MSc

Full time (one year) or part time (two years)

Postgraduate Diploma

Full time (eight months) or part time (16 months)

Postgraduate Certificate

Part time (eight months)

Digital Colour Imaging

A postgraduate award of

THE LONDON INSTITUTE

(Subject to validation)

Course Outline

School of Printing & Publishing

London College of Printing

Version 3.0 20 September 2001

Introduction

New technologies enable visual communications to be made on an expanding range of media, both physical and electronic. Digital imaging now also dominates the existing printing and publishing industries, and the potential for radically new products and ways of working afforded by new imaging technologies are increasingly being recognized.

The requirement to reproduce colour images with optimal quality on these different media has created great challenges and opportunities for existing professionals and for new graduates in the imaging industries.For many professionals the transition to new technologies has inevitably meant a growing gap between their prior training and experience and the demands of the new technologies. This new postgraduate course offers an opportunity to engage with colour imaging at an advanced level, to explore individual interests with the support of subject experts and other imaging professionals, and to develop knowledge and skills of critical importance to the development of a career in any field of imaging technology.

The course is concerned with colour imaging technologies that support visual communication in a wide range of different media. Some of the fundamental technologies addressed in the course are also relevant to specialist applications of digital imaging such as the acquisition and interpretation of image data in scientific fields, including medicine, forensics, geographic information systems and space imaging. The unique approach of the course lies in its emphasis on role of imaging in the graphic arts, and this differentiates it from other related courses at postgraduate level.

The London College of Printing

A constituent college of the London Institute, the LCP is one of the leading specialist institutions in the field of communications in the world. It comprises specialist schools in Printing and Publishing, Media, Graphic Design, Retail Studies and Marketing and Management.

The School of Printing and Publishing

The School of Printing and Publishing has an outstanding reputation in research and teaching in colour and reproduction, with a large number of staff active in teaching, research, publication and consultancy. The School has a long-standing strength in colour printing and printing materials technology, and is a leading centre for the study of digital printing. The School is equipped for the study of all the major printing processes, recent additions including a four-colour Heidelberg Quickmaster DI digital press.

The School offers a wide range of study in digital imaging and digital media from short courses through to a degree scheme and collaborative international programmes. Digital imaging also forms part of the curriculum in other undergraduate and postgraduate courses such as the Publishing and Digital Media schemes. The School also has strong links to industry, external research bodies, and to other specialist courses within the London College of Printing such as the Schools of Graphic Design and Media.

Colour Imaging Group

The course is delivered mainly by members of the Colour Imaging Group, who make a strong contribution to international research and standards activities in colour imaging and graphic arts. Members participate in bodies such as the Society for Imaging Science and Technology, the Graphic Technology committee of the ISO, the international colour standards body CIE, the newspaper research organisation IFRA, the International Colour Consortium, the Technical Association of the Graphic Arts, and the Association of Research Institutes in Graphic Arts.

Links with other courses and institutions

Participants on the postgraduate (MSc/Diploma/Certificate) Digital Imaging are part of a postgraduate community in the London College of Printing sharing common interests in establishing a context for critical enquiry in visual communication. As a result there are exciting opportunities for links to be made between the different disciplines, and interactions with participants in other programmes of postgraduate study.

The Colour Imaging Group has links to other centres of postgraduate study and research in colour imaging, including the Colour and Imaging Institute at Derby University, the Image Technology Rresearch Group and the University of Westminster and the Munsell Colour Science Laboratory at Rochester Institute of Technology. In addition the School has developed links with most of the major manufacturers and vendors of digital imaging equipment, as well as users of digital reproduction technologies such as printing and photography. Where appropriate, it would be possible for course participants to complete projects in conjunction with another institution of the above type, or with a sponsoring employer. Moreover, the modular nature of the course facilitates the transfer of credits gained to other postgraduate programmes, and enables credits from other courses to be applied to this award.

Postgraduate Certificate in Digital Imaging.

The Certificate provides a solid and detailed grounding in colour science and the technologies of colour imaging. A PG Certificate graduate would have the skills required for (e.g.) production management in an imaging company.

Postgraduate Diploma in Digital Imaging.

The Diploma provides greater depth on the material covered in the Certificate phase of the course, together with further specialist study of subjects

A graduate of the PG Diploma would have a sound appreciation of current research and development in imaging, and would have the skills required by (e.g.) a technical developer or technical director.

MSc Digital Imaging.

In the MSc phase, participants build on the knowledge and skills acquired in the taught modules and undertake a research-oriented Major Project. MSc graduates will be well placed to move into challenging technical posts, or into full-time research and development in commercial or higher education sectors.

Progression beyond the MSc award

On completion of the course, participants have the opportunity to move on to further postgraduate research in the School leading to an award of MPhil or PhD. The course team can provide supervision in postgraduate research programmes in colour imaging and graphic arts.

Target audience

The course is aimed at all those working in visual communication technologies who wish to develop their understanding of colour imaging at postgraduate level. It will be of particular interest to those working in photography, publishing, printing, and imaging applications and equipment. The course has developed particular strengths in colour imaging in the prepress, newspaper and cultural heritage sectors, and has a number of partnerships with businesses in these areas. The work undertaken on the course is fundamental to the successful development of colour management strategies, image digitisation projects, the development of image libraries and the use of the Internet and XML for applications such as image access, distribution and archiving, and remote proofing.

The programme will also be of interest to graduates of related courses (both in the UK and overseas) who wish to enhance their subject knowledge and their employment prospects, or to prepare for further research-based postgraduate study in the subject.

Modes of study

The programme is offered in both full-time and part-time modes. This is intended to meet the needs of both those for whom a short and intensive period of study is preferable (such as those who live at a distance from London and who may have to move for the duration of the course), and those in employment for whom a part-time mode would be more attractive as it would allow them to combine study with work.

Course aims and objectives

	The course aims to develop:	**PG Cert Digital imaging**	**PG Dip Digital Imaging**	**MSc Digital Imaging**
1	A systematic understanding of knowledge in colour imaging, informed by a critical awareness of current problems and recent research	●	●	●
2	A framework within which participants can continue to develop the knowledge and intellectual skills that will enable them to deal with the imaging technologies of the future	●	●	●
3	A conceptual understanding that enables the participant to critically evaluate past and present research in colour imaging		●	●
4	A comprehensive understanding of techniques applicable to research in colour imaging, and a practical understanding of how such techniques are applied to interpret and advance existing knowledge		●	●
5	A community of enquiry and research in colour imaging, with links to other such communities nationally and internationally			●
	The course objectives are that participants will be able to:			
1	demonstrate an understanding of colour science and technology, and apply this in practical applications in the context of image reproduction	●	●	●
2	communicate the results of their work clearly to specialist and non-specialist audiences	●	●	●
3	demonstrate a quantitative understanding of colour and colour measurement, and an ability to render a colour appearance across different media		●	●
4	demonstrate an advanced knowledge of imaging processes, including capture and digitisation, processing, and output on a range of media and devices, and originality in its application		●	●
5	critically evaluate their own work, identify weaknesses and propose alternative solutions			●
6	plan and conduct a self-managed programme of research and enquiry			●

A high level of commitment is necessary to achieve the course objectives. As a guide, each 10 credits requires a total of 100 hours of study, including taught sessions, independent study and project work. The major project requires approximately 600 hours of study, including planning, development, and writing. Participants will thus need to plan their time carefully.

In addition to formal teaching sessions, participants will also engage in independent study, course work, project work and the preparation of a major project, for which tutor support is provided through individual tutorials and e-mail.

Formal teaching normally takes place over two days per week during the taught period of the full-time mode, and one day per week of the part-time mode. The MSc is offered over twelve months full time, or 24 months part time. The Diploma requires eight months full time or 16 months part time to complete, while the Certificate is offered only in part time mode over eight months.

Course structure

The course is divided into three phases.

Phase 1

In the three modules in Phase 1 of the course an outline of current knowledge in colour science and imaging, and its application to current problems, is presented. The perspectives developed in these modules create the context for the development of subsequent stages of the programme and establish the core themes in colour reproduction. On successful completion of these three modules, participants will have acquired 60 credits and may choose to exit with the award of Postgraduate Certificate in Digital Imaging.

Phase 2

In Phase 2, participants take a series of specialist modules with a total credit value of 60 credits. This element of the programme includes module options and the opportunity to develop individual interests.A participant who successfully completes a total of six modules and gains 120 credits may choose to exit from the programme with the award of Postgraduate Diploma in Digital Imaging.

Phase 3

In the final phase of the course, leading to the award of MSc, participants expand on the particular interests that have emerged during the earlier phases of the programme in a Major Project. The project also has a credit value of 60 credits.

Participants are encouraged to accommodate their own interests within the projects they undertake. Exceptionally, project briefs that diverge from those given in the module, but give the participant an opportunity to demonstrate achievement of the module objectives in a context more relevant to their personal interests and their professional development, will be considered by the module tutors. Projects can, if appropriate, be carried out partly in conjunction with sponsoring employers or other organisations such as Pira International.

Digital imaging is a field of study in which the pace of change is rapid, and as a result the programme of study will evolve to reflect the changing nature of the discipline and the needs of participants. The module timetable in the Supplementary Handbook issued at the commencement of the course contains details of when individual modules are offered.

Equivalent and appropriate modules taken at other institutions will be considered for credit transfer in place of some of the modules on the present course, and, similarly, participants may, where appropriate, transfer credits gained on this course to other programmes of study.

Modules offered

To successfully complete the course a participant must achieve a pass in six taught modules, together with a major project which is the equivalent of 3 modules. As a guide, each 10 credits requires approximately 100 hours of learner commitment. An outline of the taught modules and the major project are given in the following pages.

	Module	Credits
Phase 1	Introduction to imaging and scientific methods	20
	Colour perception and measurement	20
	Colour imaging systems	20
Phase 2	*One of:* Programming for colour imaging Colourants and their carriers	20
	Research methods for colour imaging	20
	Colour management	20
Phase 3	Major project	60

KEY:

Certificate

Diploma

Masters

Introduction to imaging and scientific methods

Phase:	1	Lectures:	30
Module Value:	20	Practical workshops:	12
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module develops an understanding of the fundamental characteristics of digital systems used in imaging, together with general concepts of science, quantitative methods and presentation at postgraduate level

Learning outcomes

On completion of this module the student will be able to:

- Describe methods of capturing and reproducing images in digital systems.
- Describe methods of encoding colour images
- Demonstrate an appreciation of the nature of scientific knowledge.
- Make appropriate use of mathematical techniques in colour imaging
- Demonstrate the use of tools such as spreadsheets and specialist maths applications to solve problems in colour imaging
- Produce a formal report and oral presentation in an appropriate style

Indicative content

- Fundamentals of digital systems
- Sampling, quantisation and encoding
- Vector and raster images
- Introduction to academic enquiry and discourse and the problem of knowledge
- The basis of scientific knowledge
- Using spreadsheets and maths applications such as MatLab
- Mathematical techniques including matrix algrebra, regression analysis and statistics
- Interrogating published sources
- Written and oral presentation

Assessment requirements

This module will be assessed through:

a) a seminar presentation on an aspect of scientific method (40%)

b) an essay on a topic in colour imaging (60%)

Colour perception and measurement

Phase:	1	Lectures:	21
Module Value:	20	Practical workshops:	21
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module develops an understanding of colour and its reproduction in the context of digital devices.

Learning outcomes

On completion of this module the student will be able to:

- Describe the perceptual attributes of colour and the different systems for the representation of colour
- Demonstrate the use of colour measurement instruments and the interpretation of colour measurement data
- Demonstrate the computation of uniform colour space coordinates from reflectance measurements
- Describe the requirements for consistent colour reproduction across different media.

Indicative content

- Fundamentals of colour: light, surface and observer
- Human colour vision and perception
- Colour rendering to hard copy and displays
- Colour models for digital imaging
- Colorimetry and colour difference
- Evaluating colour measurement instruments
- Uncertainty in colour measurement
- Colour space conversion
- Colour appearance models
- Device-independent colour reproduction

Assessment requirements

This module will be assessed through:

a) a comparison of two or more colour imaging devices or colour order systems (40%)

b) an analysis of the performance of two or more colour measuring instruments. (60%)

Colour imaging systems

Phase:	1	Lectures:	21
Module Value:	20	Practical workshops:	21
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module provides an opportunity to study methods for image acquisition and reproduction in the context of production systems.

Learning outcomes

On completion of this module the student will be able to:

- Demonstrate an understanding of current device technologies for input and output of colour images
- Demonstrate the acquisition and rendering images using a range of devices, with an appropriate understanding of the underlying technologies and of the copyright and legal implications of their use
- Make critical comparisons of original and reproduced images

Indicative content

- Image encoding principles and file formats
- Spatial resolution and data resolution
- Scanning and digital photography
- Imagesetters, scan recorders and digital printing
- CRT and flat panel displays
- Ethical, legal and copyright issues
- Evaluating colour images
- Sourcing and archiving digital images

Assessment requirements

This module will be assessed through an analysis of the performance of two or more colour imaging devices. Following critical review by the module assessor, students will be expected to resubmit the project having addressed the points made in the review.

Research methods in colour imaging

Phase:	2	Lectures:	14
Module Value:	20	Practical workshops:	28
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module develops an understanding of the methods appropriate to research in colour imaging.

Learning outcomes

On completion of this module the student will be able to:

- Define a research question and select an appropriate research design
- Carry out a literature survey
- Conduct experiments in colour imaging
- Select and use methods of data analysis appropriate to the research design.
- Produce a formal research report and presentation.

Indicative content

- Concepts in research methods
- Defining a research question
- Designing experiments
- Psychophysical experiments for assessment of colour and images
- Data analysis
- Presenting research outcomes

Assessment requirements

This module will be assessed through a research project leading to

a) a seminar presentation (30%)

b) a seminar paper (70%)

Programming for colour imaging

Phase:	2	Lectures:	14
Module Value:	20	Practical workshops:	28
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module provides an opportunity to study programming and scripting in the context of imaging.

Learning outcomes

On completion of this module the participant will be able to:

- Demonstrate an understanding of programming concepts
- Demonstrate an appreciation of the software design process
- Devise, develop and implement algorithms for image processing and colour space transformation
- Demonstrate the use of a programming language to solve a computing problem in colour imaging.

Indicative content

- Variables and data types
- Algorithms and control structures
- Structured programming
- Software design and the user interface
- Interpreted and compiled programming languages: Visual Basic, C++, Java, PostScript
- Development methods for Internet publishing
- Document structuring using XML and HTML
- Scripting and macro writing with VBA and Perl
- Colour space transforms and image manipulation with MatLab
- Image compression
- Spatial domain and frequency domain processing
- Developing filters for image-editing applications

Assessment requirements

This module will be assessed through:

a) a software application in colorimetry, with full supporting documentation (30%)

b) a software application using either colour imaging, Internet or image processing technologies (70%)

Colour management

Phase:	2	Lectures:	18
Module Value:	20	Practical workshops:	24
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aim

This module provides an opportunity to engage with practical and theoretical aspects of device-independent colour reproduction.

Objectives

On completion of this module the participant will be able to:

- Use numerical methods to characterise colour devices for input, output and display
- Generate, apply and and evaluate ICC device profiles
- Apply and evaluate colour and imaging standards

Indicative content

- The need for colour management systems and their architectures
- Colour space conversion
- Characterisation and calibration of devices
- Standards for colour and imaging
- PostScript colour management
- The ICC colour profile
- Colour appearance models
- Colour gamut mapping
- Creating and evaluating device profiles

Assessment requirements

This module will be assessed through:

a) a documented mathematical model of the relationship between device quantities and colorimetric quantities (40%)

b) a set of device profiles with an evaluation of their performance (60%)

Colourants and their carriers

Phase:	2	Lectures:	21
Module Value:	20	Practical workshops:	21
Level:	4	Access to facilities:	18
Indicative Learning Hours	200	Self Directed Study:	140

Aims

This module develops an understanding of the requirements and properties of colourants and carriers employed in digital printers and analyses how these materials can be effectively re-used.

Learning outcomes

On completion of this module the student will be able to :

- identify the characteristics of the major ink and dye systems
- analyse the chemical and physical principles involved in ink drying and dye adsorption
- test and evaluate the critical properties for ink/dye quality control
- evaluate the environmental impact of ink/dye systems

Indicative content

- function and composition of inks
- physical properties of pigments and dyes
- dispersion stability and colloid formation
- rheological measurement of inks - viscosity, thixotropy, tack, elasticity
- ink transference and dye adsorption
- ink drying mechanisms
- health and safety issues in ink/dye production and use
- environmental impact of inks/dyes

Teaching and learning methods

Lectures and practical workshops

Assessment requirements

This module will be assessed through:

a) practical course work
b) a written project on the the colourants used in digital printing systems and their areas of application

Computing experience and facilities

Participants will need access to a personal computer (PC or Mac) in order to complete their projects and dissertation. They will also need some previous experience of computing.

As a guide, the following are minimum requirements:

> A Pentium PC or 68040 Apple Macintosh with 64MB RAM, CD-ROM drive and a 28.8Kbps modem.

A preferred system would be:

> A Pentium II/III PC or Macintosh G3/G4 system with 128 or 256MB RAM, 56Kbps modem or broadband access through ISDN or DSL, CD-ROM drive and some form of removable storage drive such as Zip or CD-R.

Participants should be familiar with the use of computers, and should have a working knowledge of operating systems, file management and software applications. A qualification of A-Level or BTEC Computing is preferred, unless candidates can demonstrate that they have reached an equivalent level through other programmes of study or through professional experience. A knowledge of word processing and spreadsheets are essential for the preparation of written projects and analysis of data. Participants who are not familiar with spreadsheet applications such as MS Excel are recommended to gain experience in their use before commencing the course.

An Internet connection through an Internet Service Provider is a requirement for all participants, together with Internet applications including e-mail, browser and FTP client software.

Computer facilities of the standard described above are available to all students in the college's Learning Resources department, but due to the heavy demand for these facilities and the computer-intensive nature of the course, course members will need to have access to equipment outside of the college. This is particularly important for participants on the part-time mode.

Both MS Windows and Mac OS platforms are supported, and where documents are made available electronically they are almost invariably in cross-platform formats. However, participants should be aware that for some types of project (such as programming) there may be more resources available for a given platform, usually Windows.

The Colour Imaging Group lab is available for the use of participants both during scheduled teaching sessions and at other times, subject to the use of the equipment for research purposes, access arrangements, the availability of consumables and where necessary supervision in the use of equipment. Facilities include colour measuring equipment, a range of imaging systems such as scanners and printers, and a limited number of computers.

Whilst every endeavour will be made to provide the course and services described in this outline, The London Institute reserves the right to make such changes as may be appropriate for reasons of operational efficiency or due to circumstances, including industrial action, which are beyond its control.