

BEng (Hons) Chemical and Environmental Engineering - E400

1. Aim

The Degree Programme has been designed to help meet the future needs of the Mauritian economy. Consumer demand for a variety of processed and convenience foods and drinks including sugar, many based on local agricultural products, are to be anticipated and this will, in turn, create new process industries. The rise in GNP will also lead to the growth of industries providing liquid and gaseous fuels, fertilisers, building materials, rubber and plastics, pharmaceutical and medical products, and speciality chemicals and there will be a role for chemical engineers in all these. The service industries required by an increasingly sophisticated society to supply water, electricity and other forms of energy, effluent and sewage treatment and environmental control will likewise need their share of chemical and process engineers.

2. General Entry Requirements

As per General Entry Requirements for admission to the University for Undergraduate Degrees.

3. Programme Requirements

Credit in Physics at SC/ 'O' Level.
2 GCE 'A' Level Passes in Mathematics and Chemistry.

4. Minimum Credits Required for the Award

MODULES	Minimum Credits Required	
	Degree	Diploma (Any Level)
Humanities & Management	9	3
Basic Sciences & Mathematics	12	6
Engineering	109	45
Diploma Project*	-	6
TOTAL	130	60

Note:

- For the degree award, students should satisfy the examiners in all core modules.
- Industrial Training must be completed satisfactorily for the award of the degree.
- *A student may opt for a Diploma in Chemical and Environmental Engineering provided s/he satisfies the minimum requirements. The Diploma project would normally be of 8 weeks duration for an input of at least 90 hours.

5. Programme Duration

	Normal (Years)	Maximum (Years)
BEng (Hons) Degree:	4	7
Diploma:	2	3

6. Credits per Year: Minimum 18, Maximum 48 subject to Regulation 5 above.

7. Assessment

Assessment will be based on a written examination of 2 to 3-hour duration (normally a paper of 2 hour duration for modules carrying less or equal to 3.5 credits and 3 hour paper for modules carrying four-six credits) and on continuous assessment done during the semester or year.

Written examinations for all modules, whether taught in semester 1 or in semester 2 or both, will be carried out at the end of the academic year (unless otherwise stated).

The continuous assessment will count for 10-40% of the overall percentage mark of the module(s), except for a Programme where the structure makes for other specific provision(s). Continuous assessment may be based on laboratory work, seminars and/or assignments and **should include at least 1 class test.**

There will be a compulsory class test for all modules taught in semester 1 at the end of semester 1 of the given academic year unless stated otherwise in the Programme Structure.

A minimum of at least 30% should be attained in each of continuous assessment and written examination, with an overall total of 40% for a candidate to pass a module.

Special examinations (e.g. class tests) will be arranged at the end of semester 1 or semester 2 for exchange students who have registered only for one semester. In case of yearly modules, credits will be assigned on a pro-rata basis.

8. List of Modules

CORE MODULES

Code	Module Name	L+P Hrs/Wk	Credits	Exam Duration
Basic Sciences & Mathematics				
MATHS 1111(1)	Mathematics 1	D.E.	3	2 hrs
MATHS 1211(1)	Mathematics 2	D.E.	3	2 hrs
MATH 2001Y(3)	Mathematics 3	1.5+0	3	2 hrs
MATH 1231(3)	Probability & Statistics	D.E.	3	2 hrs
Engineering				
CSE 1010e(1)	Introduction to Information Technology	O.E.	3	2 hrs
CHE 1002Y(3)	Thermodynamics	1.5+0.5	3.5	2 hrs
CHE 1001Y(1)	Chemistry & Basic Chemical Engineering	3+1	7	3 hrs
CSE 1020(1)	Computer Programming	2+2	3	2 hrs
CIVE 1101(1)	Engineering Materials	3+1	3.5	2 hrs
MECH 1213(1)	Applied Mechanics	3+1	3.5	2 hrs
CHE 2001Y(3)	Fluid Mechanics	3+0.5	6.5	3 hrs
CHE 2002Y(3)	Heat & Mass Transfer	3+1	7	3 hrs
CHE 2003Y(3)	Instrumentation & Chemical Process Control	3+0.5	6.5	3 hrs
CHE 2004Y(3)	Introduction to Environmental Engineering & Renewable Energy Technologies	3+0.5	6.5	3 hrs
CHE 2005Y(3)	Reaction Engineering	1.5+0.5	3.5	2 hrs
CHE 2006Y(3)	Sugar Technology	1.5+0.5	3.5	2 hrs
CHE 3201(5)	Chemical Engineering Economics	3+0	3	2 hrs
CHE 3202(5)	Chemical Process Design	4+0	4	3 hrs
CHE 3203(5)	Chemical Process Safety & Loss Prevention	3+0	3	2 hrs
CHE 3204(3)	Design Project 1	1+6	4	0
CHE 3100	Industrial Training	-	0	0

CHE 3001Y(5)	Unit Operations	3+0.5	6.5	3 hrs
CHE 3205(5)	Wastewater Management	3+1	3.5	2 hrs
CHE 4000Y(5)	Degree Project	-	10	-
CHE 4101(5)	Design Project 2	1+8	5	-
CHE 4001Y(5)	Environmental Management Tools	1.5+0	3	2 hrs
CHE 4002Y(5)	Solid Waste Management	1.5+0.5	3.5	2 hrs
CHE 4003Y(5)	Water Pollution Control	1.5+0	3	2 hrs

Humanities & Management

COMS 1010(1)	Communication Skills	D.E.	3	2 hrs
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ELECTIVES

Engineering

MECH 1111(1)*	Engineering Graphics 1	2+2	3	0
CHE 3207(5)	Chemical Thermodynamics	3+0	3	2 hrs
CHE 3206(5)	Chemistry for Environmental Engg.	3+1	3.5	2 hrs
CHE 4004Y(5)	Cleaner Production Technologies	1.5+0	3	2 hrs
CHE 4206(5)	Energy Engineering	3+0	3	2 hrs
CHE 4005Y(5)	Quality Systems	1.5+0	3	2 hrs
MECH 4163(5)	Operation Research 1	3+0	3	2 hrs

Humanities & Management

ACF 1000(1)	Accounting for Financial Decision Making	3+0	3	2 hrs
ECON 1015(1)	Economics	3+0	3	2 hrs
MGT 1063Y(3)	Quantitative & Research Methods	3+0	6	3 hrs

*Module MECH 1111(1) will be assessed solely by continuous assessment (3 class tests, two using drawing board and tee square and one using CAD software).

9. Programme Plan – BEng (Hons) Chemical & Environmental Engineering

YEAR 1

YEARLY MODULES

Code	Module Name	L+P	Credits
CORE			
CHE 1001Y(1)	Chemistry & Basic Chemical Engg	3+1	7
CHE 1002Y(3)	Thermodynamics	1.5+0.5	3.5

SEMESTER MODULES

Code	Module Name	Sem	L+P	Credits
CORE				
MATHS 1111(1)	Mathematics 1	1	D.E.	3
MATHS 1211(1)	Mathematics 2	2	D.E.	3
CIVE 1101(1)	Engineering Materials	1	3+1	3.5
CSE 1010e(1)	Introduction to IT	1	O.E.	3
COMS 1010(1)	Communication Skills	2	D.E.	3
CSE 1020(1)	Computer Programming	2	2+2	3
MECH 1213(1)	Applied Mechanics	2	3+1	3.5
ELECTIVES				
ECON 1015(1)	Economics	1	3+0	3
MECH 1111(1)	Engineering Graphics I	1	2+2	3
ACF 1000(1)	Acc for Fin Decision Making	2	3+0	3

YEAR 2

YEARLY MODULES

Code CORE	Module Name	L+P	Credits
MATH 2001Y(3)	Mathematics 3	1.5+0	3
CHE 2001Y(3)	Fluid Mechanics	3+0.5	6.5
CHE 2002Y(3)	Heat and Mass Transfer	3+1	7
CHE 2003Y(3)	Inst. & Chemical Process Control	3+0.5	6.5
CHE 2004Y(3)	Intro to Env. Engg & Renewable Energy Technologies	3+0.5	6.5
CHE 2005Y(3)	Reaction Engineering	1.5+0.5	3.5
CHE 2006Y(3)	Sugar Technology	1.5+0.5	3.5
ELECTIVE			
MGT 1063Y(3)	Quantitative & Research Methods	3+0	6

SEMESTER MODULES

Code CORE	Module Name	Sem	L+P	Credits
MATH 1231(3)	Probability & Statistics	2	D.E.	3

YEAR 3

YEARLY MODULES

Code CORE	Module Name	L+P	Credits
CHE 3001Y(5)	Unit Operations	3+0.5	6.5

SEMESTER MODULES

Code CORE	Module Name	Sem	L+P	Credits
CHE 3100	Industrial Training	1	-	-
CHE 3201(5)	Chemical Engineering Economics	2	3+0	3
CHE 3202(5)	Chemical Process Design	2	4+0	4
CHE 3203(5)	Chemical Process Safety & Loss Prevention	2	3+0	3
CHE 3204(3)	Design Project 1	2	1+6	4
CHE 3205(5)	Wastewater Management	2	3+1	3.5
ELECTIVES				
CHE 3206(5)	Chemistry for Environmental Engineering	2	3+1	3.5
CHE 3207(5)	Chemical Thermodynamics	2	3+0	3

YEAR 4

YEARLY MODULES

Code CORE	Module Name	L+P	Credits
CHE 4000Y(5)	Degree Project	-	10
CHE 4001Y(5)	Environmental Management Tools	1.5+ 0	3
CHE 4002Y(5)	Solid Waste Management	1.5+0.5	3.5
CHE 4003Y(5)	Water Pollution Control	1.5 + 0	3
ELECTIVES			
CHE 4004Y(5)	Cleaner Production Technologies	1.5+0	3
CHE 4005Y(5)	Quality Systems	1.5+0	3

SEMESTER MODULES

Code CORE	Module Name	Sem	L+P	Credits
CHE 4101(5)	Design Project 2	1	1+8	5
ELECTIVES				
CHE 4206(5)	Energy Engineering	2	3+0	3
MECH 4163(5)	Operation Research 1	2	3+0	3

10. Outline Syllabus

This outline syllabus is not prescriptive and is intended to serve as a guide only.

Note: Pre-requirement (PQ); Pre-requisite (PR).

ACF 1000(1) - ACCOUNTING FOR FINANCIAL DECISION MAKING

The Role of Accounting Information; Recording and Summarising Transactions; Accounting Concepts & Preparing Final Accounts; Adjustments to Final Accounts; Capital v/s Revenue Expenditure; Bank Reconciliation Statement; Accounting Ratios; Accounting for Internal Decision Making Techniques; Elements of Cost; Costing Methods & Techniques; Decision Making Techniques; Accounting for Manufacturers; Budgets.

CHE 1001Y(1) - CHEMISTRY & BASIC CHEMICAL ENGINEERING

Physical Chemistry; Molecular Structure; Spectroscopy; Non-Electrolyte Solutions; Ionic Equilibria; Organic Chemistry: Structure and Bonding, Stereochemistry, Reaction Mechanisms.

Units and Dimensions; Chemical Equation & Stoichiometry; Properties of Gases; Phase Phenomena; Concept of Equilibrium; Material Balance (Steady state material balances, balances in non-reacting and reacting systems, by-pass, purge and recirculation); Energy Balance (General energy balance, reversible processes, heat of solution).

CHE 1002Y(3) - THERMODYNAMICS

Thermodynamics System and Properties of Substances; First and Second Laws and their Applications; Enthalpy and Auxiliary functions; Work, Heat and Power Cycles; Use of Relevant Tables e.g. Steam, Psychometric Charts; Vapour Power Cycles; Rankine Cycle; Superheat and Reheat; Gas Power Cycles; Internal Combustion Engines; Gas Turbine Powerplants; Refrigeration and Heat Pump Systems; 2nd Law of Thermodynamics, Availability Balance for Closed and Open Systems, Second Law Efficiency; Energy and Energy Applications.

CHE 2001Y(3) - FLUID MECHANICS

Fundamental Concepts relating to Fluids; Hydrostatics; Fluids in Equilibrium; Principles of Fluid Motion; Momentum Equation and its Application; Energy Equation and its Application; Flow in Pipelines and Open Channels; Transmission and Losses of Energy in Pipelines; Rotodynamics; Dimensional Analysis and Similarity.

CHE 2002Y(3) - HEAT & MASS TRANSFER

Fundamentals of Heat Transfer; Differential Equations of Heat Transfer; Steady-State Conduction; Convective Heat Transfer; Radiation Heat Transfer; Design of Heat-Exchange Equipment – Heaters, Evaporators; Film Heat Transfer Coefficients; Extended Surface Equipment; Diffusion and Mass Transfer; Fick's Law of Diffusion; Diffusivity and Mechanisms of Mass Transport; Theory of Ordinary Diffusion in Gases; Diffusion through varying cross-sectional area; Diffusion from a Sphere; Molecular Diffusion in Liquids and Solids; Diffusion in Porous Solids; Diffusion with Chemical Reactions.

CHE 2003Y(3) - INSTRUMENTATION AND CHEMICAL PROCESS CONTROL

Temperature, Pressure, Flow and Level Measurements; Process Instrumentation Diagrams, Control of a Chemical Process: its characteristics and associated problems; Mathematical Modelling of the Chemical Processes; Analysis of Dynamic Behaviour; Feed-Forward and Feedback Control.

CHE 2004Y(3) - INTRODUCTION TO ENVIRONMENTAL ENGINEERING & RENEWABLE ENERGY TECHNOLOGIES

Introduction to Environmental Engineering; Environmental Protection Act 2002; Criteria and non-criteria air pollutants, dispersion into the atmosphere and engineering control; Current Legislation.

Hydrological cycle; Disposal of domestic wastewater, types, sources, impacts of water pollutants. Standards of Wastewater Discharge into the Environment; Introduction to Wastewater Treatment Systems; Generation of Solid Wastes; Handling, Collection and Disposal; Solid Waste Management; Legal Aspects of Solid Wastes Handling; Energy Sources; Utilisation and Potentials; Fossil Fuels – Solid, Liquid and Gas; Renewable Energy – Hydro Power, Solar, Wind, Biomass, Geothermal, Ocean Thermal, Wave, Tidal.

CHE 2005Y(3) - REACTION ENGINEERING (PQ: CHE 1001Y(1))

Types of Chemical Reactions; Rate and Order of Reaction; General Mole Balance Equation. Batch and Continuous Reactors; Conversion and Reactor Sizing; Reactors in Series; Rate Laws & Stoichiometry; Stoichiometric Tables for Different Types of Reaction; Reaction with Phase Change; Isothermal Reactor Design; Collection and Analysis of Kinetic Data; Catalytic and Enzyme Reactions.

CHE 2006Y(3) - SUGAR TECHNOLOGY

Basic Physico-Chemical Principles underlying Sugar Extraction; Basic Principles of Sugar Manufacture – Milling, Clarification, Heating, Evaporation, Crystallisation, Centrifugation, Drying; Fundamentals of Energy Management in Sugar Processing; Chemical Control applicable to the Sugar Industry; By-products from Sugarcane and their Utilisation.

CHE 3001Y(5) - UNIT OPERATIONS (PQ: CHE 2002Y(3))

Particulate Solids (particle characterisation, particulate solid in bulk); Size Reduction of Solids; Filtration; Membrane Separation Processes (Ultrafiltration, Reverse Osmosis); Centrifugal Separation; Drying; Leaching; Distillation, Gas Absorption; Liquid-Liquid Extraction.

CHE 3100 - INDUSTRIAL TRAINING

Students will be attached to a firm for a period of at least 20 weeks. The objective is to provide the students with the opportunity to apply theoretical knowledge at their industrial placement and to function within the organisational structure of the firm. Students have to perform satisfactorily in this module before qualifying for the award of the degree.

CHE 3201(5) - CHEMICAL ENGINEERING ECONOMICS

Introduction to Chemical Engineering Economics; Critical Path Analysis and PERT Analysis of Projects, Capital Cost Estimation, Cost Index, Manufacturing Cost and Cost of Product, Depreciation; Taxes and Insurance; Break-Even Analysis, Profitability of Project using Ratios, Project Appraisal Techniques: Payback Period, Discounted Cash Flow Method, Net Present Value, Internal Rate of Return, Legal Financial Aspects.

CHE 3202(5) - CHEMICAL PROCESS DESIGN

Formulating Balance Problems; Degree of Freedom Analysis; Solution Strategy using D.O.F.; Single and Multiunit Configurations; Non-Reacting and Reacting Systems; Sequencing with Complete and Partial Solutions; Strategy for Machine Calculations.

CHE 3203(5) - CHEMICAL PROCESS SAFETY AND LOSS PREVENTION

Sources & Evaluation of Exposure to Hazardous Substances; Hazard Control; Hazard and Operability Study; Hazan; Risk Assessment; Occupational Health & Safety Management; Health & Safety Audit in work places; Types, Effect and Control of Noise; Noise Survey; Safety in Chemical Process Industry; Occupational Health Hazards (types, health effects and standards).

CHE 3204(3) - DESIGN PROJECT 1

Problem definition, Process Consideration, Block Diagram, Mass Balances, Energy Balances, Preliminary Sizing of Equipment & Costing, Control Strategy, Preliminary Hazop, Basis for Detailed Design.

CHE 3205(5) - WASTEWATER MANAGEMENT (PQ: CHE 2004Y(3))

In-depth Analysis of major Wastewater Characteristics: Biological oxygen demand (BOD) and chemical oxygen demand (COD); Nitrification and De-nitrification; DO-sag curve; Treatability & Toxicity Studies; Sampling Techniques. Measurement Techniques; Water Pollution Surveys; Water Re-cycling and Re-use; Reduction of Water Pollution-at-source; Wastewater Segregation; Sludge Handling & Disposal.

CHE 3206(5) - CHEMISTRY FOR ENVIRONMENTAL ENGINEERING

Fundamentals of Chemistry for Environmental Engineering; Parameters of Water and Wastewater Analysis (pH, acidity, alkalinity, hardness, turbidity, dissolved oxygen, conductivity, redox potential); Chemistry of Nitrification/Denitrification and Phosphorus removal.

CHE 3207(5) - CHEMICAL THERMODYNAMICS (PQ: CHE 1002Y(3))

Partial Molar Quantities; Gibbs-Duhem Equation in Multicomponent Systems; Phase Rule and Equilibria and Thermodynamics of Solutions; Activity Coefficients; Fugacity; Reaction Equilibria; Thermodynamic Analysis of Processes.

CHE 4000Y(5) - DEGREE PROJECT

Project related to Chemical Engineering or Energy and Environmental Engineering.

CHE 4001Y(5) - ENVIRONMENTAL MANAGEMENT TOOLS

Environmental Impact Assessment (EIA); Environmental Performance Evaluation; Environmental Management in Industry with special emphasis on Chemical Industries; ISO 14000 Standards; Environmental Management Systems (EMS)/ Environmental Auditing.

CHE 4002Y(5) - SOLID WASTE MANAGEMENT (PQ : CHE 2004Y(3))

Solid Wastes Characterisation, Physical, Chemical and Biological Properties; Integrated Solid Waste Management Hierarchy, Hazardous Wastes Management; Recycling; Composting; Anaerobic Digestion; Incineration; Landfilling; Overview of Regional Waste Management Practices.

CHE 4003Y(5) - WATER POLLUTION CONTROL (PQ: CHE 3205(5))

Design and Operation of Physical and Biological Wastewater Treatment Systems; Advanced Chemical and other Wastewater Treatment Processes; Design of facilities for the treatment, handling and disposal of sludge; Natural Treatment Systems.

CHE 4004Y(5) - CLEANER PRODUCTION TECHNOLOGIES

Fundamentals of Ecological Sustainable Production Processes; Process Modifications and Waste Minimisation Techniques for Cleaner Production; Cleaner Production Tools; Life-Cycle Analysis.

CHE 4005Y(5) - QUALITY SYSTEMS

Introduction to Quality Management Systems, ISO 9000, Integration of OHSAS 18001 with Quality Systems; Internal Auditing, Problem Solving, Introduction to Statistical Process Control, Quality Control Tools, Sampling Plans, Continuous Improvement, Benchmarking, Total Quality Management.

CHE 4101(5) - DESIGN PROJECT 2

Redefining Basis for Detailed Design; Material & Energy Balances; Detailed Design of at least 2 Major Equipment; Detailed Hazop and Instrumentation around a major Unit operation; Detailed PFD and PID; Equipment Schedule; Costing.

CHE 4206(5) - ENERGY ENGINEERING

Energy Sources and Utilisation, Energy Technologies & Environmental Implications of Energy Production and Use; Conventional and Emerging Techniques for Energy Production and Conservation; Energy Management and Economic Considerations, Co-generations.

CIVE 1101(1) - ENGINEERING MATERIALS

Properties of Materials - Hydraulic and Bituminous Binders; Plastics; Glass; Ceramics and Composite Materials; Materials Science - Crystal Structure; Plastic Deformation; Properties and Behaviour of Materials.

COMS 1010(1) - COMMUNICATION SKILLS

Writing skills, non-verbal communication, modes of speech delivery and presentation aids, speeches, perception and listening skills, business and technical writing.

CSE 1010e(1) - INTRODUCTION TO INFORMATION TECHNOLOGY

IT and Computers; Stepping in the Computer; Input and Output Devices; Secondary Storage; Programming; Systems Software; Applications Software; Systems Development; Computer Networks; The internet; Computer Security; Software Utilities; Issues and Trends in IT.

CSE 1020(1) - COMPUTER PROGRAMMING

Basic types; arithmetic & logical operators and expressions; decision and loop structures; arrays (one-dimensional and two-dimensional); functions; value and reference parameters. Files: creation, opening, writing, closing; introduction to structures data types.

ECON 1015(1) - ECONOMICS

Microeconomics: Economics and the Economy; Demand, Supply and the Market; Elasticity Concept; Theory of Consumer Choice; Theory of Supply: Costs and Production; Market Structure; Labour Market; Introduction to Welfare Economics.

Macroeconomics: Introduction, National Income Accounting; Determination of National Income Equilibrium; Aggregate Demand; Fiscal Policy and Foreign Trade; Money and Banking; Monetary and Fiscal Policy; Unemployment; Inflation; Economic Growth.

MATHS 1111(1) - MATHEMATICS 1 (PR: A-Level Mathematics)

Calculus of one and several variables; Polar Coordinates; Complex Numbers; Hyperbolic Functions; Limits; Ordinary Differential Equations.

MATHS 1211(1) - MATHEMATICS 2 (PR: A-Level Mathematics)

Matrix Algebra: Matrices and Determinants; Solution of Linear Systems of Equations; Eigenvalues and Eigenvectors; Infinite Series: Comparison test and ratio test for non-negative series; Vector Algebra: Scalar and Vector Products, Triple Products; Vector Equations; Vector Analysis: Gradient, Divergence and Curl; Line and Multiple Integrals; Green's Theorem in the Plane; Divergence Theorem and Stoke's Theorem.

MATH 1231(3) - PROBABILITY & STATISTICS

Elementary Probability; Conditional Probability; Discrete and Continuous Distributions; The Central Limit Theorem; Introduction to Linear Regression; Estimation and Hypothesis Testing.

MATH 2001Y(3) - MATHEMATICS 3

Laplace and Fourier Transforms; Numerical Solutions of Differential Equations.

MECH 1111(1) - ENGINEERING GRAPHICS I

Introduction to Drawing Office Practice, BS 308, etc; Geometrical Constructions; Introduction to Development (Prisms, cylinders, etc); Orthographic Projection (systems of projection); Dimensioning and Tolerancing; Sections and sectional views; Isometric Projection; Standard Parts (Threading, Fasteners, etc); Introduction to Assembly Drawing.

Computer Aided Drafting: Introduction to the AutoCAD Window Environment, Basic Drawing & Editing Commands, Layers, Blocks, Managing Object Properties, Plotting, etc.

MECH 1213(1) - APPLIED MECHANICS

Statics; Dynamics; Friction; Work Power and Energy; Direct Stress and Strain; Shear and Torsion; Shear Force and Bending Moment.

MECH 4163(5) - OPERATION RESEARCH 1

Linear Programming Techniques; Forecasting Techniques; Decision & Utility; Theory; Advanced Inventory Model; JIT Systems; Scheduling of Manufacturing & Service Systems; Queuing Theory; Network Models.

MGT 1063Y(3) - QUANTITATIVE & RESEARCH METHODS

Unit 1: Revision of Basic Maths, Functions & Graphs, Time Series Analysis, Linear Regression and Correlation, Applications of Progressions, Set Theory, Probability Theory, Representation of Data, Measures of Central tendency, Measures of Dispersion.

Unit 2: Problem and Hypotheses Formulation, Research Design, Data Collection Method, Data Collection Forms, Sample Design, Analysis and Interpretation of Data, Use of SPSS, Research Report.