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# TRAINING FOR COLOUR TELEVISION

## INTRODUCTION

Television broadcasting, on its inception as a public service in 1936 by the BBC, presented new problems from the operational point of view because it involved new concepts of studios and the employment of people with skills in lighting, make-up and in operating television camera channels and transmitters. From the outset, very high technical standards were laid down in the specification of studio and transmitting equipment, and so manufacturers and broadcasting authorities had to find engineers with the ability and knowledge to produce and to maintain the necessary complex systems and sophisticated equipment. The extension of the television system to provide nationwide coverage in the United Kingdom and the introduction of commercial television in 1955 meant that large numbers of suitable engineers and technicians had to be found and, if necessary, trained in the special techniques used in television.

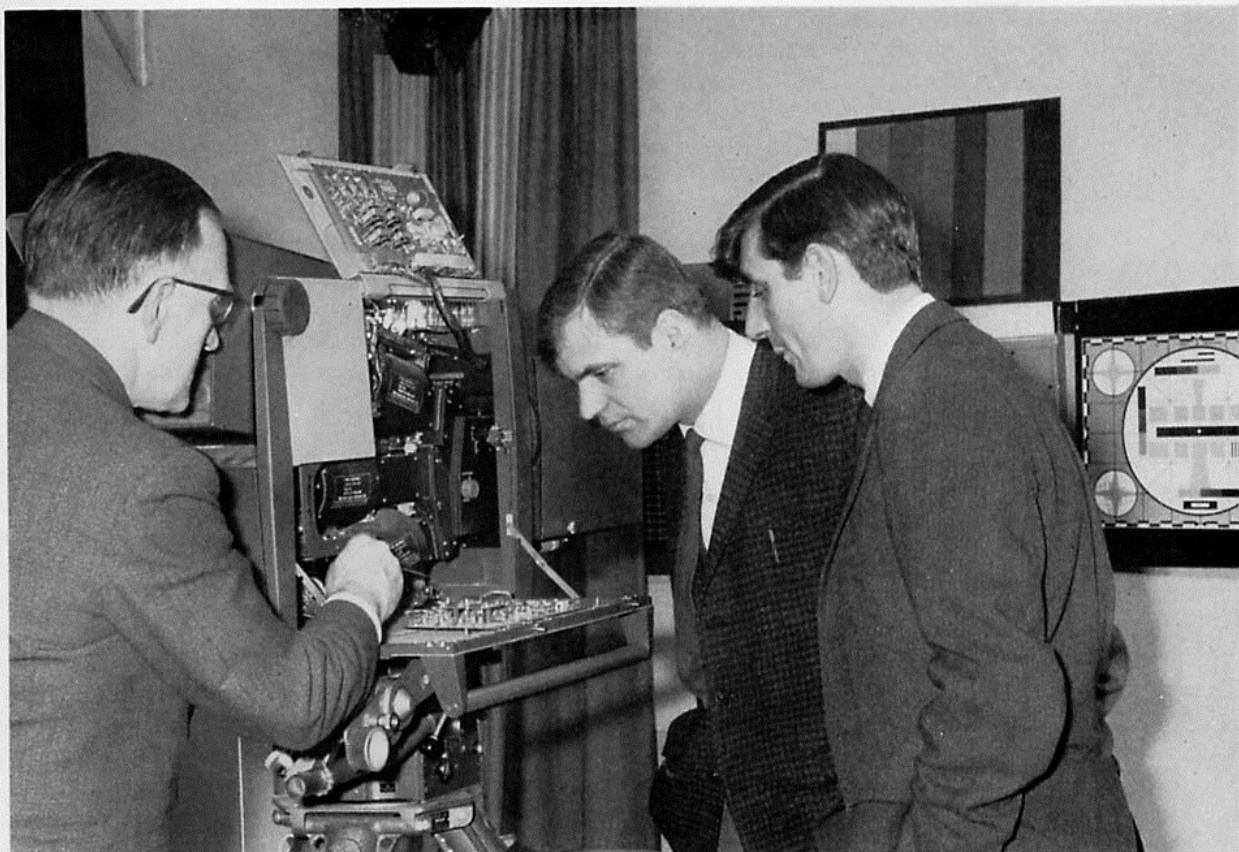
The introduction of a colour television service

operating in the u.h.f. bands and the need for working to very tight tolerances impose enormous demands on those concerned with planning, design, development, manufacture, testing, operation and maintenance of the colour television system and equipment. In the United Kingdom, using the PAL 625-line system, regular colour broadcasting was started by the BBC in 1967. Independent Television will commence a regular service in 1969 whilst many countries throughout the world are in the process of extending their black-and-white services to provide for colour. As the number of engineers with knowledge and experience of colour and u.h.f techniques is very limited, there has arisen a demand for the extensive training of engineers in the new techniques.

The Marconi Company is deeply involved in the development of modern television systems and supplies professional studio and transmitting equipment to customers throughout the world. It is the purpose of this article to outline the contribution



*Fig.1 Part of the Marconi College.*



*Fig.2 Students with the author in the College colour TV studio.*

made by Marconi College in meeting the challenge of training engineers for the ever expanding television universe and, in particular, to show the training facilities that exist in the field of colour television.

### **MARCONI COLLEGE**

The primary purpose of the College, founded in 1901, is to provide a training service to The Marconi Company and its customers. It has the responsibility of teaching Marconi graduates how to apply their knowledge to the practical design problems they are likely to encounter in their future work as development engineers and to extend their knowledge to include a familiarity with the techniques currently in use and likely to be used in the future. As well as studying new devices and general circuit techniques, the graduates attend a series of lectures and demonstrations on a variety of practical systems; included in the latter exercise is a review of Colour Television Principles and Practice and the problems of U.H.F Television Transmission.

For the training of customers' engineers and technicians, courses are available to cover nearly all aspects of electronics. Although the need for training has arisen normally from the purchase of equipment by a customer, the courses are not generally limited to an analysis of the circuitry and of operational and maintenance procedures; it is usually necessary to provide a treatment of basic principles, new devices and current techniques.

Further details on the general activities and facilities of the college are given in a brochure obtainable from the Company.

### **TRAINING PROBLEMS AND METHODS**

The Product Divisions of the Company are in direct contact with their customers and, knowing the system and equipment involved, are aware when the need for training arises. Discussions then take place between the customer, the Division and the College to clarify the requirements and to formulate a training proposal. The College prepares a syllabus and, when this is approved and the duration of a course is agreed upon, arrangements are made for dates, number of students, equipment and accommodation. The training may be agreed simply by letter, it may be included in a particular contract for equipment or, if long term training is required, a separate training contract may be drawn up.

Whether the engineers attending a course are from one customer or several, it is inevitable that the range of ability and knowledge will vary enormously. Although a syllabus is used as a guide, every attempt is made in the early days of a course to assess the abilities of the students and to modify the timetable to meet their needs and to fill in any gaps in their knowledge. The college staff are in close contact with sales, contract, development and test engineers, so they are in touch with the latest modifications and have a realistic appreciation of the performance of the equipment.

Although lectures are undertaken in a classroom, emphasis is given to the tutorial nature of the training and every attempt is made to get away from the definition of a lecture as the process of transferring information from the lecturer's notebook to that of the student without the mind of either being involved. Great importance is attached to the provision of laboratories with up-to-date equipment and



test instruments so that the training is realistic and the students leave with a feeling of confidence in carrying out operating, maintenance and specialized test procedures.

For the major part of the teaching process, reliance is placed upon the close contact between tutor and student; wherever it is appropriate, however, advantage is taken of new teaching methods and aids. Thus, although the blackboard is still present, use is made of prepared handouts, overhead projectors, film and slide projectors, demonstrations, programmed learning and punchboard testing. The close contact between customer and the Company ensures a continuous and critical assessment of the success of training against the requirements of the customers' operational environment.

### COLOUR STUDIO TRAINING

An essential requirement of a colour television system is that it should be compatible with an existing black-and-white service. Similarly, it is required that the knowledge and experience of studio supervisory and maintenance engineers should be compatible for the two systems. The extension of black-and-white to colour experience is a large one and the College has provided courses to alleviate the difficulty.

The Mark VII Colour Camera Channel, with many outstanding technical features, provided the impetus

to set up training courses to meet customers' needs. In the hectic atmosphere of television studios, every man is needed and it is difficult to release personnel for prolonged training. Bearing this in mind, courses lasting four weeks were started in October 1967. This intensive course assumes a knowledge of black-and-white practice and essentially provides familiarization of the Mark VII camera so that it can be operated and maintained to the best advantage. The opportunity is taken, however, to provide information and experience of colorimetry, colour television principles, coding and decoding techniques, and the new generation of synchronizing generators using micrologic circuits. To provide practical experience in setting-up and maintenance, a colour camera studio is provided at the College with a small set, test charts and cloths, a single camera channel, colour monitors, a vertical aperture corrector, coding equipment and mobile test racks to demonstrate video sweep testing and accurate differential phase and gain measurements.

An exercise is also undertaken at the more sophisticated studio at the development laboratories to practise camera colour balancing and to record a test programme on video tape.

So far, nine courses have been run with overseas students coming from Australia, USA, Canada, Thailand, Denmark, Mexico, Czechoslovakia and East Germany. Also attending have been engineers from United Kingdom programme contractors



*Fig.3 Details of the high-power television transmitter being explained.*



*Fig.4 A typical student's room at the College.*

Granada, Tyne Tees, Scottish, Southern and Yorkshire Television.

For a considerable part of its programme material a television studio relies on the use of telecine, and the training of engineers in the special complexities of colour telecine operation has become important. The College, in following the policy of providing training when it is most needed, has begun courses based upon the Full Facilities Colour Telecine Equipment. The course, lasting two weeks, assumes a knowledge of colour television principles and practice; its prime purpose is to familiarize the student with the basic design principles, circuitry, setting-up procedures and operational requirements of the equipment. As, however, the film stock available often leaves much to be desired and use is made of negative colour film, the course also provides information on colour film processes, colour film response, process masking and electronic masking. The UK programme contractors taking advantage of the training are, so far, ITN, Yorkshire, Granada, Harlech, ATV Network and Tyne Tees.

#### **TRANSMITTERS FOR COLOUR**

The concept of transmitter work as involving only brute force and ignorance has never been true, but with the sophisticated techniques necessary for colour operation the lie can be buried.

The BBC and the Independent Television Authority consider it essential to provide a nation-wide service. The introduction of colour services has raised many problems – the need to operate at u.h.f. to accommodate the wider channel widths associated with the 625-line colour system, the need to provide higher transmitter powers because of the propagation path losses at u.h.f., the restriction of available sites and the advantages of co-siting with existing v.h.f. transmitters wherever possible.

These problems have been greatly reduced by the decision to use power klystrons which provide high gain and stability at u.h.f. but which introduce other problems.

The klystron is provided with a low-level modulated input but it is a progressively non-linear device, hence the video signal must be pre-corrected not only for linearity, but also for differential gain, differential phase and group delay before being applied to the ultra linear modulator.

In addition, isolation between parts of the system is obtained by the use of sophisticated devices such as 3dB directional couplers and ferrite circulators.

In the face of these changes in transmitter practice, it is obvious that further training of station staff is needed. The BBC has its own training establishment but the Independent Television Authority has used the facilities at Marconi College for the bulk of its training. Since 1957 thirty-two courses, each of sixteen weeks' duration, have been held at fundamental and advanced levels dealing with basic principles, television techniques and v.h.f. transmitter practice. The Authority is keenly aware of the value of training and has had the wisdom to anticipate the extension of its service to u.h.f., and the introduction of broadcast colour programmes in 1969. Thus, since September 1967, additional four-week courses have been run for senior engineers on the principles and practice of colour television, and since September 1968 the courses have been extended to eight weeks to include u.h.f. transmission techniques, standards conversion and transposers. For the training, the Authority has supplied the College with a solid-state driver transmitter, a 5kW klystron amplifier, a colour slide scanner, a standards converter and a wide range of ancillary and test equipment. Arrangements have been made to train seventy-five engineers on such courses during 1969.