# Gem-A Foundation in Gemmology Specifications







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## Introduction

The Gem-A Foundation in Gemmology Course (In this document, referred to as the Foundation course) leads to the Gem-A Level 4 Certificate in Gemmology qualification.

This course is designed to encourage and enable students to:

- Create and sustain interest in and enjoyment of gemmology both for those students not studying beyond this stage and for those continuing their studies in gemmology and related fields. (The Foundation course is a requirement for those wishing to progress to Gem-A's Diploma in Gemmology course.)
- Provide students' with a scientific knowledge of gemmology and make a contribution towards life-long learning for students working in and around gemstone- and jewellery-related jobs.
- Prepare students to work and develop their careers in gemstone and jewellery related jobs.
- Develop essential knowledge and understanding of the principles of gemmology.
- Gain an appreciation for the characteristic and identifying features of the gemstones found commonly within the gem trade.
- Appreciate the gemstone pipeline from origin to cut stone.
- Handle confidently rough and cut gem materials.
- Report clearly results and conclusions.
- Achieve the Gem-A Level 4 Certificate in Gemmology.

## Entry Requirements

Students are not required to have prior knowledge or experience of gemmology to study this course, although beginners or those with no existing gemmology knowledge, may find it useful to study Gem-A's GemINTRO course as a first step.
Students must be aged at least 18 when they start their course. Students need to be proficient in the language (in listening, speaking and writing) in which they will be studying and assessed and may be asked to provide evidence of this. The end-of-course assessment is an in-person two-paper written examination.

## Certification Title, Level and Learning Hours

This course leads to Gem-A's Certificate in Gemmology (Ofqual 600/7103/5).
This qualification is Level 4 on the UK Regulated Qualifications Framework.
There will be a minimum of 18 Guided Learning Hours, and the total qualification time is up to 200 hours.

## Learning Outcomes

By the end of the course, students should be able to demonstrate that they can:

1. **Knowledge and understanding**
    - Recognise, recall and show understanding of specific gemmological knowledge, including;
        - Describe the chemical, optical and physical properties, as well as uses of gem materials.
        - Describe the various stages of the gemstone pipeline, including geology and formation, mining, fashioning and understanding laboratory reports.



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- Understand and explain the processes of common treatments of gem materials and the production of synthetics.

2. Skills
   - Demonstrate the use of basic gem testing equipment and report on the observations and results of tests on gemmological specimens.
   - Identify common gem materials on the Foundation syllabus.
   - Compare and contrast the features and properties of natural, artificial, synthetic and treated materials on the Foundation syllabus.
   - Apply knowledge of gemstones to their care and commercial use.
   - Explain the value and price factors of gemstones.

## Scheme of assessment

Students need to complete coursework and an end-of-course examination:

| Title | Mode of Assessment | Duration | Weighting |
|---|---|---|---|
| Assessed coursework | Coursework | - | 10% |
| Practical endorsement | Coursework | - | Completion required |
| Foundation paper 1 | Written examination | 2 hours | 45% |
| Foundation paper 2 | Written examination | 2.5 hours | 45% |

### Assessed coursework

Gem-A approved Foundation tutors and/or approved practical providers assess students' Coursework and Gem-A carries out external moderation. The coursework is broken into four blocks of study and a practical endorsement.

*Online assessment*
Students complete each block of study with an online assessment.
This assessment contains short questions including multiple choice (computer marked) and questions requiring more open-ended responses (tutor marked).

*Practical endorsement - Demonstrating the ability to use the standard gemmological instruments*
All students will attend in-person practical sessions with a Gem-A approved tutor.
Students need to be able to demonstrate the use of standard gemmological instruments, as well as make observations and measurements with appropriate precision, and record these accurately and methodically.

Students will be observed on the following instruments and practical tasks:
- Crystal observation
- 10× loupe
- Refractometer
- Spectroscope
- Polariscope
- Dichroscope
- Chelsea colour filter (CCF)
- UV
- Conoscope
- Weight estimation
- General observation and testing.



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The Gem-A approved tutor will record that students have observed all necessary stones and equipment and completed necessary practical tasks. This evidence is compulsory for students to achieve the qualification.

End-of-course assessment

At the end of the course, students should be able to:
- Bring together principles and concepts from different areas of gemmology and apply them in a particular context, expressing ideas logically and using appropriate specialist vocabulary.
- Use gemmological observation and testing skills in contexts which bring together different areas of the subject.

This assessment is an invigilated written examination. The question papers at the end of the Foundation course have a common format and each paper includes short questions and questions requiring more extended answers.
- Paper F1 — Practical based examination - 2 hours
- Paper F2 — Theory examination - 2 ½ hours

Sample examination papers can be obtained in pdf format from the Gem-A education office by contacting education@gem-a.com.

Results and grades

Markings and grades are for the assessed coursework and both examination papers; these are added together to give one grade:

| Grade | % Limits | Result |
|---|---|---|
| A | 80 - 100 | Pass |
| B | 60 - 79 | Pass |
| C | 40 - 59 | Re-sit final exam |
| D | 20 - 39 | Re-sit final exam |
| E | 0 - 19 | Re-sit coursework and exam |

A and B are pass grades; C, D and E are fail grades.
Students receiving an E grade may be required to re-sit both their coursework and written examinations.

A special award may be given to the candidate who achieves the highest marks in the examination year. Gem-A may give more than one type of award. See Gem-A's website for further details on this.

## Course Contents

Foundation Block 1

Chapter 1 – Gemmology and Gems
Chapter 2 – Observation and Magnification
Chapter 3 – Materials and Structures
Chapter 4 – Durability

Foundation Block 2



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Chapter 5 – Weight, Density and Specific Gravity
Chapter 6 – Light and Optics
Chapter 7 – Colour
Chapter 8 – Other Gem Properties

Foundation Block 3

Chapter 9 – The Geology of Gems
Chapter 10 – The Gemstone Pipeline
Chapter 11 – Fashioning Gemstones
Chapter 12 – Gems and Jewellery

Foundation Block 4

Chapter 13 – Gemstone Treatments
Chapter 14 – Artificial, Synthetic and Imitation Gem Materials
The Gemstones – See detailed syllabus below for a list of gem materials covered

## Detailed Syllabus

This syllabus shows the possible areas of the subject which can be examined in the Foundation examination. Not all content will be assessed in each exam, and the full breadth and depth of the syllabus will be covered in assessments over time to make sure our exams retain their validity. All students need to cover the full syllabus. Practical observation techniques and the use of the hand-held gemmological equipment forms a very important part of this examination.
Due to the specialised nature of gemmology and the need for accurate and reliable study materials, Gem-A provides course notes to guide and assist students through the coursework and final examinations. For further information about the course materials provided as part of the course, please contact Gem-A.
The specific, relative level and amount of information required in the examination is also indicated by the potential marks printed next to each examination question.

- Chapter 1 – Gemmology and Gems

What is gemmology?
What is a gem?
Myths, legends and history
Where is gemmology used?
Gemmological practice

*After studying chapter 1, students will be able to:*

- Explain what gemmology is.
- Describe the attributes of a gemstone.
- Define the terms gem, gemstone, gem material, mineral, rock, biogenic, natural, artificial and synthetic.
- Describe the role of gemmologists and their field of work, and the gemmological practical approach.
- Describe the contents of the Gem-A gemmological instrument kit.



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- Chapter 2 – Observation and Magnification

Visual characteristics of a gem
    Colour, lustre transparency, shape and style of cut, measurements, optical effects
External and internal features
Reporting observations
Illumination and magnification

*After studying chapter 2, students will be able to:*

- Assess the visual characteristics of a gem as the initial part of the identification process.
- Methodically observe colour, lustre, transparency, shape and style of cut, measurements, optical effects, and external and internal features.
- Describe gem materials and create a gem report using diagrams.
- Understand and describe illumination, magnification, the 10× lens (loupe) and the microscope.

- Chapter 3 – Materials and Structures

The chemistry of gems
    Chemical elements, atoms and electrons
    The chemical classification of gems
The structure of gems
    Amorphous materials
    Crystalline materials
Crystal systems
    Crystallographic axes and symmetry
    The seven crystal systems
Describing crystals
    Crystal forms, crystal habits, surface features, twinning
Observation features
Important features of the Foundation course crystals

*After studying chapter 3, students will be able to:*

- Define the terms atom, element and chemical compound.
- Explain the meanings of the terms oxide, silicate and carbonate.
- Define the terms amorphous and crystalline materials and give examples of both.
- Define the terms polycrystalline and cryptocrystalline and give examples of both.
- Explain what is meant by reference axes.
- List and describe the seven crystal systems.
- Recognise and name the crystal forms, crystal habits and surface markings described in this chapter.
- Explain what is meant by twinning.
- Recognise, sketch and name types of twinning, including simple, lamellar, interpenetrant and cyclic twins, and be able to give an example of each.
- Sketch, describe and name crystals of those stones described in the chart of rough gem materials on the Foundation course syllabus.

- Chapter 4 – Durability

Hardness
Toughness
Stability
Summary of durability of some common gem materials



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Storing, wearing and display, cleaning, jeweller's studio

*After studying chapter 4, students will be able to:*

- Describe the significance of hardness.
- Explain the principles of the Mohs scale of hardness.
- Explain the significance of toughness, and define and recognise fracture and cleavage.
- Explain what is meant by stability.
- Apply durability knowledge to the identification, care, fashioning and setting of gem materials.

- Chapter 5 – Weight, Density and Specific Gravity

Units of weight
Weight and price
    Weighing loose stones
Density and specific gravity
Weight estimation of mounted materials
    Weight estimation formulae
    How to estimate the weight of a mounted stone
    Size versus weight

*After studying chapter 5, students will be able to:*

- Explain the concept of weight and its use in gemmology.
- Define and explain the concepts of density and specific gravity (SG) and their uses in gemmology.
- Estimate the weight of gems set in jewellery using weight estimation formulae.

- Chapter 6 – Light and Optics

Light energy and light waves
    Features of a wave
    The electromagnetic spectrum
Interactions of gem materials and light
    Reflection
    Refraction
    Total Internal Reflection (TIR)
    Unpolarised light and polarised light
    Light in solids
Observations and tests using optical properties
Internal reflection effects in gemstones
    Chatoyancy (cat's-eye effect)
    Asterism (star effect)
    Aventurescence
    Brilliance
Light and gemmological instruments
    The polariscope, the conoscope, the refractometer

*After studying chapter 6, students will be able to:*

- Describe light waves.
- Define wavelength, specify the position of visible light in the electromagnetic spectrum, and indicate the directions of propagation and vibration.
- Define and explain reflection.



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- Explain what is meant by refraction and refractive index.
- Distinguish between:
  - single and double refraction, using gemstone examples.
  - ordinary and polarised light.
  - double refraction and birefringence.
  - uniaxial and biaxial gemstones.
- Explain Total Internal Reflection (TIR).
- Describe and explain the cause of chatoyancy, asterism and aventurescence.
- Name and describe the use of polarising filters and explain what is meant by crossed polarisers.
- Describe a polariscope and its uses.
- Describe a conoscope and its uses.
- Describe a refractometer and its uses.
- Explain the usefulness of RI and birefringence in gem testing, using examples from the RI table at the end of the chapter.

- Chapter 7 – Colour

Light and colour in gemstones
    Body colour and selective absorption of light
    Colouring elements
    Dispersion
    Diffraction
    Iridescence
Absorption spectra and the spectroscope
Colour filters
The colour-change effect
Pleochroism
The dichroscope

*After studying chapter 7, students will be able to:*

- Describe the visible spectrum.
- Define and explain selective absorption in coloured gem materials.
- Name and define colouring elements, and explain how these elements affect the colour of gemstones.
- Define and explain dispersion, diffraction and iridescence.
- Describe a spectroscope, its uses and how to observe and record spectra using this instrument.
- Identify and describe twelve spectra.
- Explain what a colour filter is and how it is used in gem testing.
- Describe the Chelsea colour filter (CCF), its uses, and how to observe and interpret results.
- Explain the colour-change effect in some gemstones.
- Explain pleochroism and why it is important for gem testing.
- Describe the London dichroscope, its uses, and how to observe and interpret results.

- Chapter 8 – Other Gem Properties

The electromagnetic spectrum
    Gamma rays



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X-rays
Ultraviolet radiation
Infrared radiation
Luminescence
Fluorescence
Phosphorescence
Uses of UV radiation in gemmology
Uses of X-ray energy in gemmology
Uses of infrared energy in gemmology
Thermal properties
Electrical properties
Advanced testing in gemmological laboratories

*After studying chapter 8, students will be able to:*

- Explain how various frequencies of the electromagnetic spectrum (excluding visible light) can be used in gemmology.
- Define luminescence (fluorescence and phosphorescence).
- Describe the use of ultraviolet (UV) radiation in gem testing. Explain the use of X-ray luminescence and X-ray imagery in gem testing.
- Describe the use of thermal and electrical properties in gem testing, and their limitations.
- Understand when further testing in gemmological laboratories can be required and give examples of situations in which it might be needed.
- Briefly discuss the main advanced testing instruments (Raman, UV-Vis, FTIR and XRF spectrometers, as well as diamond screeners).

- <u>Chapter 9 – The Geology of Gems</u>

The Earth
The crust
Plate tectonics
Earth materials
Rock types and gem deposits
Igneous rocks
Pegmatite deposits
Diamond deposits
Metamorphic rocks
Sedimentary rocks
Gems forming in sedimentary rocks
Placer deposits
Hydrothermal deposits
Origin, occurrence and locality

*After studying chapter 9, students will be able to:*

- Sketch and briefly describe the core, mantle and crust of the Earth, with approximate depths.
- Give a simple account of plate tectonics.
- Define mineral, rock and glass.
- Describe briefly — and distinguish between — igneous, metamorphic and sedimentary rocks, giving examples of gems found in each.
- Briefly describe the following terms: pegmatites, volcanic diamond deposits, hydrothermal deposits and placer deposits (including alluvial deposits), and give examples of gems relevant to each term.



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- Define the terms geographical origin, occurrence and locality.

- Chapter 10 – The Gemstone Pipeline

Gem mining and recovery
- Primary and secondary deposits
- Mining coloured gemstones
- Mining diamonds
- Mine closure and rehabilitation

The gemstone pipeline
1. Mining and recovery
2. Rough gemstone dealers
3. Treaters and cutters
4. Cut gemstone dealers
5. Jewellery manufacturing
6. Retailers
7. Customers, and the second-hand market (auctions, jewellery dealers, pawnbrokers)

Ethical, responsible and sustainable gem sourcing

*After studying this chapter, students will be able to:*
- Describe the principles of coloured gemstone mining.
- Describe the principles of diamond mining and explain why and how it differs from that of coloured gemstones.
- Describe the route a gemstone might take from the mine to the customer (the 'gemstone pipeline').
- Discuss the issues surrounding ethical, responsible and sustainable gem sourcing.

- Chapter 11 – Fashioning Gemstones

Cutting styles
- Non-faceted styles
- Faceted styles

Choice of cut
- Yield, colour, transparency, fire and brilliance, clarity and inclusions, optical effects, double refraction, durability, and desirability

Lapidary

Appraising cut
- Symmetry
- Proportions
- Polish
- 'Native' cuts, commercial cuts and precision cuts

*After studying chapter 11, students will be able to:*
- Recognise the main non-faceted and faceted styles of cut.
- Understand the reasons why a particular shape and cutting style are chosen when fashioning a gem material.
- Understand the general process for faceting coloured gemstones.
- Understand how the quality of a cut is appraised.

- Chapter 12 – Gems and Jewellery

Gemstone settings and styles

Settings and traditional gem arrangement styles



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Jewellery metals
Silver, gold, platinum, palladium, and base metals
Responsibly sourced jewellery
Assaying and hallmarking
Appraising and valuing gems and jewellery
Types of valuations
Handling gemstone jewellery
Testing gems set in jewellery
Appraising gemstone quality and understanding value factors
Price guides

*After studying chapter 12, students will be able to:*

- Recognise the main gem settings and styles in jewellery and discuss the reasons for choosing a gem setting or particular style.
- List the main metal alloys used in gem-set jewellery and explain the use of hallmarking and assaying.
- Describe the different types of valuation.
- Explain the process of taking in gemstone jewellery for valuation and/or repair.
- Describe ways to test gems set in jewellery and the difficulties which might be encountered.
- Discuss the value factors which should be considered when assessing and valuing gems and jewels.
- Explain how to use, and check, diamond grading and gem identification reports.
- Discuss the uses and limitations of price guides in jewellery valuation.

- Chapter 13 – Gemstone Treatments

Disclosure of treatments
Foiling
Bleaching
Dyeing
Surface coating
Impregnation
Fracture filling
Opal, Emerald, Corundum, Diamond
Heat treatment
Amber, Corundum, Aquamarine, Quartz, Topaz, Tourmaline, Zircon, Zoisite, Tanzanite
Diffusion treatment
Irradiation
Topaz
Safety of irradiated materials
Laser treatment of diamond
Laser drilling and KM laser treatment

*After studying chapter 13, students will be able to:*

- Define the term 'treatment'.
- Explain the importance for disclosure of treatments.
- List and define the most common types of treatments (foiling, coating, bleaching, dyeing, impregnation, fracture filling, heat treatment, surface diffusion, irradiation and laser treatments).
- Explain why and how treatments are carried out on certain gemstones.
- Detect different treatments in gems using observation and standard gemmological tests.



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- Explain the limits of standard tests and understand when further advanced testing is necessary.

- Chapter 14 – Artificial, Synthetic and Imitation Gem Materials

Terminology
Synthetic materials
    Crystal growth from a melt: The Verneuil flame-fusion method
    Crystal growth from a solution
        Flux method
        Hydrothermal method
Synthetic diamond
Artificial imitations
Composite gem materials

*After studying chapter 14, students will be able to:*

- Define and distinguish between the terms natural, artificial and synthetic.
- Understand and define the terms imitation, composite materials and pressed materials.
- Define and describe the Verneuil flame-fusion (VFF) method- and identify materials that are made using this process.
- Define and briefly describe the solution growth methods — namely flux method and hydrothermal method — and identify some materials that are made using these processes.
- Name and identify the following materials either practically or from images of diagnostic features: synthetic corundum (Verneuil flame fusion and flux -grown), Verneuil flame-fusion synthetic star corundum, Verneuil flame-fusion synthetic spinel, flux-grown synthetic emerald and hydrothermal synthetic emerald.
- Name methods of synthesising diamonds (including HPHT and CVD methods), and name key features that can help to preliminarily identify some synthetic diamonds.
- Name and identify some types of imitation materials, including common composites and pressed materials.

- The Gemstones

| | | |
|---|---|---|
| Amber | Jades: Pyroxene jade, Jadeite/Fei Cui | Turquoise |
| Beryl | Jades: Nephrite | Zircon |
| Chrysoberyl | Lapis lazuli | Zoisite, tanzanite |
| Corundum | Malachite | |
| Diamond | Opal | |
| Feldspar | Pearl | |
| Fluorite | Peridot | |
| Garnet | Quartz | |
| Glass (artificial) | Spinel | |
| Iolite | Topaz | |
| Ivory (elephant and mammoth) | Tourmaline | |



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*After studying The Gemstones, students will be able to:*

- Name and describe the gems on the Gem-A Gemmology Foundation course syllabus, including:
    - Colours and varieties
    - Appearance
    - Chemistry and structure
    - Durability
    - Fashioning
    - Treatments
    - Synthetics
    - Materials with a similar appearance
    - Origin, occurrence and localities
    - Quality factors
- Understand their characteristic features and the most relevant tests used to identify these gems.
- Understand the characteristic features of, and be able to describe and identify, the main artificial and synthetic materials on the course syllabus.

## Further Information

Other related documents available from Gem-A:

- Prospectus which includes information on course fees and examination dates – see www.gem-a.com/education
- Sample past examination papers and exam reports
- Gem-A Student Policies including:
    - Reasonable adjustments and special considerations policy and procedures
    - Absenteeism, Engagement and Attendance policy
    - Equality and Diversity policy
    - Recognition of Prior Learning and Exemptions policy

Progression:

On successful completion of the Foundation course, students may apply to continue their education with Gem-A's Level 6 Diploma in Gemmology. Other courses from Gem-A include the Level 5 Diploma in Gem Diamond.

Beyond the Gemmology Diploma, the Federation of European Education in Gemmology (FEEG), of which Gem-A is a founding member, offers a qualification open to candidates who have already achieved a Gemmology Diploma delivered by one of the FEEG member associations. Birmingham City University, School of Jewellery, offers a BSc (Hons) Gemmology and Jewellery, and holders of both the Gem-A Diploma in Gemmology and Diploma in Gem Diamond may apply for entrance directly into the third year of this programme. This list is not exhaustive and is subject to change.



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