education

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SUBJECT GUIDELINES

PHYSICAL SCIENCE

NQF Level 4

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PHYSICAL SCIENCE – LEVEL 4

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INTRODUCTION

A. What is Physical Science?

Physical Science focuses on investigating physical and chemical phenomena through scientific enquiry. By applying scientific models, theories and laws, it seeks to explain and predict events in our physical environment. This subject also deals with society's desire to understand how the physical environment works, how to benefit from it and how to care for it responsibly.

B. Why is Physical Science important in this programme?

Physical science plays an increasingly important role in the lives of all South Africans due to its influence on scientific, technological and engineering development, which underpins our country's economic growth and the social well-being.

Physical Science focuses on the scientific knowledge and principles used in the vast engineering and related technology context. The engineering subjects focus on the equipment, design and related communication applications, systems and processes used. This subject cuts across all engineering fields and the chemical industry, as all fields use both chemistry and physics.

The Physical Science curriculum must ensure increased access to scientific knowledge, scientific literacy and access to higher education in the context of engineering.

C. The link between Physical Science Learning Outcomes and the Critical and Developmental Outcomes

The Physical Science Learning Outcomes were adapted from the Critical and Developmental Outcomes and the relationships are indicated as follows:

- The practical assignments and all content represent Critical Outcomes 1 to 5 by focussing on process skills, scientific reasoning, critical thinking, problem solving and working effectively with others and individually. The activities are also reflected in Developmental Outcome 1.
- All content in the Subject Outcomes represent Critical Outcomes 4 and 5 by focussing on constructing, understanding and applying scientific knowledge. The content is also reflected in Developmental Outcomes 1 and 4.
- Subject Outcome 7 specifically represents Critical Outcomes 1, 3, 4, 6 and 7 as students show the ability to see the world as a set of interrelated systems by understanding the interrelationship between science, technology, society, ethics and the environment. The Subject Outcome is also reflected in Developmental Outcomes 2 and 3.

D. Factors that contribute to achieving Physical Science Learning Outcomes

Physical Science, as a subject, should:

- Enhance understanding of chemistry and physics in such a way that the understanding of these two bodies of knowledge complements each other.
- Give students the opportunity to work in A scientific manner to understand and deal with the natural and physical world in which they live and study.
- Stimulate students' curiosity, deepening their interest and allow them to reflect on the natural and physical world in which they study and live.
- Develop useful skills and attitudes that will prepare students for real-life situations.
- Develop insights and respect for different scientific perspectives and sensitivity to cultural beliefs and practices in society.
- Enhance understanding that the technological applications of the Physical Science should be used responsibly towards social, human, environmental and economic development both in South Africa and globally.

Progression in Physical Science is reflected in the differentiation of the problem-solving situations as they increasingly use less routine problem-solving skills and more higher order problem-solving skills. Increasing the problem-solving concepts need not increase the complexity of the problem.

Progression in the content of Physical Science is reflected in the increase in quantity and depth of understanding of the applied principles of the core content to develop a well-organised knowledge base.

Progression in the increased ability to analyse and evaluate the impact of science and technology on the environment and socio-economic development is reflected where knowledge of Physical Science is applied in everyday situations and industry.

1 DURATION AND TUITION TIME

This is a one year instructional programme comprising 200 teaching and learning hours. The subject may be offered on a part-time basis provided all of the assessment requirements set out hereunder are adhered to.

Students with special education needs (LSEN) must be catered for in a way that eliminates the barriers to learning, such as use of learning material with bigger font, access to classrooms and venue for practical sessions, and others.

2 SUBJECT LEVEL FOCUS

Describe, analyse and apply scientific and technological knowledge, the nature of science and its relationship to technology, society and the environment.

Range of scientific and technological knowledge includes mechanics, waves, electricity and magnetism, matter and materials, chemical changes and chemical systems in the industry

Associated Assessment Criteria:
Process skills, scientific reasoning and strategies to investigate and solve problems in a variety of scientific, technological, environmental and everyday contexts are used by the student.
Scientific and technological knowledge are stated, analysed and applied in scientific and technological contexts.
Impact of scientific knowledge on the quality of human, environmental and socio-economic development is identified and critically evaluated.

3 ASSESSMENT REQUIREMENTS

This subject also strives towards the preparation of a student with a range of skills, supplemented by a broad knowledge base, a positive attitude and values that will ultimately serve the student to become an economical active, responsible and a participating member of society.

Achievement in this subject will be assessed internally, with various assessment tools measuring different skills, knowledge and values, as well as externally for maintaining standard.

The assessment consists of two components:

- formative assessment (site-based assessment) during the year that is internally set and assessed and externally moderated and reflected in a Portfolio of Evidence; and
- summative assessment at the end of the year that will be externally set, internally marked and externally moderated.

The assessment programme can be summarised as follows:

PROGRAMME OF ASSESSMENT (100 marks)			
INTERNAL SITE-BASED ASSESSMENT (completed during the year) **50% (100 marks)** -presented in Portfolio of Evidence		**SUMMATIVE ASSESSMENT** (completed at the end of the year) **50% (100 marks)**	
Tasks	**Value**		
• 1 mark consisting of 2 control tests.	10	• Theoretical examination consisting of 2 papers:	**Value**
• 1 exam (mid-year).	20	Paper 1	200
• 1 mark consisting 2 assignment – research tasks	20	Paper 2	200
• ISAT	10		400/4
• 1 mark consisting of 4 practical tasks	40		
	100		

3.1 Internal assessment (50 percent)

3.1.1 Theoretical Component

The theoretical component will form 50 percent of the internal assessment.

The number and type of theoretical tasks are paced in the following year programme as follows:

Tasks	Term 1	Term 2	Term 3	Term 4
• 2 control tests each of 45 min	Test 1		Test 2	
• 1 mid year examination consisting of 1 paper of 1.5 hours		Exam		
• 2 research assignments that are industry related	Project		Project	

3.1.2 Practical Component

Practical investigation and performance tasks are set both on chemistry and physics equally.

These tasks are based on the theory for a comprehensive understanding of the content and integration of skills, values and attitudes.

A suggested year pacer is the following:

Tasks	Term 1	Term 2	Term 3	Term 4
• 2 practical tasks based on physics	Prac	Prac		
• 2 practical tasks based on chemistry		Prac	Prac	
• ISAT				ISAT

- **Definition of the term "Structured Environment"**

Structured environment for the purposes of assessment refers to
- a laboratory
- or classroom simulated as a laboratory
- or a class that is adapted for group work, clear escape route, space for apparatus set up and where chemicals and water can be used

- **Required skills for practical assessments tasks**

Conducting a practical task in a structured environment will involve some of the following seven skill areas are:
1. Group work skills
2. Manipulative or procedural skills – the way experiments are performed*
3. Write-up skills – the layout of a practical report
4. Observation and measuring skills
5. Recording skills – display of measurements
6. Interpretation skills – mathematical manipulation
7. Skills to interpret results and conclusion

Skill areas 1 and 2 are assessed during practical assessment sessions.

All practical reports should have the following headings:

HEADING	DESCRIPTION
Aim or hypothesis	This clearly states what the experiment is about and the problem that you want to solve or investigate. The final result or conclusion of the practical has to be reflecting the aim.
Apparatus	A labeled diagram of the experimental set up or apparatus/ reactants listed.
Method	How the experiment was performed in point form.
Observation	What you have noticed, using your senses. Ticker tape dots spacing, bulbs brighter; colour changes, bubbles, smell and sound.
Results recorded	• A table must be used to record the data (measurements or observations) • In the table the heading must state the variable and its unit - it must be informative. • No units must be written with the recordings. • Experiments must be repeated to verify the results; if these differ, a second repeat must done in order to find the correct results. This will give three sets of readings, all noted in the table.
Interpretation of results	• A graph is used to interpret the data in the table. • The graph must have a title.

	• Appropriate axes must be used – the axes must be labeled and with the correct scale. • Look at the results in the table to see if there are any patterns or anything that supports or refutes the investigative question. • Calculations needed to manipulate the data or for explanations must be shown. • Explain, if possible, the result.
Conclusion	Mention if the data and interpretations answered the investigative question. The following questions should also be answered in the conclusion: • Did the results/data support the hypothesis? • Can (and if, what) predictions be made from the results/data? • What sources of error could have influenced the result? • Should (and if, what) safety / hygienic measures be taken?

- **Evidence in practical assessments**

All evidence pertaining to evaluation of practical work must be reflected in the student's Portfolio of Evidence. The assessment instruments used for the purpose of conducting such assessments must be part of the evidence contained in the PoE.

- index;
- all continuous assessment tasks and the evaluation of each task;
- declaration of own work done by the student.

For the Portfolio of Evidence to be regarded as valid evidence an officially assigned supervisor must sign it off.

3.1.3 Processing of internal assessment mark for the year

Calculation of a year mark consisting of the internal assessment tasks as indicated in the table below is suggested:

	Tasks	Total marks	Value
Questionnaire	• 2 control tests:	2 x 50 = 100	10
	• 1 mid year examination consisting of 1 paper	200	20
Research	• 2 assignments: 1 based on physics and 1 on chemical content; both related to industry	2 x 20 = 40	20
Practical (hands on skills)	• 2 physics practical tasks	2 x 25 = 50	40
	• 2 chemistry practical tasks	2 x 25 = 50	
	• ISAT	1x20	10
	Total for Site Based-Assessment		100

3.1.4 Moderation of internal assessment mark

Internal assessment is subject to both internal and external moderation procedures as contained in the *National Examinations Policy for FET College Programmes*.

3.2 External assessment (50 percent)

A national examination is conducted annually in October or November each year by means of two papers set externally and marked and moderated internally.

External assessment details are set out in the *Assessment Guidelines: Physical Science* (Level 4).

4 WEIGHTED VALUES OF THE TOPICS

TOPICS/TOPICS	WEIGHTED VALUE
PAPER 1	
1. Measurements	5%
2. Mechanics	40%
3. Waves, sound and light	20%
4. Electricity and magnetism	35%
TOTAL	**100**

PAPER 2	
1. Matter and materials	45%
2. Chemical change	50%
3. Chemical systems and industry	5%
TOTAL	**100**

5 CALCULATION OF FINAL MARK

Continuous Assessment: Student's mark/100 x 50/1 = a mark out of 50 (a)

Theoretical Examination Mark: Student's mark/100 x 50/1 = a mark out of 50 (b)

Final Mark: (a) + (b) = a mark out of 100

All marks are systematically processed and accurately recorded to be available as hard copy evidence for, amongst others, purposes of moderation and verification.

6 PASS REQUIREMENTS

The student must obtain at least fifty (50) percent in ICASS and fifty (50) percent in the examination.

7 SUBJECT AND LEARNING OUTCOMES

On completion of Physical Science Level 4 the student should have covered the following topics:

Topic 1: Measurements
Topic 2: Mechanics
Topic 3: Waves, sound and light
Topic 4: Electricity and elctronics
Topic 5: Matter and materials
Topic 6: Chemical change
Topic 7: Chemical systems and industry

7.1 Topic 1: Measurement

7.1.1 Subject Outcome: Identify and apply symbols

Learning Outcomes:

Identify and use *Systeme Internationale* (SI) symbols and units correctly as applied at this level.
Identify hazardous warning symbols (related to chemical, radiation, electricity and other symbols).

Learning activities:

Integrate content with applicable topics of this level.
Worksheet: Identify correct units and symbols to be used in this level.
Research: Identify warning symbols used in laboratories or where chemicals are handled or transported; state where they are used and what danger do they represent. Give examples of chemicals that are classified under the symbols.

7.1.2 Subject Outcome 2: Conduct scientific investigations to collect, represent and interpret data.

Learning Outcomes:

Plan and conduct a scientific investigation to collect data systematically with regard to accuracy, reliability and the need to control variables.
Seek patterns and trends in the information collected and link it to existing scientific knowledge to help draw conclusions.
Present collected information and conclusions with relevant scientific arguments.

Learning activities:

Practical tasks: integrated with content of other topics in this level.

7.2 Topic 2: Mechanics

7.2.1 Subject Outcome 1: Interpret, evaluate and apply motion of free falling bodies.

Learning Outcomes:

Analyse, describe and solve problems on vertical motion presented in diagrams, equations and graphs.
Identify that gravitational acceleration is independent of the mass of an object.
Apply principles of projectile motion to diagrams and solve problems using equations of motion.

Learning activities:

Worksheet on bodies dropped or projected vertically upwards and caught again or objects projected at an angle from a height and then falling to ground.
Student practical: Determine "g". Drop object and record initial time of dropping and the time that it landed as well as distance covered.
Demonstration: Investigate which object will reach ground first:

-Two are masses at same height – one object is dropped the same time that another object is projected horizontally and allowed to fall – apply to missiles.

-Drop two masses of different magnitudes from the same height to illustrate that "g" is independent of mass.

7.2.2. Subject Outcome 2: State, explain, interpret and apply momentum and force.

Learning Outcomes:

Define and calculate momentum and the change of momentum of an object.
Define impulse (F_{nett} t) as the change in momentum and use $F_{nett}\ \Delta t = m\Delta v$ for calculations and problem solving.
Define Newton's 3rd Law and identify examples of interacting objects that exert equal forces on each other.
Define law of conservation of momentum and apply to collisions.
Identify and distinguish elastic and inelastic collisions; refer also to conservation of kinetic energy.

Learning activities:

Worksheet: Contextualise calculations of momentum and momentum change on sport; use law to solve problems dealing with car crashes, explosions etc.

Practical**:** Determine if the collision between two trolleys is elastic; or use a mass falling on a trolley.

Research: Identify three different applications of Newton's 3rd Law; identify the force on each and the effect of the forces.

7.2.3 Subject Outcome 3: Define, interpret and apply principles of work, power and energy.

Learning Outcomes:

Define work and identify examples where no work is done by an applied force.
Calculate work done on an object and/or system for vertical and horizontal displacement.
Define, interpret and calculate mechanical power.

Learning activities:

Work sheet to determine work done when an object is lifted; work done by an object falling through glass; work done on an object landing in water or in sand; work done on a moving object by friction of a surface etc.

Assignment: Identify examples of moving objects where there is no mechanical work; discuss the work done and power by cranes and earth moving equipment.

Class test.7.2.4 Subject Outcome 4: State, evaluate and apply mechanical advantage.

Learning Outcomes:

Define torque and identify its application on simple machines.
Describe and identify the mechanical advantage in a wheel and axle.
Define a pulley and distinguish between fixed and movable pulleys.
Identify and describe the mechanical advantage for pulleys and belt systems.
Define gears and gear trains and distinguish between gears and pulleys
Identify, analyse and apply law (equation) of simple machines on pulleys (hoist) to determine the mechanical advantage.

Learning activities:

Worksheet: Identify and determine the mechanical advantage in a pulley, belt system and gears or gear trains.

Research: Find applications of mechanical advantage where pulleys, belt system and gears are used; state also the type of mechanical advantages.

Demonstration: Show the mechanical advantage using pulleys, belt system or a set of gears; or find the mechanical advantage using more than one pulley when lifting a heavy mass piece.

7.3 Topic 3: Waves, sound and light

7.3.1 Subject Outcome 1: Describe and apply properties of waves on everyday life contexts.

Learning Outcomes:

Identify and describe the basic concepts of the Doppler-effect with sound and ultrasound.
Apply the Doppler-effect to radar and examples of sonic boom.
Define EM radiation; identify the EM spectrum and identify examples (light, radio waves, microwave, IR , UV and others) and their application.
Describe the dual nature of EM radiation; i.e. wave and particle nature.
Identify the relationship of wavelength to frequency to explain colour and energy of light.
Define lasers and give examples of its application.
Explain and apply the photo-electric effect give examples of its application.

Learning activities:

Worksheet: Describe Doppler effect used in radar, to explain the difference in pitch of sound of a passing ambulance; light, microwaves IR and UV identified as waves from EM spectrum; wave property of EM applied on light and the difference of energies identified; describe the photo electric effect.

Research: One of the following topics:

Find the use of Doppler-effect in industry e.g. radar (speed regulation, used for search and location, airport traffic control); or find examples of the effect of shock waves on structures, supersonic planes and high speed vehicles;

Find the wavelength of radio waves or microwaves and the different applications of the chosen wave.

Research laser technology- find out how lasers work, the different types of lasers and their applications.

Describe the photo electric effect and where it is applied.

Demonstration: Refer students to the change of sound of a police or ambulance siren; show photo voltaic cells.; use micro wave kits to demonstrate the wave property of EM waves.

7.4 Topic 4: Electricity and Electronics

7.4.1 Subject Outcome 1: State, explain, interpret and apply principles used in electrodynamics.

Learning Outcomes:

Identify and differentiate between stationary and moving electrical machines (generator and motor).
Describe the efficiency of stationary and moving electrical machines.
Define single-phase and three-phase and identify its applications.
Define and calculate energy transfer in an electrical circuit.
Define and calculate electrical power and identify its application on tools etc.
Determine the relationship between current, pd, resistance and power.

Learning activities:

Work sheet: Classify transformers, generators and motors as moving or stationary electrical machines; identify the type of energy transfer in the specified electrical machines. Identify the common specification use of three- phase and one phase. Calculate energy transfer, power of an electrical circuit or tools. State the relationship between A, V, R and P.
Research: Differentiate between motors and generators: how they work, energy transfer, sizes and their applications in industry.
Discussion: Best choice of electrical tool based on electrical specifications; Explain why you can watch TV if 2 phases are out.
Class Test

7.4.2 Subject Outcome 2: State and apply principles and components used in electronics.

Learning Outcomes:

Define capacitance and inductance and the application thereof.
Describe conduction in semi-conductors

Identify intrinsic properties and doping- properties by design.

Describe principles of the p-n junction.
Identify basic principles of digital electronics- logical gates.

Identify symbols and use of active circuit elements and identify components from circuit diagram.

Range: Active circuit elements are LED, diode, transistor and operational amplifier.

Learning activities:

Worksheet: Describe capacitances and inductance and give an example; describe doping and write a diagram showing p-n junction, explain the junction diode; Identify (And, or, Not- gates); draw a circuit and identify the symbols.

Practical: Assemble an electronic circuit from an instruction sheet (Oscillator can be included). Explain the function of the circuit.

7.5 Topic 5: Matter and materials

7.5.1 Subject Outcome 1: Identify and critically evaluate the impact of atomic nuclei on the quality of human, environmental and socio-economic development.

Learning ourcomes:

Describe the nuclear structure of an atom and its stability.
Define radioactivity and identify its particles and how it is measured.
Identify and evaluate examples of use in industry and the biological effects of radiation and safety.
Differentiate between nuclear fusion and nuclear fission and evaluate nuclear power.

Learning activities:

Worksheet: Define radioactivity, units of radioactivity and instruments identified, effects of radiation stated and safety levels indicated

Research: Radioactivity and its uses in industry (other than source of electrical energy), include human safety;

Nuclear power as a safe alternative source of energy is discussed in Topic 7.

7.5.2 Subject Outcome 2: State, evaluate and apply properties of fluids on every day life and industrial contexts.

Learning Outcomes:

Define and apply hydrostatic pressure and its relation to depth and density of a liquid.
Define, give examples of, and use Pascal's' principle.
Describe fluid flow and use a Venturi meter to show the relationship between pressure, cross-section of the pipe changes speed of fluid flow.

Learning activities:

Work sheet: Define and apply hydrostatic pressure using examples; define Pascal's principle and apply on examples; describe fluid flow, the effect of pressure and cross-section of the pipe changes speed of fluid flow.

Research: Write a report on a case study of industrial application of Pascal's principle, and Bernoulli's principle in fluid flow.

Demonstration: Refer students to increase of pressure experienced by deep sea diving; show the flow of a liquid in clear pipe- system of different diameters.

7.5.4 Subject Outcome 4: Identify and apply knowledge of organic molecules in every day life and industrial context.

Learning Outcomes:

Identify organic molecular structures - functional groups, saturated and unsaturated structures, isomers.
Define hydro carbon and organic molecules and identify its use as fuels.
Identify fractional distillation of crude oil as a source of different fuels.
Identify physical property as the effect of chain length and give examples.
Identify functional groups, saturated and unsaturated structures of organic molecules and relate it to chemical properties.
Name (IUPAC) organic molecules and write the structural formulae down; identify isomers.
Describe plastics and polymers refer to related South African industry.
Describe thermoplastics and thermo set.

Learning activities:

Worksheet: Identify and write structural formula down of stated molecules; identify the phase of the hydrocarbon using chain length; identify chemical properties of the functional groups; describe plastics and polymers and thermo plastics.

Research: Identify the type of plastic or polymers manufactured in the South African polymer industry and name a few applications.

7.6 Topic 6: Chemical change

7.6.1 Subject Outcome 1: Identify and apply knowledge of acids and bases.

Learning Outcomes:

Define acid, base and identify buffers using definitions of Arrhenius and Lowry Bronstaed.
Identify and apply pH values.
Write neutralisation (acid-base) reaction down and calculate unknown value.
Identify the use of indicators and titration.
Identify industrial acids and alkali and their application.

Learning activities:

Worksheet: Identify a chemical as an acid or base using Arrhenius and Lowry Bronstaed definitions; the meaning of pH values.

Practical: Plan and conduct a titration to determine unknown concentration and use indicators correctly.

7.6.2 Subject Outcome 2: Identify and apply knowledge of electrochemical cells.

Learning Outcomes:

Define oxidation, reduction, cathode, anode and electron transfer.
Write oxidation and reduction half reactions.
Describe the purpose a sacrificial anode and corrosion of metals and write reactions down to illustrate.
Describe an electrochemical cell and identify examples in every day life/ industry.
Draw and label an electrochemical cell and determine cell potential and compare with cells used in everyday life (Li, Cd, Pb- cells).

Learning activities:

Worksheet: Identify oxidation and reduction reactions and identify the transfer of electrons, cathode and anode described, sacrificial anode identified from examples, cell

Practical: Construct an electrochemical cell and determine the potential difference.

Assignment: Corrosion of metals and examples and purpose of sacrificial anode and corrosion protection; or research examples of batteries and or electrochemical cells.

7.6.3 Subject Outcome 3: Describe, analyse and apply the rate and extent of chemical reaction.

Learning Outcomes:

Define rates of reactions and identify factors effecting rate and refer to examples.
State mechanism of reaction and of catalysis.
Define chemical equilibrium and identify conditions for equilibrium.
Identify factors affecting equilibrium apply and evaluate the effect on chemical reactions using Le Chatelier's principle.
Define and interpret equilibrium constant.

Learning activities:

Worksheet: Identify the factors that affects the rates e.g. dust in coal mines or flour mills, accelerators or catalysts used in fibreglass and cement; differentiate between rates of reaction and equilibrium; identify the effect on products produced if concentration, pressure and temperature of a chemical reaction is varied. Use and interpret the value of equilibrium constant.

Practical: Conduct a practical to determine the effect of change in surface area/ concentration/ temperature on the rate of chemical reaction.

Assignment: Discuss the effect of temperature and accelerators on cement, fibreglass and metals in terms of rate of chemical reactions.

7.7 Topic 7: Chemical systems and industry

7.7.1 Subject Outcome 1: Identify and critically evaluate the impact of exploiting the lithosphere on the quality of human, environmental and socio-economic development.

Learning Outcome:

Identify and evaluate the energy resources, their use, pollution and renewability.
Range: Coal, oil, gas, solar, hydro, wind, electrochemical, nuclear, geothermal, vegetative and other energy sources.

Learning activities:

Worksheet: List the natural resource, how the energy is transferred to electrical or mechanical energy and its pollution.

Group discussion: Assess the impact using the different energy sources on the environment. Select the best option in your area to enhance the quality of human and sosio-economic development

7.7.2 Subject Outcome 2: Identify and critically evaluate the impact of scientific knowledge on the chemical industries and the quality of human, environmental and socio-economic development.

Learning Outcomes:

Study the following industrial examples with appropriate topics in terms of resources, needs and the chemical connection:

- Organics: Sasol, Polyfin (monomer and polymers); petroleum industry, paint and adhesive industry.
- Acids and Alkali: Chloralkali (soap, PVC etc), cement (Lafarge and PPC), mines (extraction of ore), explosives (AECI), fertilizer industry (N, P, K).
- Redox reactions: Electrochemical and battery industriesIdentify and critically evaluate the impact of scientific knowledge on the chemical industries and the quality of human, environmental and socio-economic development.

Learning activities:

Compulsory research: Identify and critically evaluate the impact of one of the South African chemical industries and its effect on the quality of human, environmental and socio-economic development.

RESOURCE NEEDS FOR THE TEACHING OF PHYSICAL SCIENCE – LEVEL 4

7.1 Human Resources

The lecturer should be proficient in physics as well as chemistry. The lecturer must be (or become) familiar with the engineering and industrial context applicable to Physical Science and the OBE teaching and assessment principles.

A laboratory assistant may be needed if this is justified according to the number of students and classes.

Other Resources

Learning and training material needed are the following:
Lecturers will need general teaching materials
Students will each need textbooks or guidelines
Each student will need a portfolio file and the necessary paper
Each classroom will need wall charts (in particular the Periodic Table), a board ruler and pair of compasses, and any other equipment and materials that the lecturers considers necessary

Physics	
Mechanics/motion	• Air track & accessories • Air blower Or • Track, 2x trolleys, pulley, ticker timer, carbon disks and tape • Stop watch • Power supply
Gears	• Set of gears
Waves	• Microwave kit • Light kit • Oscilloscope
Electricity Electrostatics	• Circuit board Worcester and accessories, batteries • Resistors, rheostat sliding • Voltmeter, ammeter • Leads croc-croc clips • Bridge rectifier, wheat stone bridge • Capacitance sub box, diode tube , electrolytic capacitor • Electronics kit or UNILAB alpha electronics kit

Chemistry	
	• Thermometer
	• Retort stand, clamps & boss head

	• Crucible tongs • Test tube brushes • Safety goggles • Filter paper • Paper towel & dispenser • Disposable plastic syringes • Rubber tubing • Rubber stoppers for flasks& test tubes • Cork borer • Wash bottle • spatula	
Glassware	• Beaker squat 50 cc, 100 cc , 250 cc, 1000cc • Erlenmeyer flask 250 cc • Volumetric flask 50cc,100 cc, 250 cc, 1000 cc • Test tubes • Funnel • Watch glass • Pipette • Burette • Measuring cylinders 25 ml, 50ml, 250ml • Water trough • Mortar & pestle • Medicine droppers • Bottle dropper • Reagent bottles	
Chemicals	• acetic acid • ammonia sol 25% • ammonium chloride • bromothymol blue • carbon • calcium hydroxide • calcium carbonate marble • calcium powder • cobalt chloride • copper sulphate • copper metal turnings • hydrochloric acid 32% • iodine crystal • iron sulphide • steel wool • iron(iii)chloride • lead nitrate • litmus paper	• itmus solution • magnesium ribbon • magnesium sulphate (Epson salts) • methyl orange • phenolphthalein • potassium hydroxide • potassium permanganate • propanoic acid • sodium carbonate • sodium bicarbonate • sodium dichromate • sulphuric acid • universal indicator • xylene • zinc granular • zinc carbonate