

AC 27/2/13

Item no. 4.61

UNIVERSITY OF MUMBAI



Syllabus for Sem V & VI

Program: B.Sc.

Course: GEMMOLOGY

(Applied Component)

(Credit Based Semester and Grading System with effect from the academic year 2013–2014)

| Course | | | | |
|------------|-------|--------|---------|-------------------|
| USACGEM601 | Units | Topics | Credits | Lectures/ week |

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| | I | Gem enhancement and synthesis | 2 | 4 |
| | II | Laboratory equipment and methods. | | |
| | III | Fashioning of Gemstones | | |
| | IV | Descriptive Gemmology (excluding Organic gemstones) | | |

Practicals

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|-------------------|------------------------------------|----------|----------|
| USACGEM6P1 | Gem properties and characteristics | 2 | 4 |
|-------------------|------------------------------------|----------|----------|

**T.Y.B.Sc.
Applied Component
Gemmology
Credit Based Semester and Grading System
To be implemented from the Academic year 2013-2014**

**SEMESTER V
Theory**

| Course code | Essentials of Gemmology | | | |
|--------------------|--------------------------------|---|----------------|----------------------|
| USACGEM501 | Units | Topics | Credits | Lectures/week |
| | I | <p>History of Gemmology: The evolution of the science of gemology Gems as inorganic and organic natural products possessing special qualities (beauty, rarity, durability). The Geological Sources of Gems Rocks and processes that formed them. Gem regions. Gem recovery methods.</p> <p>Crystal Chemistry Cryptocrystalline, massive and metamict states. Atoms, ions and chemical bonding</p> | 2 | 4 |

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| | <p>Isomorphism, polymorphism, pseudomorphism and exsolution.</p> <p>Units of Measurement: Metric carat, pearl grain, kilogram, gram, milligram, meter, millimeter, micrometer, nanometer, Angstrom, litre, milliliter.</p> | | |
| II | <p>Mineralogy of gemstones Crystalline and amorphous materials.</p> <p>Mineral: forms, habits, twinning, and growth patterns of crystals, polycrystalline and metamict minerals</p> <p>Physical Properties: Hardness: definition, Mohs' scale, selection of reference minerals, application in gemmology, limitation of use, differential hardness.</p> <p>Cleavage: definition, description, importance in gemmology and lapidary work.</p> <p><u>Specific Gravity</u> Definition, determination, hydrostatic weighing using two-pan and single-pan balance, construction and use of balance, heavy liquids (bromoform, methylene iodide, sodium polytungstate and Clerici solution), flotation and pycnometer method</p> | | |
| III | <p>Optical properties - Reflection & Refraction: Nature of colour: absorption of light, allochromatism, idiochromatism</p> <p>Lustre, sheen, chatoyancy and asterism in gemstones, play of colour, dispersion, metamerism,</p> | | |

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| | <p>use of Chelsea colour filter, cross filter test. 10 X lens, construction and use of microscope and its other optical applications.</p> <p><u>Reflection and Refraction</u> Reflection: laws of reflection, importance in gemmology. Refraction: laws of refraction, refractive index, total internal reflection, use and design of refractometer, measurement of R.I. and birefringence by refractometer and other methods. Isotropism and Anistropism in gemstones, anomalous double refraction, optic axes.</p> | | |
| <p style="text-align: center;">IV</p> | <p><u>Optical Properties- Polarisation and Absorption</u> Nature and production of polarized light, design and construction of polariscope and its use in gemmology. Differential absorption of light, pleochroism, dichroscope, construction and use; spectroscope – construction and use, absorption spectra, other spectroscope versions, interference and diffraction.</p> <p><u>Luminescence</u> Fluorescence and phosphorescence, photoluminescence and Stoke’s law, Applications of ultra-violet and X-rays to gem testing. Other forms of luminescence. Magnetic and electrical properties: electro conductivity, piezoelectricity, pyroelectricity, triboelectricity, photoconductivity. Thermal conductivity and thermal</p> | | |

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| | | conductivity meter. | | |
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Practicals

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| USACGEM5P1 | Gem Properties and Characteristics | 2 | 4 |
| | 1. Study of mineral forms, habits; and growth features of various gemstones. 2. Specific gravity problems. a) Hydrostatic method, b) comparison of specific gravity of gemstones. 3. Refractive Indices problems a) Isotropic stones, b) Uniaxial stones, c) Biaxial stones. 4. Weight Estimation Problems 5. Study luminescence and absorption spectrum of gemstones. | | |

Reference Books

1. Read P.G. (2005), Gemmology (3rd edition), Elsevier.
2. Webster R. (1976), Practical Gemmology (6th edition), NAG Press.
3. Anderson B.W. (1990), Gem Testing (10th edition), Butterworth & Co. Ltd.
4. Schumann W. (2010), Gemstones of the world (4th edition), Sterling Pub. Co. Inc.
5. Webster R. (revised by Anderson B.W.) (1995), Gems (4th edition), Butterworth-Heinemann.
6. O'Donoghue M. and Joyner L. (2003), Identification of gemstones, Butterworth-Heinemann.
7. O'Donoghue M. (2006), Gems: their sources, description and identification (6th edition), Elsevier.
8. Matlins A. L. and Bonanno A. C. (1997), Gem Identification Made Easy, Gemstone Press.
9. Robbins M. (1994), Fluorescence: Gems and Minerals under Ultraviolet Light, Geoscience Press.
10. Arem J.E. (1987), Color Encyclopedia of Gemstones (2nd edition), Chapman and Hall.
11. Newman Renee (2003), Gemstone Buying Guide: How to evaluate, identify, select and care for colored gems, International Jewelry Publication.
12. Korbel P. and Novak M. (2001), The complete encyclopedia of minerals, Grange Books PLC.
13. Schneider Stuart (2011), Collecting fluorescent minerals, Schiffer Pub. Ltd.
14. Liddicoat R. T. (1989), A handbook of gem identification (12th Ed.), rev. Santa Monica CA: Gemological Institute of America.

SEMESTER VI

Theory

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| Course code | Gemstone Identification |
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| | Units | Topics | Credits | Lectures/ week |
|------------|-------|--|---------|-------------------|
| USACGEM601 | I | <p>Gem enhancement and synthesis Methods of staining, heat treatment, diffusion treatment, fracture filling, cavity filling, coatings, dyeing, laser drilling, atomic irradiation and their detection</p> <p><u>Synthesis of gemstones</u> Methods of manufacture: flame-fusion (Verneuil), flux-melt, hydrothermal, crystal-pulling (Czochralski), skull-crucible method, zone melting, diamond synthesis, thin diamond films, carbon vapour deposition (CVD), ceramic techniques.</p> <p>Gemstone simulants: Glass, plastics, diamond simulants, assembled or composite stones</p> | 2 | 4 |
| | II | <p>Internal features in Gemstones Growth lines and colour zoning, twinning, types of inclusions. Identification features of natural gemstones, synthetic gemstones and simulants based on localities and process.</p> <p>Laboratory equipment and methods. Electron microprobe, scanning electron microscope, spectrophotometers, Raman spectroscopy, Quantitative cathodoluminescence. X-ray equipment.</p> | | |

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| <p style="text-align: center;">III</p> | <p>Fashioning of Gemstones Cutting styles, critical angle, composite stones, gemstone polishing, lapidary techniques and gemstone carving.</p> <p>Diamonds: Diamond cutting and polishing methods, diamond grading including cut, colour, clarity and carat weight.</p> <p><u>Organic products</u></p> <p>Organic products: Pearls – native and cultured (nucleated and non-nucleated), their formation, structure, and identification with the help of pearl microscope, endoscope, x-ray photography and diffractometry (lauegrams).</p> <p>Other organic products and simulants identification, including amber, coral, jet, ivory, tortoise-shell, ondontolite, shell, vegetable ivory, operculum and fossils.</p> | | |
| | <p>Descriptive Gemmology (excluding Organic gemstones) Includes crystallography, chemical composition, physical and optical properties, inclusions, enhancements and diagnostic features.</p> <p>IV</p> <p>Important gemstones including beryl, chrysoberyl, corundum, diamond, garnet, jadeite, opal, spinel, topaz, tourmaline, zoisite,</p> <p><u>Less Important gemstones:</u> andalusite, apatite, calcite, diopside, epidote, fluorite,</p> | | |

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| | feldspar, gypsum, hematite, idocrase, iolite, kyanite, lapis lazuli, malachite, nephrite, , peridot, quartz, rhodochrosite, rhodonite, scapolite, serpentine, sodalite, spodumene, talc, turquoise, zircon. | | |
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Practicals

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| USACGEM6P1 | <p style="text-align: center;">Gem properties and characteristics</p> <ol style="list-style-type: none"> 1. Procedures of distinguishing, different gemstones using a dichroscope, polariscope and a loupe, on the basis of their various physical and optical characters. 2. Study of growth features and inclusions of the gemstones. 3. (a) Identification of natural, cultured, and imitation pearls on the basis of structural data. (b) Drawings of part of light beam from endoscope through natural and imitation pearls. 4. Problems on design, gemstone cuts. a) Light ray path through a profile of cut; b) facet patterns and facet tally of various types of cuts; c) cabochon cuts. d) Drawings of various types of composite gemstones. 5. Appraising gemstones | 2 | 4 |
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Reference Books:

1. Crowe Judith (2006), The Jeweller's Directory of Gemstones, Page One Pub.
2. Pagel-Thiesen Verena (2001), Diamond grading ABC The manual (9th new revised and enlarged edition), Gemmological Association of Great Britain.
3. Brunton Eric (1978), Diamonds (2nd edition)
4. Gubelin E.J and Koivula J. (1992), Photo atlas of inclusions in gemstones (Vol I, II and III), ABC Ed.

5. Liddicoat R.T. (1989), A Handbook of gem identification (12th edition) re. Santa Monica CA: Gemological Institute of America.
6. O'Donoghue M. (1997), Synthetic, Imitation and treated Gemstones, Butterworth-Heinemann.
7. O'Donoghue M. (2005), Artificial Gemstones (2005), Butterwoth-Heinemann.
8. Newmann Renee (2008), Diamond Handbook. A Practical Guide to diamond evaluation, International Jewelry Publications.
9. Newmann Renee (2003), Gemstone Buying Guide: How to evaluate, identify, select and care for colored gems, International Jewelry Publication.
10. Pedersen M.C. (2010), Gems and ornamental materials of organic origin, Robert Hale.

Industrial Visit: Gem and Jewellery designing centre.