push to ON, push to OFF, push to ON / OFF, SPST, SPDT, DPDT. Working and application of limit switches, proximity switches, relays.

Microcontrollers: Simple block diagram of 8 bit microcontrollers – application.

Mobile technology: CDMA and GSM. Compare – 2G and 3G technologies.

Inverter & UPS: Block diagram. Compare – inverter and UPS. Online and off line UPS – differentiate. Battery selection for UPS and inverter.

E-waste: Health hazards of e-waste.

Part III :

FLUID MECHANICS

Properties of Fluids: Density, Specific gravity, Viscosity, Newton's law of viscosity, Newtonian and Non-Newtonian fluid, Viscosity Index, Red wood viscometer

Pressure Measuring Instruments: Absolute Pressure, Gauge Pressure, Total Pressure
Liquid column Manometers – U Tube, Differential & Inclined Tube Manometers

Types of Flows: Viscous, Turbulent Flow, Critical Velocity, Reynolds Number, Transition range & Velocity distribution in pipes

Fluid Head - Static head, Impact head, Velocity head, Potential head, Computation of Total Mechanical energy, efficiency. Velocity distribution in pipes – relation between maximum and average velocity. Expressing Fluid Friction
Wake formation (Description only)
Friction in straight pipe – Hagen-Poiseuille equation for viscous flow (no derivation) and problems. Reynold's number and relative roughness on friction factor. Empirical equation for friction factor. Involving friction loss in pipe fittings. Economic pipe diameter.
Method - mechanical method and special methods.
Expressions – simple problems.
Measurements – Displacement meters, wet gas meter, rotating disc meter and piston meters, Current meters – Electro magnetic flow meter.

Transportation of fluids: Pipes and pipe fittings: Pipes & tubes – pipe and tube standards
Pipe fittings – fittings for screwed, welded and flanged joints.
Gaskets. Sealing of rotating shafts – stuffing boxes and mechanical seals
Fundamentals of flow control mechanism and valve classifications

1. Gate valve and its variations like sluice valve and slide valve
2. Plug valve (cocks) – 2 way and 3 way and non-lubricating plug valves
3. Ball valves
4. Stop valves – Globe valve
5. Butterfly valve
6. Diaphragm valve

Pump Classifications: Positive displacement and Centrifugal.
Simplex and duplex – single acting and double acting.
Diaphragm pumps – Rotary – gear pump, screw pumps, lobe pumps.
Fluid displacement pumps – Airlift, Acid egg, Jet pumps, Electro magnetic pumps
Double suction type - Split case and multistage pumps - Priming of centrifugal pumps and self-priming
Blowers, Compressors and Vacuum Systems - Displacement compressors, vacuum pumps and ejectors. Nash Hytor.

PARTICLE TECHNOLOGY

Filtration as a solid, liquid separation and its application in industry. Classification of filters

1. Sand filter – open – closed
2. Filter presses – plate and frame filter press, non-washing, open delivery, washing, closed
3. Leaf filters – pressure and vacuum types – Moore filter
4. Continuous filter – rotary drum – working cycle – methods of cake discharge – installation

Filter operation – effect of pressure – constant pressure and constant volume filtration.
Centrifugation
Centrifugal force developed in centrifuges – classification of centrifuges – batch – semi

Size Reduction: Nature of the materials to be crushed – hardness, structure, moisture content, crushing
Types of crushing equipments, coarse crushers – Intermediate crushers – fine grinders – open
Laws of crushing – Kick's law – Rittinger's law – Bonds law – Jaw crusher – gyratory – Average particle size – specific surface of mixture, volume surface mean diameter

Size Separation and Fluidization: Screens: Tyler and U. S. standard screens
Screen analysis: efficiency and capacity of screens
Types of screening equipment – grizzlies – trammels, shaking screens, vibrating screens
Air separation methods: cyclone separator – air separator – bag filter. Electrostatic

Fluidization: Mechanism of fluidization – conditions for fluidization – batch fluidization – boiling effect

Sedimentation, Agitation and Mixing: Sedimentation separation in liquid medium – batch sedimentation – application of batch - Principle of froth floatation cells - froth floatation cells – simple flow sheet for floatation plant

Agitation and Mixing: Purpose of agitation – agitation equipment – propellers, paddles and turbines - Flow pattern in agitated vessels – prevention of swirling – draft tubes and baffles – their power consumption in agitated vessels – simple problems in determination of power.

Storage and Transportation of Solids, Gases and Liquids: Storage of solids – Hoppers – bins – angle of repose. Devices for discharge of solids – Conveyor types – belt conveyor – chain conveyor – scraper conveyor – apron conveyor – screw conveyors – pneumatic conveyors – pneumatic conveying system auxiliary equipments
Storage of liquid – storage tanks
Storage of volatile liquids – floating roof
Storage of gases: Horton sphere – pressure cylinders – gas holders – wet and dry specifications

Part IV :

STOICHIOMETRY

Units and dimensions, conversion of units, dimensionless group, chemical formulae, mass

Gas Laws and Their Applications: Ideal gases – gas laws (derivation is not required), simple problems involving single gas.
Gas mixtures – Dalton's Law, Amagat's law, Volume %=mole% = partial pressure %. Average
Material Balances – Not involving chemical reactions
Types of processes – Material balances equations – key component – material balances problem

Material Balances involving Chemical Reactions: Chemical reactions, complete and incomplete reactions, stoichiometric proportions of reactants

FUELS & COMBUSTION

Petroleum – fractional distillation – petroleum products – cracking – catalytic, thermal, hydrocracking – polymerisation – knocking agent – octane number – cetane number – removal of sulphur – gasoline, kerosene, LPG storage of liquid fuels.

Solid Fuels and Gaseous Fuels: Solid fuels – classification – composition of wood – origin of coal – theories of origin of coal – ranking of low temperature carbonization – Storage of coal – Beehive oven – Otto Hoffman by product oven – composition, calorific value and uses of above gas fuels – blast furnace gas.
Preparation of nuclear materials – preparation of nuclear material. Uranium, Thorium, Plutonium fuel.

Analysis of Fuel, Fuel Burning Systems and Furnaces: Properties and uses of coal for industrial purpose – Classification of furnaces – construction and working.

Non conventional Energy: Cooling and refrigeration – distillation – solar drying and cooking – working of silicon cell – conversion – Schematic diagram of OTEC – Geo thermal power – Geo thermal power station in India

Part V :

HEAT TRANSFER

Heat Transfer by Conduction: Heat transfer by conduction in solids – steady state and unsteady state flow – definition – units of heat flow. Single wall – derivation of equation and simple problems – Thermal conductivity – units.
Steady state conduction through composite wall in series derivation of equation and problems. Steady state conduction through cylindrical wall and spherical wall derivation – problems of overall heat transfer coefficient from individual heat transfer coefficient – simple problems

Forced Convection and Radiation: Transfer to fluid without phase change – thermal boundary layer – hydro dynamic boundary layers. Liquids – flash building sub cooled boiling – saturated boiling – regimes of boiling – maximum

Heat Transfer Equipments: Calculation in heat exchangers – Heat transfer equipment – Heaters and heat exchangers – single pass shell floating head heaters – use of baffles on shell side of heat exchangers, double pipe heat exchangers – plate basis of classification – horizontal tube – vertical tube – climbing film – falling film – forced circulation

Multiple Effect Evaporators: Area – capacity – steam economy – factors that control heat transfer coefficient and effect of hydrostatic method of feeding – advantages of multiple effect evaporation – steam economy and capacity. – simple problems in determining concentration and temperature in each effect – industrial uses – optimum temperature differences – incorporating heat pump cycle in evaporation of fruit.

MASS TRANSFER

Diffusion: Molecular diffusion – molar flux – Fick's rate equation – steady state diffusion of gas A

Absorption: Mechanism of Absorption – conditions of equilibrium between gas and liquid – Henry's law

Humidification: General mechanism of diffusional processes – Definitions and mathematical expressions for Adiabatic saturation temperature – wet bulb temp cooling towers – atmospheric – natural

Drying: Purpose and industrial applications – drying equipment – classifications – tray dryer – tunnel

Distillation: Distillation as an interphase mass transfer – industrial application – definition of terms – less

Fractionation: Rectification, Azeotropic distillation, extractive distillation, and molecular distillation, rectification

Leaching: Applications of leaching – batch and continuous – heap leaching – percolation tanks – shank

Part VI :

Chemical Technology: Diaphragm cell – mercury cell – membrane cells – manufacture of solid caustic soda. Chlorine

Introduction to Chemical Engineering, Chemical Industrial Process:
Major industries in Kerala and India – Raw materials and products – Economic importance of

Water: Water sources – impurities – characteristics – softening methods, Lime soda process

Sulphuric Acid: Introduction – Importance of Sulphuric acid – properties and uses – raw materials – sulphur pyrites – production of sulphur dioxide, sulphur burners – cleaning

Nitric Acid: – Properties and uses – reaction – catalyst – manufacturing process – concentration

Hydrochloric Acid: - Properties and uses and commercial grades – manufacture of Hydrochloric

Phosphoric Acid:- Properties, uses and grades, raw materials manufacturing process. Wet and dry

Preparation and purification of brine, reaction and flow diagram, light and heavy soda Ash, Different source of synthesis gas low and high pressure process for the manufacture of Ammonia grade urea - Merits and demerits.

Glass – manufacturing method; different grades – uses. Alumna brick, carbon ceramics – raw material – main unit operation and process

Oils And Fats: Of rancidity – acid value, saponification value and iodine value. Extraction of oils – oil expellers - Refining of vegetable oils, neutralization, bleaching and deodorisation
Catalysts - Materials, manufacturing process for toilet & laundry soaps. Batch and continuous process, comparison with soap. Biodegradability of detergents, detergent additives and formulation

Pulp & Paper : Paper – Paper industry in India and its future - Soda mechanical pulping – details of process and plant - Paper manufacture - Details of paper machine
Explosives and Insecticides: Glycerine, cellulose nitrate, smokeless powder, trinitrotoluene manufacture - Action – inorganic – sulphur compounds – phosphorus compounds – chemistry – mode of action

Sugar, Starch and Leather: Streadding and classification by liming, evaporation, crystallization and centrifuging. Refined glusers removal, bleaching, filtration and drying. Different grades of starch – bleaching. Synthetic tanning agents, and finishing operations

Biotechnology: Micro organisms – enzymes – definition, functions and types. Definition of substrate, nutrients Brewing – production of alcoholic beverages by fermentation (a schematic outline)

Part VII :

POLYMER TECHNOLOGY

Introduction to polymers: Speciality Thermoplastic / Thermosetting plastics - Plastics – Rubber – Fibre – adhesive – coatings

Important sources of monomers and manufacturing of the following: Ethylene, Propylene, Vinyl Chloride, Styrene.

Types of polymerisation reaction: Addition polymerisation, Step polymerisation, Chain polymerisation, Anionic and cationic polymerisation, Polymerisation by condensation
Different types of co-polymers – Random, block, graft co-polymer
Characteristic features and applications of co-polymerisation - polycondensation

Manufacture of thermoplastics: Commodity plastics
(1) Polyethylene (2) Poly propylene

Engineering Plastics
Manufacture of Man made Fibres – Nylon, Viscous Rayon, Polyester

ENVIRONMENTAL ENGINEERING

Water Pollution: Secondary, Tertiary – BOD, COD determination

Air Pollution and Control: Of dust emissions – ESP, Bog filters, absorbers, scrubbers, etc – sources of gaseous pollutants

Noise Pollution – Solid Waste – Radioactive Pollution: Noise – pollution control programme – TLV, SIL, NEI – Noise barriers – Composition of earth – methods of disposal. Sources of radioactive waste – effects of radioactive pollution – monitoring

Maintenance – Plant Inspection: Replacement – maintenance of chemical plant equipments – Troubles and remedial actions – start

Safety, Fire Engineering: The importance and need for safety measures in industries - Define the meaning of the term – factory, accident, frequency rate, security rate, accident pronnes - Identify the various accident factors, mechanical factors, environmental factors, personal factors - Discuss the 4 E's of accident prevention technique - List the precautions to be observed while working in an hazardous environment - Explain briefly the artificial respiration methods - Safety practices in a chemical industries – explosive limit – Flammable limit – Inflammable limit – characteristics of hazardous material – TLV, STEL, TLV – C, LD 50, LC 50 – flammable liquids

Instrumentation & Process Control: Principles of measurement – Instruments for indication, recording and remote control.

1. Temperature – filled system thermometers – bimetallic – thermocouples – resistance
2. Pressure and vacuum – manometers – diaphragm gauges, bellow gauges, strain gauges

Different flow meters and level measuring instruments: Level measurement: Sight glasses, float type, displacement type (torque tube), diaphragm box

Specific gravity, Humidity & Instrumental methods of analysis: Specific gravity - Off line and on line measurement – Humidity - Dew point method, wet bulb method, hygrometry, electrical type - Moisture content in different products - Chromatographic analysis – flame photometry, spectrophotometry, mass spectrograph

Process Control: Recorders, timers – transducers - Characteristics of measuring elements and process control system – open and closed loop systems

Computerized Control and Instrumentation Diagrams: Descriptive treatment of the following
Telemetering devices, Analog and digital signal transmission, A/D, D/A converter, analog and Instrumentation diagram for the following

1. Heat exchangers
2. Distillation plant

Control room – panels and control room functions

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.