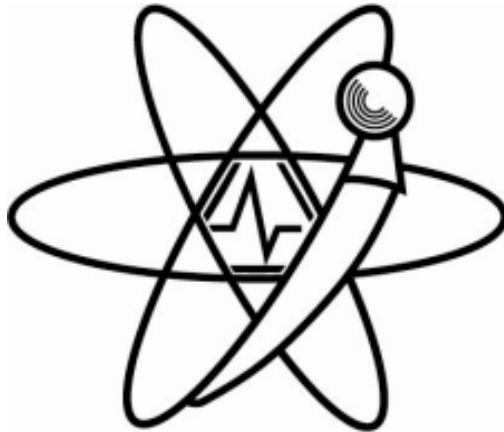


# Institute of Physics and Engineering in Medicine

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**Fairmount House  
230 Tadcaster Road, York YO24 1ES  
Tel: 01904 610821  
Fax: 01904 612279  
Email: [office@ipem.ac.uk](mailto:office@ipem.ac.uk)  
Web site: <http://www.ipem.ac.uk>**

**Registered Charity No: 1047999  
Registered in England & Wales No: 3080332**

# Training Prospectus for Medical Physicists and Clinical Engineers in Health Care

In preparation for:

Clinical Science Diploma of IPEM [DipIPEM(S)]

Registration as a Clinical Scientist

Corporate Member of IPEM

Chartered Scientist

Chartered Engineer

This Prospectus is valid for enrolments from:

**September, 2010**

and will apply to enrolments no later than:

**September, 2012**

**Version 5**

This version of the Prospectus supersedes the one that applied to enrolments between September, 2008 and September, 2010.

The following operational and competency changes have been made to this present version from the previous version:

1. The total length of training for a Part I trainee is confirmed as at least two years but there is an allowance for the hospital based training to be 12 months (and not 15 months) if, exceptionally, the Training Co-ordinator can confirm in writing that the total length of Part I training has been a full 2 years.  
In addition, there is a comment on Part-time training for Part I.  
(section 1.3 and 2.1)
2. There is a statement that enrolment on the Part I Training Scheme is not confirmed until the candidate has received a formal written acknowledgement of enrolment from IPEM.  
(section 1.9)
3. There is a requirement that all Training Co-ordinators must be Clinical Scientists and also be members of IPEM at a minimum of Corporate Membership.  
There is an allowance for locally-appointed Assistant Training Co-ordinators but with the strict proviso that the named Training Co-ordinator remains the one point of contact for IPEM correspondence.  
(section 3.1)
4. There is a need for Part I trainees and those involved with providing the Part I training to be conversant with the Guidance Note on the IPEM's website on complying with the Caldicott Principles together with there being an explicit statement on the front page of each portfolio.  
(section 3.5.2)
5. There is need to formally notify IPEM of any Part I additional training following a viva failure and, in some instances, to provide an additional report.  
(section 3.7)
6. The comments in amendment 4. (above) also apply to Part II advanced trainees and reports submitted to IPEM for Corporate Membership.  
(section 7.3)

7. There are extensive textual changes relating to Part II training.  
(sections 1.3, 2.2, 7.1, 7.2, 7.3, 7.5, 7.6, 7.7 & 7.12)
8. The section provided by APEN has been updated. A comment concerning the Induction Days has been included.  
(section 10)
9. There are changes to the Competence Listings for Part I training, namely:

Core Competencies (including a general requirement to be aware of emerging technologies)

Radiotherapy Physics

Diagnostic Radiology

Nuclear Medicine

Non-ionising Radiations

Information & Communications Technology (\*)

Medical Equipment Management

(\*) Note the change of name of this Subject to "Clinical and Scientific Computing"

(Note: Training Centres accredited to provide training in Information & Communications Technology will be automatically transferred to being accredited to provide training in Clinical and Scientific Computing.)

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# 1. An Overview of Training and the Awards Achievable

## 1.1 Introduction

This Training Prospectus is concerned with the training of Clinical Scientists in Medical Physics and Clinical Engineering. A separate prospectus is published by the Institute of Physics and Engineering in Medicine (IPEM) concerned with the training of Clinical Technologists. The aspiring Clinical Scientist (medical physicist or clinical engineer) entering the profession will normally have a good honours degree in a physical science or engineering subject accredited by the Institute of Physics or the Engineering Council. A Guidance Note on the acceptability of degrees not accredited by IoP or EC is available.

Medical Physics and Clinical Engineering are concerned with the application and development of the principles and techniques of physics and engineering to the diagnosis, treatment and prevention of human disease. The diverse range of work carried out within this field, and the evolution of identifiable sub-disciplines within it, require that there is a formal approach to the training of new entrants to the profession. This ensures a proper vocational foundation to their careers.

The Council of IPEM has appointed the Professional and Standards Board (PSB) to administer and develop all aspects of the training and career progression of medical physicists and clinical engineers. The structure of PSB is for various competent Panels to report to it and one such panel is the Clinical Scientists' Education & Training Panel (CSETP). The CSETP considers all aspects of Clinical Scientists' training and reports to the PSB. PSB studies this Panel's opinion and advice and takes recommendations to Council.

IPEM issues its own internal awards of the Clinical Science Postgraduate Diploma, DipIPEM(S), Corporate Membership (MIPEM) and Fellowship (FIPEM). In addition, IPEM is licensed by the Science Council to award Chartered Scientist (CSci) and is also a Nominated Engineering Institution, being licensed by the Engineering Council to award *inter alia*, Chartered Engineer (CEng). In this latter capacity, IPEM is licensed to approve training schemes (leading to the award of CEng) and degree courses (which meet the academic requirements of CEng). PSB has responsibility for ensuring the appropriate content and assessment of the different elements of training and the accreditation of centres in which training takes place.

Whilst NHS trainees form the largest cohort undergoing training as Clinical Scientists, it is recognised that many other individuals join the profession and are employed within associated academic departments and in other aspects of the health care industry. This Prospectus gives details of the different stages of career development and the associated content of the training programmes. It is hoped that this will be a useful reference for everyone in the wider profession.

## 1.2 Career development

The main components in the career development of a medical physicist or clinical engineer following graduation are likely to be:

- Part I Training leading to:  
the award of DipIPEM(S)
- Part II Training leading to (as appropriate):  
application to Association of Clinical Scientists (ACS) for its Certificate of Attainment (leading to Registration with the Health Professions' Council),  
the award of MIPEM,  
the award of CSci,  
the award of CEng

The title "Clinical Scientist" is protected by statute and can only be used by individuals on the Register of the Health Professions' Council. However, this title encompasses other scientific disciplines within healthcare such as biochemistry. Within this booklet, whenever the term "Clinical Scientist" is used, it should be taken as applicable to medical physics and clinical engineering.

## 1.3 Part I and Part II Training

### Part I

In this structured training route, the trainee undertakes the Part I Training within a Training Centre, accredited by IPEM, normally for two years. This leads to the award of the Clinical Science Diploma of the Institute, DipIPEM(S) and is a period of hospital based training with an MSc accredited by IPEM taken on a full-time, block or day release basis.

Alternatively, the trainee may enter training having already obtained an accredited MSc and then follow a period of hospital training lasting 15 months. The over-riding consideration is that the total length of Part I training must be two years. However, exceptionally, if the Training Co-ordinator can confirm in writing that this time period has been undertaken by an individual Part I trainee, then an application for that trainee to sit the vivas after 12 months of hospital training will be allowed. In these circumstances, the Training Co-ordinator needs to confirm that the accredited MSc occupied a full 12 months (i.e., periods of leave did not exceed the standard NHS annual leave quota) and that the trainee has, in addition, undertaken placements for a further 12 months.

Part I training may be undertaken on a part-time basis. However, all applications for part-time training must be ratified by the Part I Registrar who will apply the guidance outlined on the Institute's website (Guidance Note entitled *Length of Training*).

### Part II

*(i) For those trainees who have completed the Part I Training:*

After successful completion of the Diploma, the trainee generally commences a programme of supervised practice extending over a minimum of 2 years while employed as an advanced trainee. At the end of this training, the advanced trainee would be expected to

be able to apply for both the Association of Clinical Scientists' (ACS) Certificate of Attainment (by Route One) and for Corporate Membership of the Institute. Registration is within the overall regulation of the Health Professions' Council (HPC) and the HPC has delegated to the ACS the determination of competencies to be acquired during this training and their assessment. The competencies needed are documented on its website ([www.assclinsci.org](http://www.assclinsci.org)). Assessment for the Certificate of Attainment is within the control of the ACS even though it may seek competent assessors from the IPEM. The award by the ACS of its Certificate of Attainment allows the advanced trainee to seek Registration through the HPC as a Clinical Scientist. This award of the Certificate of Attainment would also normally allow the advanced trainee to fulfil the requirements for Corporate Membership of the Institute. The awards of Chartered Scientist and Chartered Engineer are described in sections 1.7 and 1.8.

The choice of Job Title for individuals undertaking Part II Training is clearly a matter for local employers. The term "pre-registrant" is used by ACS for individuals seeking Registration but IPEM recognises that not all individuals undertaking Part II Training will seek Registration. This Prospectus uses the term "advanced trainee" to describe those undertaking Part II Training and this emphasises the change in training between those on the Part I scheme and those who undertake Part II training in a particular area of endeavour.

*(ii) For any trainees who have not completed the Part I Training and, consequently, have not been awarded DipIPEM(S):*

Exceptionally, some individuals may proceed to Part II Training without having undertaken Part I Training. Any such individuals will have to satisfy the Part II Registrar that the extent of their previous training and experience, together with any approved "top up" study and training, is equivalent to having undertaken Part I training. A Guidance Note on Part I equivalence is available from the IPEM office. At the end of Part II training, the advanced trainee would be expected to be able to apply for both the Association of Clinical Scientists' (ACS) Certificate of Attainment (by Route Two) and for Corporate Membership of the Institute. The period of advanced training will usually be at least 3 years to satisfy the requirements of ACS.

#### **1.4 Registration and Corporate Membership**

*Registration* with the HPC is primarily concerned with protection of the patient by protection of title and only those individuals registered with the HPC can use the title "Clinical Scientist".

*Corporate Membership* is not a statutory requirement to practise but is recognition of high professional competence by IPEM and is important to career development. Corporate Membership is awarded by the Institute to those who can demonstrate that they satisfy the requirements set out in the Institute's Rules (Rule C:4). Corporate Membership is available to all Clinical Scientists in the NHS or the private sector as well as to other scientists and engineers in other healthcare providers, universities, industry and elsewhere working in the Institute's area of interest, who can meet these requirements.

## **1.5 Taking a PhD before or during training**

PhD's are seen as an important qualification for Clinical Scientists and may be obtained at different stages of career development. In particular the Institute wishes to encourage entry into the profession of those who take a PhD immediately after their first degree and also to encourage others to take a relevant PhD as an element of Part II Training.

Individuals who study for a PhD immediately following graduation may undergo formal Part I Training (with some allowed exemptions depending on the area(s) of work covered during the PhD) and then proceed to Part II Training. Alternatively, if the PhD is relevant to medical physics or clinical engineering, the individual may register for Part II Training immediately and undergo any necessary "top up" studies during their first year to achieve Part I equivalence (please refer to 1.3, 7.2 & 7.4).

Individuals who proceed to a PhD, whether full time or part time, following completion of Part I training, should enrol for Part II Training at the outset so that their PhD work can be fully integrated into their Part II training.

## **1.6 Entry at a more senior level**

Corporate Membership is likely to be important to career development and, as such, should be taken into account at interview and planned for from the outset. For those individuals entering the profession at a higher level with relevant qualifications and experience, Part I and Part II Training may not be recommended as the route to Corporate Membership. Rule C:4 of the Institute outlines various routes to Corporate Membership and the most appropriate of these should be considered.

## **1.7 Corporate Membership and Chartered Scientist (CSci)**

The Science Council recognises that the award of MIPEM is sufficient to allow the Institute to award Chartered Scientist. On being awarded MIPEM, the successful individual is encouraged to apply to the Institute for Chartered Scientist award if the job role does not involve a substantial aspect of clinical engineering. In this latter case, the successful individual, should consider applying to the Institute for Chartered Engineer status (but please refer to sections later which outline the additional requirements in the training of the future clinical engineer).

## **1.8 Corporate Membership and Chartered Engineer (CEng)**

Corporate Membership of the Institute and registration as a Chartered Engineer (for those with an engineering background and working in clinical engineering) can be achieved either through successful completion of Part II along with the additional requirements set out by the Engineering Council or through direct application to the Institute. Applicants applying directly need to demonstrate equivalent experience and responsibility to those who have

been through the formal training scheme. Section 9 of this Prospectus covers the requirements for CEng.

## 1.9 The Accreditation of Training

All formal training schemes need to be accredited by the Institute.

The MSc Course Accreditation Sub-Panel of CSETP is responsible for the accreditation of suitable MSc courses (see Sections 5 & 6 of this Prospectus for more details).

The Training Centre Accreditation Sub-Panel of CSETP is responsible for the accreditation of Training Centres for Part I Training.

The Engineering Course Accreditation Sub-Panel of CSETP is responsible for the accreditation of suitable undergraduate engineering (MEng) courses which could be cited in support in an application for CEng status. In addition, this Sub-Panel considers Professional Engineering MSc courses which, when combined with suitable BEng courses, could allow for a similarity with accredited MEng degree courses.

An Accredited Training Centre for Part I Training can be either a single large department or a consortium of departments. To be eligible for accreditation, a Training Centre must be able to offer training in at least six Major Subject Areas and have at least three Clinical Scientists working in each of these Areas. In addition there must be at least twenty Clinical Scientists working within the Centre. Accreditation is normally awarded for five annual intakes of trainees but the Training Centre Accreditation Sub-Panel reserves the right to audit Centres and, if necessary, to suspend accreditation if there is concern about a Centre's ability to train effectively. Applications for accreditation, or re-accreditation, need to be submitted at least twelve months in advance of the September/October intake of trainees for which accreditation is required. Application for accreditation is made by submitting a completed Application for Training Centre Accreditation form to the Institute. Guidance Notes are available from the Institute's office to help with this application process.

Details of all accredited Training Centres and the Major Subject Areas for which they are accredited are available from the Institute's office and also on the web site. Centres that are not accredited are not able to enrol trainees for Part I Training.

The **Part I Registrar** is responsible for ensuring that all applications for enrolment onto Part I Training leading to DipIPEM(S) indicate that the proposed training is to take place within an Accredited Training Centre. Enrolment onto the Part I Training Scheme is not confirmed until the candidate has received a formal written acknowledgement of enrolment from IPEM. Following enrolment, the Part I Registrar is subsequently responsible for ensuring that the training subjects undertaken are individually accredited within that particular Training Centre.

The **Part II Registrar** is responsible for the accreditation of each Part II advanced trainee's individual training programme. This training programme should incorporate all the features in the Part II Training Programme section of this booklet and this will have regard to the requirements of ACS for the award of its Certificate of Attainment if the training is aimed at obtaining Registration with HPC. It may also include the additional requirements for Chartered Engineer if the advanced trainee is involved substantially with clinical engineering.

## **2. The Pattern of Training**

The minimum duration of the total Training Scheme (Part I and Part II) leading to the award of the DipIPEM(S), Registration, Corporate Membership, CSci and CEng (as appropriate) is four years.

### **2.1 Part I Training**

Part I Training has an emphasis on acquisition of knowledge and basic practical training.

For trainees who enter the scheme directly after a first degree, an in-service accredited MSc is an essential element in the acquisition of knowledge. Lists of accredited courses are issued by the MSc Course Accreditation Sub-Panel of CSETP and are available from the Institute's office and the web site. Sections 5 & 6 of this Prospectus include a syllabus content guide indicating the knowledge requirements of the scheme.

Trainees who have obtained an accredited MSc before beginning Part I Training may complete Part I after undertaking a minimum of 15 months of practical training. (But, please refer to section 1.3 which comments on this being reduced to 12 months in exceptional circumstances.)

Part I Training is practically biased and consists of substantial periods of attachment in three Major Subject Areas, together with shorter acquaintanceship periods in a number of other specialities (normally three) within medical physics and clinical engineering. In addition a set of Core Competencies must be covered.

Appropriate Training Supervisors are appointed by the Training Centre. The trainee also receives advice from his/her Training Co-ordinator and an External Training Adviser (ETA). Their roles are detailed in Section 3.1.

Upon completion of Part I Training, the trainee is assessed by members of the IPEM's Board of Examiners. The assessment includes an evaluation of the Training Supervisors' and the Training Co-ordinator's reports, an evaluation of the trainee's three portfolios and three *viva voce* examinations (see Section 3.5). Satisfactory assessment of this and a pass in an accredited MSc is recognised by the award of IPEM's Clinical Science Postgraduate Diploma, DipIPEM(S).

## **2.2 Part II Training**

Part II Training provides the advanced training and supervised experience to allow for application to the ACS for the Certificate of Attainment and application to the Institute for Corporate Membership. It should be structured individually by an employer for each advanced trainee but it must include those requirements for the ACS's Certificate of Attainment (if Registration is being sought) and the Institute's Corporate Membership requirements (and, if appropriate, also allow for application via the Institute for CEng).

## **2.3 Science Council's requirements for CSci**

As noted in 1.7, the Science Council recognises that achievement of Corporate Membership of the Institute is sufficient to warrant the award of Chartered Scientist.

The Institute is licensed to award CSci and those who successfully achieve MIPEM are encouraged also to apply to the Institute for the award of CSci.

## **2.4 Engineering Council's requirements for CEng**

IPEM is a Nominated Engineering Institution for the award of CEng. In order to be registered as a Chartered Engineer, advanced trainees have to satisfy certain education, training and responsible experience requirements of the Engineering Council (UK). These are referenced in detail in Section 9 of this Prospectus and will normally be covered during Part I and Part II training.

CEng is normally only applicable for those trainees whose Part I and Part II training is directed towards clinical engineering.

## **2.5 The competence based format**

This Prospectus has been written with reference to competencies (see Sections 4 and 8). These emphasise that a trained medical physicist or clinical engineer is capable of undertaking a given job description of work in any medical physics and clinical engineering department in the UK or abroad.

When assessing competence against the markers provided, it is important to test the qualities normally associated with a professional physicist or engineer. These will include the ability to:

- define a problem and formulate strategies for solving it;
- interpret novel or non-standard data;
- make value judgements in unfamiliar situations;
- communicate scientific advice clearly and accurately to others;
- recognise fault situations and take suitable corrective action;
- appreciate the limitation of one's knowledge.

### 3. Part I Training – leading to the award of DipIPEM(S)

#### 3.1 Key individuals in the provision of Part I Training

Each Part I Training Centre is required to appoint a **Training Co-ordinator** who is (i) a Clinical Scientist, (ii) a member of IPEM at a minimum of Corporate membership level and (iii) employed on at least Band 8 in the NHS (or holds an appointment of equivalent status). A full set of Guidance Notes for Training Co-ordinators is available from the Institute's office. The main duties of the Training Co-ordinator are to ensure that accreditation or re-accreditation of the Training Centre has taken place; that training plans are in place (and, therefore, have been submitted to the Institute as part of the accreditation application) and Training Supervisors appointed; that each trainee is trained in a suitable combination of subject areas; and that the trainee's MSc provides the necessary academic knowledge to underpin the training (taking into account the requirements of the Engineering Council if CEng is to be sought). He/she also acts as the trainee's mentor throughout the training and informs the trainee of correct procedures with regard to enrolment onto the scheme and for the final assessment. If a trainee intends to apply for CEng after his/her Part II Training and, if the Training Co-ordinator for the Part I Training is not a Chartered Engineer, then the Training Centre should consider appointing another member of the department, who is a Chartered Engineer, to support the Part I Training and act as an additional mentor.

In addition, a Training Centre may wish to create locally-appointed Assistant Training Co-ordinators to facilitate good communications within the Training Centre but it is stressed that IPEM will only correspond with the named Training Co-ordinator on matters relating to Part I training.

(The Part II Supervisor for any advanced trainee who will be seeking CEng must be a Chartered Engineer. Please refer to 7.7.)

For each Major Subject Area for which training is offered, the Training Centre is required to appoint a **Training Supervisor**. He/she will be a Clinical Scientist who has at least 6 years' relevant post-Registration experience or is of equivalent status. The Training Supervisor ensures that every effort is made to enable the trainee to reach the necessary levels of competence as laid down in Section 4 of this Prospectus and ensures that the Training Plan (as set out in the successful accreditation application) is followed. During a training attachment, it is recommended that the Training Supervisor should have regular contact with the trainee as well as holding review meetings every few weeks. The Training Supervisor also carries out continuous assessment of the trainee's progress and competence. A set of Guidance Notes for Training Supervisors is available from the Institute's office.

An **External Training Adviser** (ETA) from outside the Training Centre acts as quality controller for the training scheme at Part I level and is responsible for ensuring that the professional standards required by the Institute are met. The ETA has two main roles relating to the Training Centre and the trainee. Firstly, he/she will consult with the Training Co-ordinator, the Training Supervisor and the trainee(s) and assess and advise on any problems associated with the training scheme both from the viewpoint of the Training

Centre and of the trainee. Any unresolved issues must be reported to the CSETP. Secondly, the ETA acts as the IPEM appointed moderator for *viva voce* examinations carried out locally by the Training Centre (see Section 3.5). A set of guidance notes for ETA's is available from the Institute's office. The ETA will be a senior member of the profession. The appointment as External Training Adviser to a Training Centre is made by the Institute.

### **3.2 The need for accreditation and the timetable of training**

Accreditation of the Training Centre is essential to the training process. All training must be undertaken within an accredited Training Centre and each training subject must be individually accredited at that Training Centre. IPEM will not assess any trainee whose training does not comply with these requirements. It is the responsibility of the Training Co-ordinator to ensure that all training is accredited by IPEM.

The Training Co-ordinator will assist the trainee to complete the Enrolment Application Form to undertake Part I Training. The training will normally commence in September/October and an enrolment form must be submitted by the Training Co-ordinator **within one month** of commencement of the Part I Training. This form notifies the Institute of the enrolment of the trainee onto Part I training, gives details of the MSc course to be undertaken (or successfully completed) and gives a likely date for the candidate's *viva voce* examination. The Part I Registrar will check that the Training Centre involved has current accreditation to carry out Part I Training.

The notification to the Institute of the selection of subjects is on a second form which must be submitted by the Training Co-ordinator to the Institute **not less than 9 months** before the date of the anticipated *viva voce* examination. The selection of the three Major Subject Areas is a matter for agreement between the Training Centre and the trainee. The Part I Registrar will check that the subjects selected have current accreditation and will reject the subject selection if any of the three subjects do not have current accreditation.

However, it is recognised that circumstances may change after the submission of this second form and that, as a consequence, the subjects selected may also change. It is essential that any changes are noted **in writing** to the IPEM by the Training Co-ordinator **at least 12 weeks** before the date of the *viva voce* examination. As with the original selection of subjects, the Part I Registrar will check that the proposed subjects are accredited at that particular Training Centre and will reject any subjects not so accredited.

***IT IS EMPHASISED THAT THE TRAINING CENTRE MUST NOT ALLOW A TRAINEE TO PRESENT FOR THE VIVA VOCE HAVING UNDERTAKEN TRAINING IN A SUBJECT FOR WHICH ACCREDITATION HAS NOT BEEN AWARDED.***

Trainees are required to be Associate Members of the Institute and, if necessary, a membership application must be submitted at the same time as enrolling for Part I Training.

The Enrolment Form must be signed by both the trainee and the Training Co-ordinator. Following receipt and acceptance by the Part I Registrar, the Institute will inform the ETA.

Examinations and re-sits are normally held in September, January and May. Confirmation of the intention of a trainee to present for the *viva voce* examination must be made to IPEM by the Training Co-ordinator.

With the exception of the local *viva voce* examination for which particular arrangements apply, the Training Co-ordinator will arrange for the trainee to submit the training portfolios to IPEM at least six weeks before the examination.

The timings of re-sit *viva voce* examinations are set out in **Section 3.7**. However, it is emphasised that if a candidate fails in more than one subject, then, other than in exceptional circumstances approved by the Chief Examiner, the re-sit examinations cannot be taken singly.

The minimum length of Part I Training (i.e., the accredited MSc and the subject placements) is 2 years and the decision to present an individual trainee for the *viva voce* can be deferred if that trainee is not ready for the assessment. Any deferment decision should be by mutual agreement between the trainee and the Training Centre but, in the case of disagreement, the Training Centre has the final decision. Any decision to defer must be in writing or by e-mail to IPEM. However, in all cases, trainees must present for their first *viva voce* examination within three years from the date of enrolling on Part I Training (with a window of 2 months either way to allow for enrolment receipt and examination dates). This first *viva voce* examination must be for all three subjects. The total time between enrolling on the Part I Training and the last *viva voce* examination should not exceed 4 years (again, with the two month's window as above). The IPEM reserves the right, at its own discretion, to allow for extensions to these timings in cases of documented illness or other exceptional circumstances.

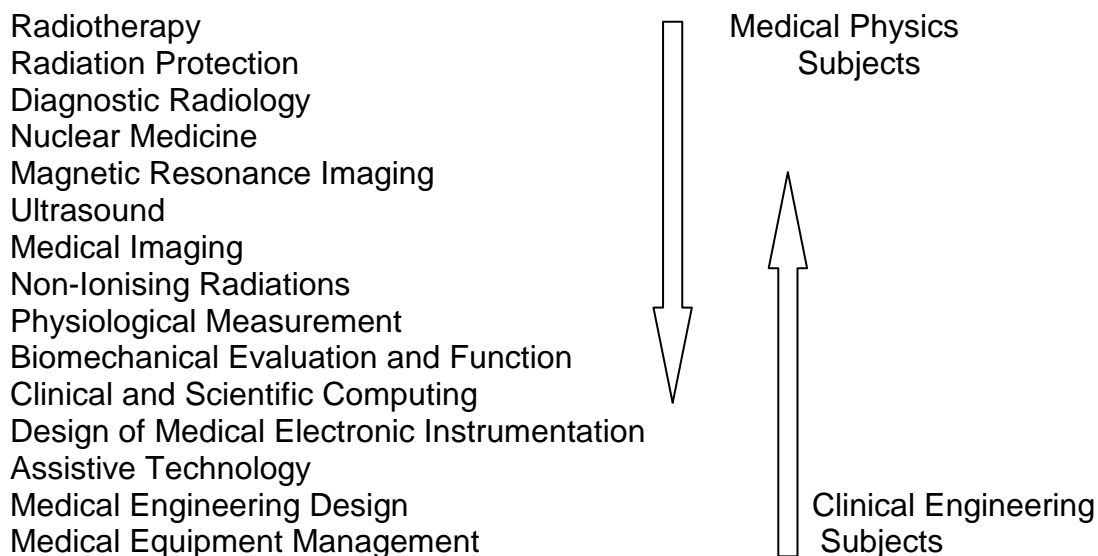
Any trainees whose employment with the Training Centre ceases before either completion of the training itself or before any *viva voce* examination must contact IPEM in writing or by e-mail to indicate these circumstances. The Chief Examiner will consider individual cases in the light of particular circumstances. IPEM would not wish to prevent any trainees receiving the award of DipIPEM(S) if they are unable to secure employment even though their training has been completed and is subsequently assessed as satisfactory.

It is assumed that accreditation continues for the full duration of the trainee's period of training. If accreditation is suspended, withdrawn or lapses for any reason, then the Part I Registrar will be informed by the Training Centre Accreditation Sub-Panel. The Part I Registrar will adjudicate, in conjunction with the Training Centre Accreditation Sub-Panel, on whether the training can continue to completion in the particular circumstances.

It is permissible to select an alternative (i.e., new) subject(s) following failure at the Part I *viva voce* examination in a particular subject(s). However, the training in any new subject(s) must have been fully accredited during the training in the new subject(s) and must have been completed prior to the *viva voce* examination for the new subject(s). The new subject(s) will be considered as a re-sit(s) and the rules governing taking re-sits must be complied with. Also, note that the time limits on the Part I training period outlined in 3.2 must be adhered to.

### 3.3 Major Subject Areas and Competencies

In addition to the **Core Competencies**, listings are included in Section 4 for the Major Subject Areas below.



It should be noted that, due to significant overlap, Radiation Protection cannot be taken in conjunction with Diagnostic Radiology or with Non-Ionising Radiations. Similarly, the options chosen within Medical Imaging may not include any imaging modality (including Nuclear Medicine) that is taken as a separate subject.

#### [Using a particular project to achieve the competences in more than one subject:]

Occasionally, an individual project carried out by a trainee may satisfy the competencies from more than one of the subject areas that the trainee is undertaking. It has become apparent that differentiating and separating work between the different portfolios during Part 1 training can sometimes be difficult and this has particularly been the case for the engineering subjects.

It is acceptable to use material from the same project in two portfolios, providing the section in each portfolio dealing with the project is written so as to satisfy the specific competencies of the particular subject (i.e. the same material must not simply be duplicated in both portfolios).

To provide a common interpretation of this issue, the following statement is provided in relation to Assistive Technology and Biomechanical Evaluation & Function.

“Compared to BEF, AT is more of a “whistle-stop tour” of all areas, with more of an emphasis on the range of equipment and techniques used, when each is used and how

configuration and training can maximise performance. On the other hand, BEF is more about biomechanical assessment using physical examination techniques alongside low and high technology measurements, analysis of data and the measurement of functional and QOL outcomes. Both subject portfolios need to evidence a clear demonstration of work undertaken by the trainee, as opposed to pure observation.”

[Selecting an appropriate MSc course:]

In selecting the three Major Subject Areas for training, care needs to be taken to ensure a synergy between the subjects and that they are appropriate to the MSc syllabus followed. Some Training Centres encourage trainees to seek a wider range of topics at Part I level whereas others seek a more focussed approach. The Institute does not want to be prescriptive but the Training Centre must always acknowledge the need to provide "fit for purpose" subjects to ensure high quality training. If the MSc does not adequately provide the theoretical knowledge required to underpin the training programme selected, it is the responsibility of the Training Co-ordinator to ensure that the trainee attends whatever additional educational courses are necessary.

### **3.4 The Part I Training Process**

To complete the Part I successfully, it is necessary to acquire the required practical competencies in the chosen subjects (see Section 4), and also knowledge of the related theoretical aspects of medical physics and clinical engineering.

#### **3.4.1 Theoretical Knowledge**

An adequate standard of theoretical knowledge is achieved through the successful completion of an appropriate and accredited MSc course.

Discussion of the content of accredited MSc courses is included in Sections 5 & 6.

#### **3.4.2 Competence Training**

Each trainee must spend substantial periods of attachment in three Major Subject Areas chosen from the options listed in Section 3.3 and detailed in Section 4. In addition, the trainee should spend shorter acquaintanceship periods (normally three) in other specialities within Medical Physics and Clinical Engineering. Each acquaintanceship placement should normally be about 1-2 week(s) and be such as to give the trainee an appreciation of that subject and, as a consequence, a wider knowledge of the roles played by medical physicists and clinical engineers.

The competencies, listed under the various subject headings in Section 4 of this Prospectus, describe the things trainees should become competent to do or discuss in order to be able to work in each of the named areas. These are generally practical tasks and activities and it will be noted that many of the listed competencies begin with words such as "perform", "operate", "measure" or "calibrate". Other areas of competence may involve familiarity with legislation or safety rules. These enable work to be performed safely, risks to be assessed in the particular area, or advice to be offered to others.

Competencies that use the words "describe" or "demonstrate an understanding of" require the trainee to have a scientific understanding of the underlying scientific or engineering principles and to be able to communicate that understanding.

For each subject attachment, the Training Supervisor needs to ensure that the Training Plan is followed and that facilities are provided to the trainee to allow him/her to achieve the competencies. The Training Plan will set out relevant activities, training methods, names of trainers and an approximate timetable. The Training Plan may contain elements such as private study, tutorials, observation, hands-on work, problem solving exercises and small projects. Although study and observation may be necessary at the early stages of training in a particular competence, **it is unlikely that the examiners will be convinced of competence without substantial evidence of direct hands-on experience.** This should be through a variety of practical scientific work rather than repetition of the same technical task. Also, the examiners will want to be satisfied of the basic competence of the trainee and, other than the particular subjects mentioned later, the training must not be restricted to a small number of detailed projects which could mask any deficiencies in the wider experience of the trainee.

Other than in exceptional circumstances documented by the Training Supervisor, all work (including clinical studies) reported in the portfolio must have been undertaken within the Training Centre. Reproducing examples from other sources such as the internet will not be acceptable.

**Any areas not covered by the trainee should be noted in the Training Supervisor's report together with any comments on these omissions.**

It is strongly recommended that, wherever possible, competence is demonstrated through practical work, small problem solving exercises and projects which the trainee has carried out personally. These activities should also give the trainee the opportunity to demonstrate his/her scientific and analytical skills, and show that he/she can work safely.

For those subject areas, which include a large element of design (i.e., Medical Engineering Design and Design of Medical Electronic Instrumentation), most of the training may be delivered through one or two major projects. For most other subjects however, large projects are unlikely to give the breadth of coverage required and small projects, which cover one or a few competencies, are usually more effective and would form only part of the overall training.

### **3.5 The Assessment of Part I Training**

Theoretical knowledge is assessed by the University which provides the accredited MSc course leading to an MSc qualification.

Assessment of the practical experiential training is carried out in three ways; by continuous assessment during training, by examination of the portfolio of evidence of training, and by *viva voce* examination. All three elements for all three areas of training are taken into account in determining the final grade of the trainee.

### 3.5.1 Continuous Assessment

The result of continuous assessment in each area of work is primarily provided by the Training Supervisor.

At the end of each major subject attachment, there will also be a discussion of the attachment and an assessment of the trainee's competence by the Training Supervisor and the Training Co-ordinator. The Training Supervisor will provide for the Training Co-ordinator a brief report as well as a confidential assessment of the trainee. This will be a measure of the trainee's performance against the competence list for the subject in question and will include a grading of the trainee's performance on a four point scale, corresponding to "distinction", "merit", "pass" and "fail". As mentioned in section 3.4, any areas not covered by the trainee should be noted in the Training Supervisor's report together with any comments on these omissions.

At the end of the whole training period, the Training Co-ordinator will also provide an overall assessment of the trainee's performance that will include an evaluation of performance in the acquaintanceship and core areas as well as in the Major Subject Areas. The Training Co-ordinator will send copies of his/her report and the three Training Supervisors' reports to IPEM at least 2 weeks before the *viva voce* examination. **Failure to provide these reports within this time limit may result in the trainee's *viva voce* examination being deferred to the next examination session.**

On receipt by IPEM, the Training Supervisors' reports will be distributed to the individual subject examiners who will note any issues highlighted by the Training Supervisor. The Training Co-ordinator's report is retained by the Chief Examiner and scrutinised following the *viva* process and before the award of a mark.

### 3.5.2 The Portfolio

Portfolios must be submitted for examination for each of the three Major Subject Areas. Each portfolio must be separate, as each has to be sent to a different examiner. Each portfolio must have the trainee's photograph on its front cover. This photograph must be digitally produced and be of passport size. **Any portfolios submitted without a photograph will be returned to the Training Centre and will only be considered for the *viva voce* examination, if they are returned to the Institute's Office in York with a photograph within one week of original receipt in York.**

Portfolios should be typed single sided on A4 paper, using single spacing and 12 point font. There must be a margin of at least 25 mm to the top, right and lower edges and at least 30 mm on the left edge. Portfolios must be individually spiral bound.

Each portfolio should be **between 60 and 80 pages in length**, including diagrams, graphs and data. Additional data, such as computer programmes, may be added as an appendix but may not be read by the examiner.

Text sheets should not be placed in transparent plastic envelopes as this adds weight to the document and the examiners have to remove the sheets for marking purposes. It is, of course, permissible to include diagrams, images, or other non-text elements within such envelopes. Each page should be numbered sequentially. This may be carried out manually after the portfolio has been assembled.

## *Portfolio Content*

The purpose of the training portfolios is to provide the examiners with evidence of the training that has been undertaken and to demonstrate the competence level and scientific ability of the trainee. The structure of each portfolio is likely to follow broadly that of the relevant competence list but should not follow it like a shopping list. It is usually more effective to present a series of reports covering the practical work, training exercises and projects carried out, each of which covers one or more competencies. For example, there may be a section on clinical applications that might include case studies, clinical measurements, treatment plans or a review of clinical applications. Practical work may include, for example, QC measurements, radiation surveys or design work. Some competencies, and particularly the scientific Core Competencies, may be covered best through project work.

Each report should contain some critical scientific analysis, together with evidence of some background reading, possibly with references showing, where possible, how the practical work links with theory. Ideally, the style of reporting should emulate that of a scientific paper. That is, there should be only enough background theory to support the work done, perhaps a short review of previous work and a statement of the aims of the present work. Descriptions of experimental procedures should include enough detail to allow the work to be repeated independently. Data should be presented in appropriate units and with specified uncertainties and should be carefully analysed and discussed. Repeated data, or measurements that do not contribute further information, are best left out as they only dilute the impact of the work. The intellectual level of the portfolio is expected to be similar to that of an MSc report although the examiners will not expect that all the material presented will have been addressed to this depth in the limited time available.

Whatever type of evidence is submitted, it is also expected to demonstrate those Core Competencies associated with communication and presentation skills. Ideally the portfolio should consist of well-presented and structured material that is interesting to read and free from inaccuracies and inconsistencies. These qualities are more likely to be achieved if the Training Supervisor has read and commented on the portfolio during its preparation.

The portfolio should include a list of contents, or summary page, identifying each section together with an indication of which competences are covered. MSc project work should not form part of the portfolio although a one-page summary may be included if appropriate.

Trainees are recommended to write up their work as they progress through the training rather than to leave it until the end of training.

The use of patient information in the portfolio and compliance with the Caldicott Principles is covered by a Guidance Notes on the IPEM website and trainees and those involved with providing the training must refer to it.

All Part I portfolios must have the following statement on the front page:

"This portfolio complies with the requirements of (XXXXX organisation) for patient data protection for teaching purposes. This portfolio is not within the public domain and no part of it will be placed in the public domain."

### 3.5.3 The *Viva Voce* Examination

Two of the Major Subject Areas will be examined at a central location to which the trainee will travel. The third subject, selected by the Institute, will be examined at the trainee's Training Centre.

For the subjects that are examined centrally, the portfolios need to be submitted to the IPEM office six weeks in advance of the examinations. **Failure to meet this deadline may result in the postponement of the *viva voce* examination.**

At the central location, each subject will be examined by an examiner who is a specialist in the subject area, together with a moderator. The moderator will examine the trainee on the core competences and acquaintanceship subjects, and will ensure continuity and uniformity of standards. The moderator will not have seen the portfolio prior to the *viva voce* examination.

Before the *viva voce* examination, the examiner will have read and marked the portfolio and will have prepared questions related mainly to the work it describes. Some standard questions may also be included to help comparison of candidates. Also some questions may be designed to explore important areas that were poorly covered in the portfolio.

Through the portfolio and the *viva voce* examination, the examiners will try to establish that the trainee has acquired an acceptable level of competence in the areas specified in the Prospectus for the subject studied. The examiners will take into account any gaps in the work undertaken (as noted in the Training Supervisor's report - see 3.4) and will make a judgement as to whether any omissions are serious enough for the trainee to be required to re-submit the portfolio with these omissions included and to re-sit the *viva voce* examination. The level of competency achieved involves demonstrating that the trainee can carry out relevant procedures, does not adopt unsafe practices and has a scientific approach to his/her work. Hence, it is important that the trainee is able not only to discuss the practical aspects of the work done, but also appreciates the strengths and limitations of the techniques used and the science behind them. The work of the trainee should also demonstrate scientific and problem solving abilities. These may also be explored to some extent in the *viva voce* examination.

At the Training Centre, a specialist subject examiner will assess the trainee in the third subject studied. The examiner shall have received the portfolio in time to make a proper assessment of it before the *viva voce* examination. The local examination should be conducted in a similar manner to the central examinations and should last a similar time, i.e. approximately 30 minutes. The local examination will be overseen and directed by the External Training Adviser who will act as examination moderator. With the consent of the trainee, the local subject Training Supervisor or the Training Co-ordinator may attend as an observer, but may not intervene in the examination (i.e., they cannot take part in the *viva* and they must leave the room at the same time as the candidate). The examiner and moderator shall take notice of the local examination guidance notes produced by the Institute.

The specialist subject examiners will have had no management responsibility for their candidates and no involvement with their training or with any mock *viva voce* prior to the examination.

### 3.5.4 Grades

Both the portfolio and the trainee's performance at each *viva voce* examination will be awarded a grade by the examiner using the scale of Distinction, Merit, Pass or Fail (or Distinction-Merit, Merit-Pass, or Pass-Fail in the case of borderline decisions). These will be used by the Chief Examiner together with the reports from the local Training Supervisors and Training Co-ordinator in determining an overall grade for the trainee. The grades are defined as follows:

**Distinction:** Awarded to trainees showing exceptional levels of competence, demonstrating strong levels of understanding, practical ability and general scientific skills.

**Merit:** Awarded to trainees showing significantly higher than average levels of competence, with no obvious weak areas of understanding, practical ability or general scientific skills.

**Pass:** Awarded to trainees showing acceptable levels of competence, with few areas of weakness in understanding, practical ability and general scientific skills, and who are considered to have adopted safe practices.

**Fail:** Trainees showing unacceptable levels of competence, with significant areas of weakness in understanding, practical ability and general scientific skills, or who have adopted working practices that could potentially be unsafe.

For each of the three Part I subject exams, the most important decision to be made is between a "Pass" and a "Fail". This decision is taken with reference to the criteria given above. The pass/fail decision for each subject is made by the subject examiner in consultation with the moderator, who both sign-off the moderator's record of the exam. In the case of a borderline pass/fail, the decision to award either a "Pass" or a "Fail" for that particular subject is taken in consultation with the Chief Examiner and the other subject examiners for that candidate, taking into consideration the reports of the Training Supervisor and Training Coordinator. The subject examiner will have received a copy of the Training Supervisor's report at the same time as the portfolio. This is always helpful in enabling the examiner to achieve a rounded view of the candidate, and is particularly helpful in borderline cases.

In the case of a "Fail" in a particular subject, the subject examiner writes a detailed report for the benefit of the trainee and Training Centre. This report, including recommendations for the way forward, is reviewed and edited by the Chief Examiner who may add his/her own comments, particularly where it is helpful to draw together comments made by the other examiners and by the Training Supervisor.

For candidates who reach the pass standard in a particular subject, there is a decision of secondary importance to be made; namely whether, for that subject, the portfolio and viva are graded as "Pass", "Merit" or "Distinction". Again, the criteria used are those laid down above and the decision is taken by each subject examiner in consultation with the moderator.

For candidates who achieve a pass standard or better in all three subjects, the overall level of the Diploma is normally decided by combining the three portfolio scores and three viva

scores. For each portfolio and viva score, the weighting factors attributed to F-P, P, P-M, M, M-D and D are 0, 1, 2, 3, 4 and 5 respectively. To be awarded a Distinction to DipIPEM(S), a total score of 24 or more is required; a Merit to DipIPEM(S) requires a total score of 12 to 23; a score of 11 or less is awarded a Pass to DipIPEM(S).

### **3.6 Communication of Results**

The results of the examinations are reviewed by the Chief Examiner. Individual results are communicated by first class post to the trainee. A full set of anonymised results is sent to the Training Co-ordinator and ETA by e-mail. The full set of results is reviewed by the Board of Examiners. The complete list of passes is published in "SCOPE". Only the overall grade will be communicated to the trainee.

There will be no communication of the results to trainees, their Training Supervisors or their Training Co-ordinators, by telephone or otherwise, in advance of the letter sent by first class post.

The Chief Examiner will feedback to the Training Co-ordinator and the Chair of the Training Centre Accreditation Sub-Panel any issues relating to a Training Centre which adversely affect its trainees.

### **3.7 Examination Re-sits**

Trainees who fail to satisfy the examiners in one or more subjects will normally be offered the opportunity to re-sit the examination(s) in the subject(s) failed. The Chief Examiner will provide confidential information to the trainee and his/her Training Co-ordinator on the reasons for failure, and may provide advice on areas where further work is necessary. The Training Co-ordinator should discuss these circumstances with the trainee and Training Supervisor and draw up a plan of work to prepare for the re-sit.

In the event of a failure, the trainee has the right of appeal to the Chair of CSETP if there are circumstances that may have affected his/her performance or the fairness of the examination.

Should a trainee fail in one subject, he/she will normally be offered the opportunity to re-sit that subject at the next examination session. Should the trainee fail in two subjects, he/she will normally be offered the opportunity to re-sit at the next examination-but-one to allow sufficient time for further training. Should the trainee fail in three subjects, he/she may be required to train for a further year before attending a re-sit examination. The Chief Examiner can, at his/her discretion, shorten these re-sit timings if the trainee has only a limited amount of remedial work to undertake.

However, it is emphasised that if a candidate fails in more than one subject, then the re-sit examinations cannot be taken singly.

Trainees will be allowed *no more than 2* re-sits in each subject failed BUT all re-sits must be taken within two years of the original failure and the overall timings set out in **Section 3.2** must be complied with in all cases.

When a trainee re-sits *and no additional training is undertaken*, the Training Co-ordinator and/or the Training Supervisor(s) may be required, at the discretion of the Chief Examiner, to supply an updated report on the trainee to the examiners.

However, *if the trainee undertakes additional training* at the original Training Centre, then the Training Co-ordinator must provide a report on this additional training.

Should the trainee move to a different location prior to the resit viva, and, if it is to the advantage of the trainee, it is permissible for the Training Co-ordinator for the additional training to change to one based at the location where the additional training is undertaken. However, it is stressed that any additional training must be provided within a Training Centre which is accredited for the subject concerned. In this particular case, the report provided on the additional training must be signed by the trainee, the original Training Co-ordinator and the new Training Co-ordinator.

## **4. Competence Listings for Part I Training**

### **4.1 Introduction**

This section is for the guidance of trainees, Training Supervisors, Training Co-ordinators and External Training Advisers. The competencies listed should be taken as a guide to the breadth of scientific application that should be achieved in each subject. This guidance is provided in part by particular words used to express levels of competence.

The Core Competencies should be applied to, and covered during, each trainee's three Major Subject Areas and included in the training plans for these. Where specific competencies cannot be covered in this way, it is the responsibility of the Training Co-ordinator to ensure that suitable additional training is provided. All Core Competencies must be covered by all trainees with the single exception of those listed under Engineering. These are intended primarily for those trainees taking Clinical Engineering Major Subject Areas and aiming for CEng in addition to Corporate Membership when they complete Part II Training. These trainees should also note the further guidelines included in Section 9 of this Prospectus which outline the requirements of the Engineering Council UK.

During their workplace training placements, trainees should apply the knowledge that they gain from their MSc course. They should learn to perform various operations under supervision and should be able to document and analyse what they do. They should be able to reflect on their work in written terms as well as in discussion with their Training Supervisor. A degree of assessment and judgement is expected, but the ability to assess a situation in order to give advice will be a major element of future Part II Training.

It is recognised by the examiners that slight variations in competencies will occur. All the competencies are written in terms of what is expected within each subject, but with an understanding that there will be variations between departments and, from time to time, within a particular department. These variations should be reflected in the Training Supervisors' and the Training Co-ordinator's reports on the individual trainee.

For acquaintanceship training, it will suffice that the trainee has an awareness of the major principles and applications of the particular subject area. For example, in Nuclear Medicine, the trainee might be expected to demonstrate an understanding of the principles of the operation of a gamma camera, to discuss the main clinical applications of radiopharmaceuticals in routine practice, and to have an awareness of the hazards involved in working with radioactive materials.

## 4.2 Core Competencies

*All Core Competencies must be covered by all trainees with the exception of those listed under Engineering that are intended primarily for those trainees taking Clinical Engineering major subject areas and aiming for CEng in addition to MIPEM when they complete Part II Training.*

The Trainee shall be able to:

### Scientific

- CC 1.1 demonstrate an understanding of the physics, engineering and life sciences relevant to a particular discipline;
- CC 1.2 demonstrate basic research skills to be able to identify problems, formulate hypotheses and develop an experimental plan to resolve a problem;
- CC 1.3 select and use appropriate measuring equipment;
- CC 1.4 recognise fault situations and take appropriate action;
- CC 1.5 assess and quantify errors in measurements and procedures;
- CC 1.6 search the literature effectively and critically;
- CC 1.7 demonstrate an awareness of emerging technologies and techniques appropriate to the Subject area being studied.

### Engineering *(for those seeking engineering registration)*

- CC 2.1 apply basic engineering principles to health care;
- CC 2.2 work through the different stages within the engineering design process;
- CC 2.3 select and use appropriate machine and hand tools in both mechanical and electronic fabrication;
- CC 2.4 demonstrate awareness of the environmental impact of the materials, components and processes used in the fabrication of medical equipment;
- CC 2.5 discuss the sources and implications of relevant UK and EU legislation;
- CC 2.6 demonstrate an awareness of emerging technologies and techniques appropriate to the Subject area being studied.

## **Clinical**

- CC 3.1 demonstrate an understanding of normal physiology and anatomy and the pathology and mechanisms of disease and trauma;
- CC 3.2 demonstrate an understanding of disease processes in areas relevant to the particular discipline;
  
- CC 3.3 demonstrate standards of appearance, personal hygiene and behaviour that engender the trust and respect of patients and clinical colleagues;
- CC 3.4 follow the Guidelines For Good Practice published by IPEM in the pamphlet Working With Patients;
- CC 3.5 demonstrate an understanding of medical ethics as it applies to Medical Physics and Clinical Engineering;
- CC 3.6 demonstrate an appreciation of the principles of clinical governance.

## **Management**

- CC 4.1 demonstrate an awareness of the functional structure of the organisation in which he/she is employed and his/her place in it;
- CC 4.2 demonstrate an understanding of the responsibilities of associated disciplines and the inter-relation between fellow professionals;
- CC 4.3 organise his/her time effectively;
- CC 4.4 demonstrate the ability to collect, collate and pass on information efficiently and effectively;
- CC 4.5 appreciate the limitations of his/her knowledge and experience and know when to seek additional guidance.

## **Communication Skills**

- CC 5.1 communicate effectively with clinical and professional colleagues understanding and practising the principles of confidentiality;
- CC 5.2 present material effectively through reports, presentations and seminars;
- CC 5.3 discuss appropriately with patients, procedures being undertaken;
- CC 5.4 demonstrate an ability to work within a team.

## **Quality and Safety**

- CC 6.1 demonstrate an understanding of, and apply the principles and practice of, Health and Safety at work to his/her own activities;
- CC 6.2 demonstrate an understanding of, and apply the principles of,

- quality assurance to his/her own work;
- CC 6.3 discuss the applicability of quality systems within Medical Physics and Clinical Engineering;
- CC 6.4 carry out a formal risk assessment of a procedure.

## **Computing**

- CC 7.1 be proficient in using general purpose computer software, such as word-processing, spreadsheets, databases and online references sources for clinical and scientific applications;
- CC 7.2 be proficient in applying different techniques such as shared filing systems and document and database management systems to organise data electronically;
- CC 7.3 demonstrate awareness of data exchange standards and NHS data security;
- CC 7.4 demonstrate an understanding of the implication and requirements of the Data Protection Act and the principles relating to security of information and data;
- CC 7.5 understand that the Medical Device Directive includes the concept that a computer can be an integral component in a “medical device” and be aware of related and relevant MHRA guidance and ISO standards;
- CC 7.6 understand the need for data exchange standards, such as DICOM and HL-7, as used in networked computer systems in common clinical use, such as PACS and Hospital Information Systems;
- CC7.7 understand the basic principles of applicable legislation, including the Data Protection Act, Computer Misuse Act and Freedom of Information Act, and of local policies;
- CC 7.8 understand the basic principles relating to clinical computing data security, including firewalls, virus protection, encryption, server access and NHS data security policies.

### 4.3 Radiotherapy

The Trainee shall be able to:

#### Dosimetry and Quality Control

- RT 1.1 describe the function and characteristics of the main items of equipment used in radiotherapy e.g. treatment units, ionisation chambers;
- RT 1.2 demonstrate an understanding of how machine performance parameters may affect the absolute dose and/or dose distribution to a patient;
- RT 1.3 operate therapy equipment safely (under supervision);
- RT 1.4 perform routine calibration and quality control tests for a representative selection of items of equipment used in radiotherapy including implementation of current UK Codes of Practice;
- RT 1.5 calibrate a field instrument for photon and electron measurements.

#### Treatment Planning

- RT 2.1 demonstrate an understanding of immobilisation devices and their application (to include mould room experience);
- RT 2.2 identify CT based anatomical data for planning and definition of target volume;
- RT 2.3 calculate doses at depth for electrons and photons for single, parallel opposed and irregular fields;
- RT 2.4 operate computer systems to produce treatment plans using 2D and 3D photon algorithms in conjunction with multi-slice CT data sets;
- RT 2.5 critically evaluate treatment plans and different methods of obtaining a suitable dose distribution;
- RT 2.6 demonstrate an understanding of the choice of energy of photons and electrons for clinical application;
- RT 2.7 calculate monitor units (or treatment time) taking into account field size factors, wedge factors, change of FSD and any other factors in common use;
- RT 2.8 demonstrate a working knowledge of the use of such terms as percentage depth dose, TMR, BSF etc.;
- RT 2.9 understand the effect of interfraction and intrafraction movement on the choice of CTV to PTV margins;
- RT 2.10 appreciate the limitations of TPS algorithms;
- RT 2.11 critically evaluate 2D and 3D image verification including the production of appropriate reference images and the effect of movement on the verification images.

## **Brachytherapy**

- RT 3.1 demonstrate an understanding of the dosimetry and planning principles and the independent verification of treatment times for intracavity treatments;
- RT 3.2 participate in the procedures for the safe use and custody of the different radioactive sources used in brachytherapy including wipe tests, the action to be taken if a source is lost, and formal disposal.

## **Quality Assurance and Safety**

- RT 4.1 demonstrate an understanding of the safe operation of imaging and treatment systems, including the purpose of interlocks;
- RT 4.2 demonstrate an awareness of environmental doserates around treatment units and perform doserate measurements with an appropriate survey meter;
- RT 4.3 discuss the scope, requirements and interpretation of relevant UK legislation, Codes of Practice, Local Rules and guidance and demonstrate an understanding of the practical implementation of local rules within all areas of radiotherapy.

## **4.4 Radiation Protection**

*In all competencies, unless specifically mentioned, the use of the term “radiation” shall mean both ionising (which includes x-rays at both high and low energies and radioactive materials) and non-ionising radiations.*

The Trainee shall be able to:

### **Use of Equipment**

- RP 1.1 outline the operation & function of the main types of equipment used for the production of radiation;
- RP 1.2 use a variety of instruments to measure the physical characteristics of the emitted radiation;
- RP 1.3 select, use and justify the choice of a detector and methodology for making a range of radiation measurements appropriate to radiation protection of staff and patients.

### **Radiation Control and Legislation**

- RP 2.1 demonstrate an understanding of the effects of radiation and associated risk factors;
- RP 2.2 describe the hazards and the practical staff safety measures

- and systems of work associated with a range of different uses of radiation;
- RP 2.3 outline the methodology of, and participate in, radiation risk assessments;
  - RP 2.4 participate in an audit of local safety arrangements and analyse and draw conclusions from the safety audit;
  - RP 2.5 describe Local Rules in the context of the local safety management structure in different radiation environments;
  - RP 2.6 perform measurements to assess radiation levels in the environment, including the assessment of staff exposure, and analyse and draw conclusions from these data;
  - RP 2.7 perform calculations to assess shielding/safety requirements for a particular radiation hazard and design safe and effective radiation facilities;
  - RP 2.8 perform appropriate measurements and/or calculations to assess patient dose for a range of applications and draw conclusions especially concerning the appropriateness of, and the risk from, the dose;
  - RP 2.9 discuss the scope, requirements and interpretation of relevant UK legislation, Codes of Practice, Local Rules and guidance.

### **Quality Assurance and Safety**

- RP 3.1 participate in the quality assurance and calibration of radiation measurement equipment.

## **4.5 Diagnostic Radiology**

*In all relevant competences the Trainee shall be able to demonstrate that appropriate test equipment has been selected and used to gather meaningful data.*

The Trainee shall be able to:

### **Equipment Performance Assessment**

- DR 1.1 demonstrate an understanding of the principles of, and the performance testing of, diagnostic imaging systems;
- DR 1.2 demonstrate an understanding of the principles of quality assurance as applied to diagnostic imaging systems;
- DR 1.3 perform measurements and test procedures etc. on a wide range of diagnostic imaging systems;
- DR 1.4 perform subjective observations and quantitative measurements to assess image quality on various types of equipment, including general radiographic and fluoroscopic systems and also to include at least two systems from computed radiography (CR), digital radiography, mammography, image intensifiers and computed tomography (CT);
- DR 1.5 analyse results and draw conclusions from these

- measurements;  
DR 1.6 demonstrate and understanding of the principles of optimisation of image quality and patient dose.

### **Patient Dosimetry**

- DR 2.1 perform appropriate measurements and/or calculations to assess patient dose for a range of examinations, which must include examples from radiographic, fluoroscopic, CT and mammographic examinations;  
DR 2.2 analyse patient dose measurements and, in the context of optimisation, draw conclusions;  
DR 2.3 assess, by simulation and/or measurement, patient dose reduction interventions;  
DR 2.4 calculate organ dose and Effective Dose, relate dose to risk and effectively communicate the risk.

### **Radiation Protection**

- DR 3.1 perform measurements to assess the hazards and demonstrate an understanding of the protection measures available to staff working in radiology departments;  
DR 3.2 perform measurements and calculations appropriate for the safe design of radiological facilities (with emphasis on the selection of suitable building materials);  
DR 3.3 discuss the scope, requirements and interpretation of relevant UK legislation, Codes of Practice, Local Rules and guidance.

## **4.6 Nuclear Medicine**

The Trainee shall be able to:

### **Use of Equipment and Clinical Applications**

- NM 1.1 describe the operation and function of the main items of equipment used in nuclear medicine, including gamma camera systems (with tomographic and hybrid imaging capabilities), PET camera systems, sample counters, radionuclide calibrators and intraoperative probes;  
NM 1.2 carry out routine operations (including data and image acquisition and processing) using examples taken for the above list of equipment, recognising artefacts in data and images and demonstrating optimal selection of data acquisition and processing parameters;

- NM 1.3 demonstrate an understanding of the facilities necessary for the production of radiopharmaceuticals;
- NM 1.4 prepare common Tc-99m labelled radiopharmaceuticals using appropriate protocols;
- NM 1.5 describe and demonstrate the salient features of common radionuclide images and tests including their clinical context and uses;
- NM 1.6 if local protocols allow, administer an oral dose of radioactive material to a patient;
- NM 1.7 demonstrate an understanding of a range of therapeutic procedures with radiopharmaceuticals.

### **Quality Assurance and Safety**

- NM 2.1 perform routine calibration and quality control tests for all major types of equipment used in nuclear medicine (this should include involvement with SPECT and /or PET), preparing and manipulating radioactive solutions to obtain suitable sources for such tests;
- NM 2.2 critically analyse the documentation and results of quality control procedures;
- NM 2.3 identify and apply radiation protection techniques to control exposure to external and internal radiation hazards and to utilise this knowledge to prepare radiation risk assessments;
- NM 2.4 identify the appropriate action following the occurrence of accidents or incidents and demonstrate decontamination techniques;
- NM 2.5 demonstrate an understanding of the role of clinical and organisational audit in Nuclear Medicine;
- NM 2.6 discuss the scope, requirements and interpretation of relevant UK legislation, Codes of Practice, Local Rules and guidance;
- NM 2.7 demonstrate an understanding of the legal standing and the practical implementation of local rules within all areas of Nuclear Medicine.

## **4.7 Magnetic Resonance Imaging**

The Trainee shall be able to:

### **Use of Equipment**

- MR 1.1 demonstrate an understanding of the basic role of the major components of an MRI system;
- MR 1.2 select appropriate RF coils and positioning for MRI of test phantoms or subjects;
- MR 1.3 use MRI equipment to obtain images of test objects;

- MR 1.4 select appropriate imaging protocols and/or parameters to produce T1, T2 and proton-density weighted images using basic spin-echo and gradient echo pulse sequences;
- MR 1.5 demonstrate familiarity with the more advanced imaging sequences and techniques in use at the training centre e.g. fast spin-echo, fast gradient echo, echo-planar imaging;
- MR 1.6 demonstrate an understanding of motion-artefact reduction strategies such as cardiac and respiratory gating and breath-hold imaging;
- MR 1.7 demonstrate a broad awareness of the range of commercially available MR systems, particularly with regard to field strength and clinical applicability.

### **Clinical Applications**

- MR 2.1 demonstrate familiarity with normal and pathological images obtained in common applications using simple pulse sequences;
- MR 2.2 demonstrate understanding of the role of imaging parameters in determining image contrast and the underlying effect of varying these parameters for spin echo and gradient-echo sequences;
- MR 2.3 demonstrate familiarity with two or more specialist techniques in use at the training centre e.g. MR angiography, MR spectroscopy, diffusion-weighted imaging, perfusion-weighted imaging, functional MRI;

### **Quality Assurance and Safety**

- MR 3.1 perform routine test procedures for image quality indices such as signal-to-noise ratio, uniformity and distortion;
- MR 3.2 be aware of the principal instrumental factors affecting image quality;
- MR 3.3 be aware of the principal sources of image artefacts in MRI and of methods for their reduction;
- MR 3.4 be aware of the potential biophysical and practical hazards of MR equipment, including hazards arising from cryogenics and in relation to fire protection and other emergency services;
- MR 3.5 be aware of the main provisions of national and international guidance on safety standards in MRI;
- MR 3.6 appreciate the differing safety implications of MR systems of different field strengths and/or designs;
- MR 3.7 demonstrate familiarity with the concept of the MR controlled area and with the administrative controls required to ensure safety in relation to this area.

## **4.8 Ultrasound**

The Trainee shall be able to:

### **Use of Equipment and Clinical Applications**

- US 1.1 describe the operation and function of the major components of an ultrasound scanner, including examples of new technology;
- US 1.2 use ultrasound equipment to obtain images of test objects and velocity information from peripheral arteries;
- US 1.3 discuss the choice of equipment and settings for particular clinical applications;
- US 1.4 recognise and explain artefacts of imaging and Doppler systems;
- US 1.5 recognise normal and pathological appearances in common areas of application using grey scale, colour flow, spectral Doppler and M-mode displays;
- US 1.6 demonstrate an awareness of therapeutic applications of ultrasound.

### **Quality Control and Safety**

- US 2.1 perform routine calibration and quality assurance tests on ultrasonic imaging systems and physiotherapy equipment;
- US 2.2 discuss quality assurance techniques for Doppler systems;
- US 2.3 analyse the results of calibration and quality assurance procedures;
- US 2.4 measure total acoustic power from diagnostic and physiotherapy ultrasound equipment;
- US 2.5 measure acoustic pressure and derived intensities from continuous wave and pulsed systems using hydrophones;
- US 2.6 carry out measurements to determine thermal and mechanical indices;
- US 2.7 discuss the rationale and application of thermal and mechanical indices;
- US 2.8 discuss the bioeffects that may be associated with the use of ultrasound, and the appropriate safety measures to be taken;
- US 2.9 demonstrate an awareness of relevant safety standards and guidelines for diagnostic and therapeutic ultrasound equipment;
- US 2.10 discuss the electrical hazards associated with the use of ultrasound equipment.

## 4.9 Medical Imaging

*This module provides training in **two** of the following imaging modalities: Nuclear Medicine Imaging, Diagnostic Radiology, Ultrasound, MRI. Trainees cannot choose any subject in this module that is also chosen as an individual subject module. The module is intended to provide a broad appreciation of medical imaging applications with in-depth training in image manipulation and assessment. The competencies apply only to the two imaging modalities selected from the list above, apart from competency MI 1.1 which applies to all four imaging modalities.*

The Trainee shall be able to:

### General

MI 1.1 compare the relative merits of all four of the imaging modalities listed above.

### Use of Equipment and Clinical Applications

- MI 2.1 describe the operation and function of the main items of equipment and acquire images using this equipment for further manipulation and processing;
- MI 2.2 describe the main clinical applications of each imaging modality;
- MI 2.3 recognise image artefacts;
- MI 2.4 demonstrate familiarity with normal and pathological images obtained in common applications (not applicable for Diagnostic Radiology);
- MI 2.5 demonstrate an understanding of the effect of bit depth and pixel size on image contrast and resolution;
- MI 2.6 use various image formats to transmit images between systems e.g. DICOM, interfile, proprietary formats, TIFF, JPEG, VRML etc;
- MI 2.7 perform basic image processing e.g. manipulating colour look-up tables and window settings used to display images, basic image enhancement (edge enhancement, smoothing), filtering in the frequency domain, the Fourier transform, dynamic image processing;
- MI 2.8 manipulate images using different display techniques e.g. the use of image reconstruction, multi-planar reformatting, 3D visualisation methods.

### Quality Control and Safety

- MI 3.1 discuss the principal instrumental factors affecting image quality and undertake routine test procedures to monitor image quality;
- MI 3.2 carry out measurements and test procedures to measure the performance of diagnostic imaging equipment;
- MI 3.3 discuss the scope, requirements and interpretation of relevant UK legislation, Codes of Practice, Local Rules and guidance;

- MI 3.4 work safely within controlled areas and demonstrate an awareness of the administrative controls required to ensure safety;
- MI 3.5 use protective clothing and equipment where appropriate.

#### **4.10 Non-Ionising Radiations**

The Trainee shall be able to:

##### **Use of Equipment and Clinical Applications**

- NI 1.1 demonstrate a basic understanding of the operation and function of common sources of coherent and incoherent radiation (e.g. medical lasers, UV phototherapy sources, blue light phototherapy sources, radio frequency sources, medical lighting);
- NI 1.2 demonstrate familiarity with several common clinical applications of medical lasers;
- NI 1.3 demonstrate familiarity with the common clinical applications of UV and blue light phototherapy;
- NI 1.4 demonstrate an awareness of the use of non-ionising radiations in other clinical techniques. (The range of techniques will depend on the Training Centre's specialist expertise but suitable techniques would be pulse-oximetry, laser Doppler techniques, photodynamic therapy, optical tomography, surgical lighting with reference to BS EN 60601-2-41 and research/novel applications).

##### **Quality Control and Safety**

- NI 2.1 use a variety of instruments to measure the physical characteristics of radiation from coherent and incoherent optical sources;
- NI 2.2 analyse and draw conclusions from the results of calibration and quality control procedures for coherent and incoherent optical sources;
- NI 2.3 demonstrate an understanding of the uncertainties associated with measurements of power and irradiance for coherent and incoherent optical sources;
- NI 2.4 demonstrate familiarity with the bioeffects and hazards of various sources of non-ionising radiation, and the safety measures to be taken;
- NI 2.5 demonstrate an understanding of the content of guidelines, safety standards and legislation relevant to non-ionising radiation;
- NI 2.6 discuss the local safety management structure and local rules

- NI 2.7 relevant to optical radiation sources, including medical lasers; demonstrate a basic understanding of the hazard assessment of medical lasers, to include calculation of the nominal ocular hazard distance (NOHD) for several different types of pulsed and continuous beam medical lasers;
- NI 2.8 demonstrate a basic understanding of the hazard assessment of incoherent optical sources and intense pulsed light sources, to include calculation of the maximum permissible exposure (MPE) time for different types of ultraviolet and/or blue light phototherapy devices;
- NI 2.9 discuss the choice of personal protective equipment for medical lasers and incoherent sources of UV and visible light.

#### **4.11 Physiological Measurement**

The Trainee shall be able to:

##### **Use of Equipment and Clinical Applications**

- PM 1.1 demonstrate a broad understanding of the principles of common physiological measurement procedures, the physiological processes involved and the significance of the measurements, covering examples from (i) electrophysiological signals and processing, (ii) pressure measurements, and (iii) flow measurements;

*(These represent basic requirements only and do not preclude the addition of other types of physiological measurement)*

- PM 1.2 identify the measurement of one parameter from each of the three examples of physiological measurement chosen and be able to demonstrate a detailed understanding of the principles, physiological processes and measurement significance. This should include the following:
  - PM 1.2.1 identify and justify the choice of equipment, including the placement / selection of the electrodes/transducer;
  - PM 1.2.2 use the equipment to obtain clinical measurements from patients;
  - PM 1.2.3 apply signal conditioning techniques, including methods to optimise the signal, improving signal to noise ratios and the role of filtering;
  - PM 1.2.4 identify artefacts and be aware of sources of error;
  - PM 1.2.5 undertake calibration procedures (applicable, where appropriate, to both stimulus and measurement equipment);
  - PM 1.2.6 apply appropriate statistical methods to draw conclusions as to the normality/abnormality of the data and/or the significance of any changes detected in response to stimulation or other intervention.

## **Quality Assurance and Safety**

- PM 2.1 identify the risks associated with the use of the equipment and the precautions to be taken with it (this must cover all three of the chosen physiological measurements);
- PM 2.2 perform measurements to ensure that the equipment used complies with all relevant safety standards (this must cover at least one of the chosen physiological measurements);
- PM 2.3 demonstrate implementation of current safety standards for the safe use of the measurement system in its clinical setting (this must cover at least one of the chosen physiological measurements);
- PM 2.4 carry out a formal risk assessment of a clinical procedure, device or software (this must cover at least one of the chosen physiological measurements).

## **4.12 Biomechanical Evaluation and Function**

The Trainee shall be able to:

### **Clinical Applications**

- BE 1.1 demonstrate an understanding of the human motor systems and the disabling conditions that give rise to motor / control deficits for a range of musculoskeletal and neurological conditions;
- BE 1.2 discuss the primary, secondary and compensatory effects of these conditions in both physiological and mechanical terms, including their biomechanical analysis;
- BE 1.3 demonstrate an understanding of human movement including normal and pathological gait;
- BE 1.4 use a variety of current clinical methods to assess mechanical and functional effects in patients in the clinical environment e.g. motor assessment, muscle activity, active and passive joint movement, activities of daily living;
- BE 1.5 demonstrate an awareness of related methods to assess quality of life and psychosocial scores.

### **Design and Use of Equipment**

- BE 2.1 use a range of clinical equipment to evaluate biomechanics and function (e.g. forces, movement, electrophysiology, interface pressure, shape and energy expenditure) including operation of a movement/gait analysis system to obtain both kinetic and kinematic data;
- BE 2.2 analyse and interpret the data obtained from the measurements;

- BE 2.3 recognise, quantify and discuss the errors in the measurements obtained and discuss their limitations;
- BE 2.4 specify, design and build a piece of equipment to be used in a biomechanical and/or functional assessment;
- BE 2.5 specify the approach required to validate this equipment against current clinical methods.

### **Quality Assurance and Safety**

- BE 3.1 identify the risks and limitations involved with each of the evaluations employed;
- BE 3.2 carry out follow up assessment of the patient;
- BE 3.3 undertake safety checks and calibration of the equipment used;
- BE 3.4 demonstrate an awareness of the appropriate standards and legislation.

## **4.13 Clinical and Scientific Computing**

The Trainee shall be able to:

### **Use of Equipment**

- CS 1.1 discuss the operation of the major components of computers, including hardware software and virtualisation;
- CS 1.2 undertake hardware configuration changes, such as for the installation of new devices and interfaces with appropriate risk assessment, testing and re-commissioning for clinical use (e.g. internal devices such a disk drives and external devices such as document scanners);
- CS 1.3 demonstrate an understanding of local and wide area networking with reference to the ISO modal, communications protocol, directory services and network topologies.

### **Software**

- CS 2.1 use and critically compare at least two standard operating systems such as Windows or UNIX and understand the system start-up options, login scripts, security management and routine “house keeping” tasks to keep a system secure and functional;
- CS 2.2 discuss common software development toolkits (e.g. Visual Basic, MatLab, LabView);
- CS 2.3 participate in the complete software-development cycle by developing a software specification to meet user requirements, converting the specification into a working application, preparing documentation and performing verification and validation, using appropriate project management methodologies and software standards;

- CS 2.4 undertake a critical comparison of the benefits and disadvantages of at least two different programming paradigms (e.g. high/low level and scripting languages) in at least one programming task;
- CS 2.5 demonstrate an understanding of different software development models, including open source methodologies;
- CS 2.6 demonstrate an understanding of software licensing principles, including common open sources licenses.

### **Applications in Healthcare**

- CS 3.1 outline the NHS strategy for the use of ICT in health and social care, including the efforts of professional and industrial bodies in this area (e.g. IPEM, IET, BCS, IHE);
- CS 3.2 practically apply and troubleshoot widely used data communications standards such as DICOM and HL-7;
- CS 3.3 apply ICT skills to a minimum of two problems (involving collaboration with a clinical scientist, clinical engineer or clinician), at least one of which shall entail the analysis of data (observations, signals or images);
- CS 3.4 participate in the routine management and administration of a major clinical system;
- CS 3.5 show technical familiarity with the major computer systems supporting at least two separate clinical areas.

### **Quality Assurance and Safety**

- CS 4.1 describe the implications of Health & Safety legislation related to computing equipment (e.g. Display Screen Regulations, electrical safety);
- CS 4.2 understand the principles of software testing;
- CS 4.3 discuss methods of protecting the security of a system including back-up and disaster recovery procedures, anti-virus software, firewalls, strong authentication, encryption and security audit;
- CS 4.4 describe data protection principles and associated legislation;
- CS 4.5 use anti-static precautions when handling electronic sub-systems, such as interface and memory devices;
- CS 4.6 apply relevant safety standards and guidance to the connection of computers to medical electronic equipment;
- CS 4.7 discuss relevant standards, e.g., ISO 9001:2008, ISO 13485:2003, ISO 14791:2007, in relation to the Medical Devices Directive and the use of computers in and with medical electronic equipment.

#### **4.14 Design of Medical Electronic Instrumentation**

*In covering these competences, the trainee is expected to produce at least one electronic instrument.*

The Trainee shall be able to:

##### **Use of Equipment**

- ME 1.1 use and justify the choice of equipment to measure signals in an electronic circuit;
- ME 1.2 identify and demonstrate the errors and limitations of the measurement techniques used;
- ME 1.3 identify, and justify the choice of components in an electronic circuit;
- ME 1.4 use and justify the choice of tools and techniques to produce an electronic circuit;
- ME 1.5 identify standard methods of fault finding and use them to fault-find in an electronic circuit.

##### **Electronic Design**

- ME 2.1 produce an initial specification from a clinical request;
- ME 2.2 implement a logical process for the design of a medical electronic instrument;
- ME 2.3 explain and justify how the design of an instrument meets a functional specification, particularly in comparison with other devices commercially available;
- ME 2.4 produce a prototype device that may, or may not, incorporate embedded software;
- ME 2.5 perform prototype assessment, identifying any performance characteristics that are inconsistent with the original specification;
- ME 2.6 test the completed instrument in the laboratory and in clinical use.

##### **Quality Assurance and Safety**

- ME 3.1 produce adequate and appropriate documentation (including block and circuit diagrams for hardware, flowcharts and appropriate comments for any embedded software);
- ME 3.2 consider the relevant quality procedures in the design, manufacture, and maintenance of electronic equipment for medical purposes;
- ME 3.3 perform a risk assessment for the design and use of an electronic device in clinical practice;

- ME 3.4 apply relevant safety standards and guidance to the connection of medical electronic equipment both to patients and to non-medical equipment e.g. computers;
- ME 3.5 demonstrate awareness of the Medical Devices Directive, the IEC standards for medical electrical equipment (EN60601) and Electromagnetic Compatibility (EMC) Compliance.

#### **4.15 Assistive Technology**

*In undertaking these competences it is expected that the trainee should gain some experience in the majority of the following areas of activity: seating and postural management; electronic assistive technology (EAT); functional electrical stimulation (FES); orthotics and prosthetics; mobility (both powered and self-propelled wheelchairs); aids for daily living.*

The Trainee shall be able to:

##### **Use of Equipment and Clinical Applications**

- AT 1.1 demonstrate an understanding of the human motor systems (including child development) and the disabling conditions that give rise to motor/control deficits for a range of musculoskeletal and neurological conditions;
- AT 1.2 assist in a patient assessment to identify and define individual requirements;
- AT 1.3 prioritise the functional implications of the main disabling conditions;
- AT 1.4 discuss with the patient and clinic team the needs and realistic expectations of assistive technology and the expected levels of enhancement;
- AT 1.5 identify indicators for any non-standard bioengineering requirements e.g. for patient with profound disability;
- AT 1.6 search effectively for any appropriate equipment that is commercially available.

##### **Specification, Design and Commissioning**

- AT 2.1 use and/or design and build appropriate equipment to meet patient requirements;
- AT 2.2 interface appropriate technology to enhance the use of equipment e.g. matching residual body movements to appropriate switches in EAT, and using sensors with control algorithms in FES;
- AT 2.3 identify suitable computer specifications and programs for particular assistive applications;
- AT 2.4 train and familiarise the patient and/or carer in the use of the

- AT 2.5 equipment;  
make appropriate adjustments to any equipment or its application to enhance function, comfort and safety;
- AT 2.6 document all work undertaken including instructions for use by patient and/or carer.

### **Quality Assurance and Safety**

- AT 3.1 identify indicators and contra-indicators for use of equipment;
- AT 3.2 understand and apply risk analysis to specification and solution;
- AT 3.3 use appropriate assessment/measurement techniques to evaluate performance;
- AT 3.4 demonstrate an awareness of the appropriate standards and legislation.

## **4.16 Medical Engineering Design**

*This set of competences is aimed at the design and development of mechanical and/or electro-mechanical medical devices. It is recommended that these competences are gained through involvement with at least two projects.*

The Trainee shall be able to:

### **Engineering Design**

- ED 1.1 develop a client specification;
- ED 1.2 prepare and present an outline project plan appropriate to a review meeting;
- ED 1.3 carry out and document a design feasibility study from a functional specification;
- ED 1.4 check that the requirements of the Medical Devices Directive and other appropriate standards and legislation are met in the design and manufacturing;
- ED 1.5 create acceptance and test specifications;
- ED 1.6 carry out conceptual and detailed part design using CAD and other media;
- ED 1.7 show familiarity with limits, fits and tolerances and justify selection of dimensional specifications;
- ED 1.8 source components and materials and assist in the preparation of a quotation.

### **Engineering Development**

- ED 2.1 identify appropriate manufacturing, fabrication and assembly techniques;
- ED 2.2 produce prototype and one-off devices;
- ED 2.3 perform prototype assessment, functional testing and approval testing;

- ED 2.4 prepare a prototype test report and carry out modifications and improvements according to the results of assessments and tests;
- ED 2.5 assist in the creation of manuals e.g. user, assembly, inspection, calibration and maintenance;
- ED 2.6 perform assigned tasks in installation and hand-over, including site surveys and purchasing.

### **Quality Assurance and Safety**

- ED 3.1 show awareness of the relevant quality procedures in design, development, manufacture and maintenance of medical devices and equipment;
- ED 3.2 show an understanding of drawing revision control;
- ED 3.3 perform a risk assessment for the design and development of a medical device;
- ED 3.4 identify and justify the choice of safety-related sections of the design of a device used in a safety-critical application.

## **4.17 Medical Equipment Management**

The Trainee shall be able to:

### **Use of Equipment**

- EM 1.1 explain the principles of operation of common types of medical equipment, including examples of diagnostic, therapeutic and life support devices;
- EM 1.2 discuss the benefits, limitations and risks associated with the use of these devices;
- EM 1.3 operate common types of medical equipment for the purposes of testing and recognise normal/abnormal readings and artefacts in common applications;
- EM 1.4 use a range of test equipment to check the function and calibration of medical equipment;
- EM 1.5 recognise potential sources of electro-magnetic interference.

### **Equipment Management**

- EM 2.1 measure the performance of medical devices in relation to alternative models and relevant standards using appropriate test equipment;
- EM 2.2 evaluate medical equipment (including pre-purchase and old) in relation to clinical requirements, risks and costs;
- EM 2.3 fault find in equipment of average complexity using standard methods;

- EM 2.4 calibrate diagnostic and therapeutic devices to appropriate accuracy, demonstrating traceability to national standards;
- EM 2.5 investigate adverse incidents involving medical equipment;
- EM 2.6 interrogate a medical equipment database and analyse information to obtain statistical data (including reliability, risks and maintenance costs);
- EM 2.7 apply statistical data and risk analysis to repair and maintenance processes;
- EM 2.8 discuss the manner in which modified equipment needs to be assessed in order to meet the requirements of the Medical Devices Directive (MDD), including the application of standard risk assessment techniques;
- EM 2.9 demonstrate an understanding of the due diligence required before modifying a medical device including a critical assessment of the reason for carrying out the modification, liaison with the manufacturer and with statutory and advisory bodies and considering the advice from the MHRA on medical device modification.

### **Quality Assurance and Safety**

- EM 3.1 discuss the requirements of the MDD and the application of these and technical standards to the safety and performance of medical equipment;
- EM 3.2 demonstrate, through inspection (including internal inspection) and testing, that medical equipment meets the requirements of relevant standards of safety and performance;
- EM 3.3 discuss the hazards to critical medical equipment from sources of EM interference, including mobile communication devices.

## **5. MSc Courses**

### **5.1 Background**

The syllabus for MSc courses will inevitably vary between courses, reflecting the particular interests and specialities of the University concerned. The intention of this section is to identify key features that should map on to the competencies listed in Section 4. Thus the Learning Outcomes for the MSc course, if it is to be accredited by IPEM for professional training, should overlap with those in Section 4. It is recognised that there is a need to acknowledge the two main pathways of the IPEM professional, i) the medical physics pathway and ii) the clinical engineering pathway. It is not anticipated that any one MSc course will cover all aspects. Indeed it would be undesirable to attempt to do so since it is likely to lead to knowledge and skills being too superficial.

The Institute recognises that the responsibility for maintaining the Master's level standards of MSc programmes rests with the University and is assured through the various quality

control measures that are in place. Thus the primary concern here is to be satisfied that the coverage of content and skills is appropriate for professional training of IPEM members rather than question the academic level at which the material is taught.

It is important to recognise the implications of the position taken by the Engineering Council UK regarding the status of the IPEM Training Scheme as a whole, for the purposes of gaining CEng status. Those trainees wishing to achieve CEng should take advice before embarking upon any particular scheme.

All trainees and Training Co-ordinators should also note that, if the accredited MSc that the trainee takes does not adequately underpin the three major subject areas selected for workplace training, further academic learning will be required.

## **5.2 Introduction**

The MSc Course Accreditation Sub-Panel of CSETP has the responsibility of scrutinising MSc courses with a view to accrediting them as being suitable for providing a component of professional training. The syllabus that follows indicates the knowledge and skills base that is deemed to be appropriate. It is implicit that any competencies that appear in Section 4 but are not adequately covered in Section 6 are the sole domain of the practical course of training examined by the portfolio and in *viva voce* examination (see Section 3.5).

In keeping with the principle of Core Competencies in Section 4, a set of Prescribed Topics is indicated. It is unlikely that a course will be accredited unless it addresses the majority of these topics satisfactorily. Over and above that is the balance between breadth and depth that is difficult to prescribe. Broadly speaking, for a course to be accredited, substantial overlap between the Learning Outcomes and the list given in Section 6 of this Prospectus must occur for at least three subject areas.

Universities wishing to apply for accreditation of an MSc course should, in the first instance, contact the Institute's office for the application form. Applications generally need to be submitted twelve months prior to the expected intake of students onto the course to be accredited. Accreditation is normally given for five annual intakes of students and needs to be renewed during the penultimate year.

## **5.3 Syllabus Structure and Details**

The syllabus is divided into two parts: the Prescribed Topics are a set of topics that is regarded as essential pre-requisites for any candidate hoping to embark on a career as a Registered Clinical Scientist and/or is seeking Corporate Membership. The Specialist Topics are grouped under similar headings to the competence listings in Section 4.

### **Prescribed Topics**

1. Anatomy, Physiology & Pathology
2. Radiation, Engineering & General Safety & Quality Management
3. Professional Topics

#### 4. Scientific Principles & Research Skills

The above four topics should encompass approximately one third of the total taught element in the course.

### **Specialist Topics**

1. Radiotherapy Physics
2. Radiation Protection
3. Diagnostic X-ray Physics
4. Nuclear Medicine
5. Magnetic Resonance Imaging
6. Ultrasonics
7. Non-ionising Radiations
8. Physiological Measurement and Functional Assessment
9. Information and Communications Technology
10. Medical Electronics and Instrumentation
11. Medical Engineering Design
12. Assistive Technology

## **6. MSc Syllabus Content Guide**

### **6.1 Prescribed Topics**

#### **6.1.1 Anatomy, Physiology and Pathology**

General structure and organisation of the body.

Anatomical position and nomenclature.

Surface anatomy.

Human development, cellular structure function and growth; tissue differentiation.

Pregnancy, growth and ageing. Homeostasis, metabolism.

Locomotor system - skeleton, head, trunk, limbs, joints, muscles.

Cardiovascular system - haematopoiesis, blood, respiration, blood flow.

Body fluids, renal, urinary, GI, reproductive, endocrine systems.

Integumentary system, senses and sense organs.

Neurological system, pathways, nerve conduction, key biosignals.

Introduction to the nature and effects of disease and trauma.

#### **6.1.2 Radiation, Engineering & General Safety and Quality Management**

X-rays, electrons (betas), neutrons, alpha and other particles

Radioactivity Units and relationships

X-ray production

Physical effects of radiation

Interaction processes with matter

Measurement and instrumentation

Biological effects of ionising radiation

Non-ionising radiations including ultra-violet (UV), radiofrequency (RF) and microwaves, lasers, infrared, magnetic fields and ultrasound

Medical applications including radiotherapy, conventional radiology plus X-ray computed tomography (CT), ultrasound and magnetic-resonance imaging (MRI), nuclear medicine including gamma cameras, single-photon emission computed tomography (SPECT) and positron-emission tomography (PET)

General Safety, first aid principles

Health and safety legislation  
Risk assessment techniques  
Fire safety  
Chemical safety; COSHH, hazards, storage, use and disposal  
Electrical safety; medical equipment, leakage currents, fault conditions, isolation and circuit protection;  
biological/physiological response to electric shock; treatment of electric shock; equipment testing  
Mechanical safety; lifting gear; guards and operation of machine and hand tools, eye and ear protection;  
fumes, dusts, moving and handling  
Biological safety; pathological and normal specimens; blood and other tissues;  
equipment contamination, cleaning, cross-contamination; handling procedures and protocols  
Theatre safety; anaesthetic agents, explosion hazard, waste gas extraction, function checks, obstacles, sterility  
Radiation safety; dose limits; national and international organisations and recommendations; legislation;  
principles of protection, safe practice, monitoring and reporting applied to:  
Ionising radiation  
UV, microwave, RF and magnetic fields, lasers and ultrasound  
Quality management

### 6.1.3 Professional Topics

Management structures/relationships  
Confidentiality  
Teamwork  
Presentation skills  
Healthcare delivery systems

### 6.1.4 Scientific Principles and Research Skills

Literature searching  
Critical literature evaluation  
Internet skills  
Experiment design  
Research ethics  
Clinical trials design  
Project planning/critical path analysis  
Report writing  
Graphical data presentation  
Verbal presentation principles and skills  
Data analysis, computing and networking (IT)  
Statistics - descriptive, probability distributions, use and value of statistical tests, parametric and non-parametric tests, multiple testing, transformations, correlation and regression.  
Qualitative research methodologies

## 6.2 Specialist Topics

### 6.2.1 Radiotherapy Physics

Malignant disease and role of radiotherapy  
Radiobiology  
Radiotherapy equipment (treatment machines and dosimetry equipment)  
Beam and dose control  
Beam modifiers  
Radiation interactions with the patient  
Dosimetry theory and methods in radiotherapy  
Data acquisition for treatment planning  
Characteristics of clinical beams  
Imaging in radiotherapy  
Target volume localisation; equipment and methods  
Principles of treatment planning  
Treatment planning systems and algorithms  
Clinical techniques

Treatment verification  
Use of sealed radioactive sources in radiotherapy including clinical dosimetry systems  
Therapeutic uses of unsealed sources  
Quality assurance, calibration, treatment accuracy and safety; standards  
Radiation protection specific to radiotherapy - local rules, protection measurements  
Computer control systems and information systems

### 6.2.2 Radiation Protection

Applied to ionising radiation and non-ionising radiation (including lasers, uv, rf and microwaves, ultrasound and magnetic fields)  
Physical and chemical effects  
Biological effects  
Protection quantity and units  
Risk factors and dose limits  
Risk-benefit, cost benefit analysis  
ALARA, ALARP  
Legislation, administration, and organisation  
Radiation working areas  
Protection Instrumentation  
Engineering control  
Design of facilities  
Personnel protection  
Patient protection and patient doses  
Population exposures  
Monitoring  
Special considerations for sealed radioactive sources  
Special considerations for unsealed radioactive sources  
Radioactive source transport and waste disposal  
Accident procedures and emergency planning

### 6.2.3 Diagnostic X-Ray Physics

Aims and problems in radiology; the radiological image  
Radiological equipment  
Measurement in diagnostic beams  
Interactions with the patient, geometric factors  
Radiological image recording systems and methods  
Contrast enhancement  
Digital radiography  
Computer tomography  
Mammography  
Clinical use of imaging modalities: relative clinical utility and method-of-choice  
Planar, multiplanar 3D and true 3D imaging methods  
Gated and time sequence imaging  
Imaging instrumentation  
Mathematical principles of image construction  
Image display characteristics and the user interface  
Image coding, storage and transmission  
Image processing and analysis: frequency methods, image restoration  
Quantification  
Patient dose control  
Quality assurance  
Radiation protection specific to diagnostic facilities

### 6.2.4 Nuclear Medicine

Radioactive decay and choice of radionuclides  
Specific properties of detectors for nuclear medicine  
Radionuclide production  
Radiopharmaceuticals  
Non-imaging tracer studies  
In-vitro assays

Imaging systems in nuclear medicine  
Clinical use of imaging modalities: image interpretation, relative clinical utility and method-of-choice  
Planar, multiplanar, 3D and true 3D imaging methods  
Gated and time sequence imaging  
Imaging instrumentation  
Mathematical principles of image construction  
Image display characteristics and the user interface  
Image coding, storage and transmission  
Image processing and analysis: frequency methods, image restoration  
Quantification  
Diagnostic applications and interpretation of radionuclide images  
Analysis methods in nuclear medicine  
Therapeutic uses of unsealed sources  
Patient doses and dose control  
Quality assurance  
Radiation protection specific to nuclear medicine  
Accident procedures

### 6.2.5 Magnetic Resonance Imaging

Principles  
Relaxation mechanisms  
Pulse sequences – image generation  
Scanner technology and artefacts  
Contrast media  
Spectroscopy  
Clinical applications  
Safety  
Quality Assurance

### 6.2.6 Ultrasonics

Nature of ultrasound  
Linear and non-linear propagation.  
Generation and Detection – transducers – piezoelectric effect  
Interactions with tissue – diffraction, reflection, scatter, absorption  
B- scanner principles – TGC, signal processing, image storage, array types.  
Resolution – focusing,  
Doppler – cw, pulsed, colour and power. The Doppler spectrum  
Contrast media  
Harmonic imaging  
Artefacts  
Ultrasound safety. On screen indices. Output measurement  
Quality assurance- test objects  
Clinical applications- to include Ob/Gyn, Cardiology, vascular  
Therapeutic applications of ultrasound

### 6.2.7 Non-Ionising Radiations

Sources -physical properties, biological effects, measurement, clinical applications and safety of:  
UV  
Lasers  
Infrared  
Microwaves,  
RF,  
Electric and magnetic fields.  
Rationale behind safety standards.

### 6.2.8 Physiological and Functional Assessment

Principles of patient care, Quality of life.  
Sources of physiological signals - electrical, pressure, flow, temperature, biochemical  
Detection of electrophysiological signals

Translation of physiological signals  
Safety issues relating to transducers and associated equipment  
Sources of artefacts  
Stimulation and evoked response techniques  
Instrumentation and signal processing  
Measurements in organ systems, e.g. cardiovascular, respiratory, neurological, urological  
Audiological and ophthalmological measurements  
Ambulatory monitoring  
Gait analysis, posture

### 6.2.9 Information and Communications Technology

Number representations  
Programming – languages, principles and practice  
Web authoring – tools and principles  
Operating systems  
Computer architectures  
Networks and communications  
Data security and management  
Overview of medical applications  
Neural networks and their applications  
Artificial intelligence and expert systems

### 6.2.10 Medical Electronics and Instrumentation

Electronic components  
Basic circuit design (analogue and digital)  
Microprocessor principles  
Data acquisition techniques  
Applied signal processing  
Biopotential electrode amplifiers  
Transducers and interfaces  
Interfacing computers, principles of wired and wire-free networks  
Telemetry  
Opto-electronics  
Electro-mechanical systems  
Ergonomics  
Intelligent systems  
Safety/reliability analysis of designs  
Instrumentation for physiological measurement and control  
Clinical applications of medical instrumentation system, e.g. electrophysiology, defibrillation, patient monitoring, drug delivery, endoscopy, life support, the operating theatre environment

### 6.2.11 Medical Engineering Design

The design process, and description of the problem to be solved  
Standards and requirements  
Prototyping and testing  
Technical Communication  
Tools and charts  
Project monitoring  
Outcome evaluation  
Finite-Element Analysis methods  
Design for All / Universal design  
Biomaterials  
Properties of cells, organs, tissues, tissue repair; tissue substitutes  
Biocompatibility, biotolerance, biodegradation  
Tissue integration, wear.  
Materials for implantation: composites, polymers  
Synthetic organs.  
Testing of materials, methods, standards, legislation.

## 6.2.12 Assistive Technology

Normal development and ageing

Understanding of communication, learning, mobility and neurological disabilities

Principles of patient assessment and rehabilitation plans

Sensory impairments and their treatment

Disability Legislation and Medical Devices Directives

Basics of ergonomics

Mobility and Postural management

Environmental controls, aids for daily living, smart homes, workplace adaptations

Augmentative and Alternative Communication

Functional electrical stimulation.

Outcome measures and research methods for assistive technology

Joints and joint movement:

Measurement of load and strain in the body.

Forces and movement in the body

Principles of kinematics and kinetics; energy and power

## 7. Part II Training

### 7.1 Part II Training as a route to Registration, Corporate Membership, CSci and CEng

Part II is a training period in which advanced trainees undertake a programme of advanced training over a minimum of two years that may lead to application to ACS for the Certificate of Attainment (and thence to Registration) and/or to Corporate Membership of the Institute (and, where applicable, Chartered Scientist and Chartered Engineer). The scheme is designed principally for those who have recently completed Part I Training. Part II Training may not be appropriate for those who enter the profession at a later stage in their career with specific independent experience; such people may be eligible for direct election to Corporate Membership, possibly through the acquisition of “bolt-on” modules. Please refer to Rule C:4 which gives details of the various routes to Corporate Membership.

Advanced trainees undertaking Part II Training will either have undertaken the IPEM Part I Training and have been awarded the Clinical Science Diploma of IPEM or will have entered the profession by an approved alternative route (e.g. after taking a relevant PhD). They are required to complete the Enrolment Form and submit it to the York office of the Institute. Applicants must be Associate Members of the Institute.

### 7.2 Objectives of Part II Training

Part II Training is designed to provide those who have acquired basic competencies in medical physics and clinical engineering across a range of specialities with further training and supervised experience in at least one speciality. This need not be one of those included in Part I Training but, if not, Part II advanced trainees have to demonstrate that

they have acquired the same level of basic competence that would have been expected for a major subject at the end of Part I Training.

Advanced trainees undertaking Part II who have not completed Part I Training are required to achieve the same breadth of basic competencies by following supplementary training in the early stages of the scheme; they are also required to have at least 3 years supervised pre-registration experience before applying for the ACS Certificate of Attainment (by Route Two). For these reasons, completion of Part II training will normally take longer than those who have completed Part I successfully.

### **7.3 Registration and Corporate Membership**

Part II Training is based upon an approved structured plan. This plan must provide the advanced trainee with sufficient training to allow application to ACS for its Certificate of Attainment and/or for application to the Institute for Corporate Membership. It should be noted that, the "approved training scheme" referred to in the ACS document refers to the Institute's Part I Training and the award of DipIPEM(S).

If Part II Training is intended only for an application for Corporate Membership (and, therefore, not Registration), then the need to comply with the ACS requirements is not relevant but compliance with the IPEM requirements still remains.

Most advanced trainees will apply for Registration after completing a minimum of two years of Part II Training. In order to become Registered, the advanced trainee will be required to comply with the guidance given by ACS on its web site ([www.assclinsci.org](http://www.assclinsci.org)).

Application to the Institute for Corporate Membership is a separate process to seeking the ACS's Certificate of Attainment. Applications for Corporate Membership may be made by any individual who can demonstrate compliance with the Institute's Guidelines for Election to Corporate Membership (Rule C:4). For those whose employment does not involve independent patient-related work in either NHS or private practice work, application for Registration may not be appropriate and an application to the Institute for Corporate Membership would be the only appropriate route for recognition of this high level of competence.

Progress during Part II Training is assessed throughout by a local Part II Supervisor, (with whom the advanced trainee has six-monthly appraisal meetings) and by an External Adviser appointed by the IPEM.

Advanced trainees who apply for enrolment on Part II Training are automatically registered for the Institute's Continuing Professional Development (CPD) Programme and are required to follow a balanced programme of CPD, agreed in terms of activity type, subject and duration with their Part II Supervisor, for the duration of the Part II Training. The content of CPD programmes for Part II Training should reflect the training and development needs of each advanced trainee and, typically, will have an emphasis on formal, well-structured modules as well as the acquisition of supervised experience.

Advanced trainees are required to maintain records of achievement, capable of audit, which demonstrate the competences acquired during Part II. Usually they will use the

material to produce the portfolio of evidence for submission in their application for the ACS Certificate of Attainment.

The application for Corporate Membership will normally include the following components:

- the ACS Certificate of Attainment **OR** a report of not more than 5,000 words to demonstrate clearly that the requirements set out in the Institute's Corporate Membership application [Rule C:4 (iii) (a)] have been fulfilled.  
(The comments made at the end of section 3.5.2 referring to patient information within portfolios also apply to Part II portfolios.)
- a statement that the advanced trainee is working in the general areas of the IPEM's professional interest or is working at a high standard as described in the Institute's Corporate Membership application Rule C:4 (iv) (a) or ( b),
- satisfactory, ongoing CPD record - this is implied by Rule C:4 (iii) (a), (b) or (c),
- two professional references, including one from the local Part II Supervisor, which gives an assessment of the advanced trainee's progress throughout Part II.

For advanced trainees who apply for Chartered Engineer registration concurrently with an application for Corporate Membership, a Professional Review Interview will be undertaken by a panel of Chartered Engineers from within the Institute.

#### 7.4 PhDs and Part II Training

PhDs are seen to be an important qualification for Clinical Scientists and it is realised that there are many ways of obtaining them.

(i) ***Some candidates will proceed to a relevant PhD following successful completion of Part I.*** In this case, it would be appropriate, and strongly encouraged, for the candidates to enrol for Part II Training if the following conditions are met:

- the candidate is carrying out the PhD in a medical physics or clinical engineering subject.
- the research work is being carried out in a NHS department (or equivalent) with, normally, some sort of academic appointment **OR** the work is carried out in an academic department with an honorary link to a NHS (or equivalent) department.
- the candidate is able to follow a balanced programme of CPD

If the PhD is full time and is completed in 3 years and the conditions above are satisfied, this would normally be equivalent to completing Part II Training. However, in addition, the advanced trainee should undertake a short appreciation of management skills that would fulfil those competencies listed by ACS to allow application for the Certificate of Attainment (if required). The advanced trainee could apply to ACS for the Certificate of Attainment after two years into the PhD work. This is the minimum time set by ACS but realistically, it would be more sensible for the trainee to seek the Certificate of Attainment on completion of the PhD work (but not necessarily waiting until the award of the PhD). On successful award of the PhD, advanced trainees could apply to IPEM for Corporate Membership since

generally, the PhD work and DipIPEM(S) would satisfy and amply demonstrate the requirement of Rule C:4 (iii) (b) and (iv) of the Institute's Corporate Membership requirements.

(ii) ***Some candidates will enter the profession with a relevant PhD and without undertaking Part I Training.*** The advanced trainee should enrol for Part II Training but would also undertake top-up studies to achieve Part I equivalence. A Guidance Note clarifying Part I equivalence for these individuals is available from the IPEM office.

A PhD could be part-time and, in this case, the timing and content of the different components of Part II need to be discussed with the Part II Registrar.

## **7.5 Enrolment onto Part II Training and consideration of the proposed training plan**

The application for enrolment, including the proposed training plan, must be submitted to the Institute for approval within a few months (but no later than 6 months) of the advanced trainee commencing the Part II. The maximum extent that an application for Part II enrolment can be backdated is 6 months.

To facilitate processing, applications are classified as standard or non-standard.

**Standard applications** are those where the applicant has recently successfully completed IPEM Part I Clinical Science training and is working as an advanced trainee scientist in Medical Physics or Clinical Engineering, under the supervision of a registered Clinical Scientist, in a NHS department or in an academic department with a formal link to a NHS department. Subject to referral to the Part II Registrar or the Assistant Registrar for resolution of any queries, these applications are allocated by the IPEM Office to an appropriate External Adviser for review. The External Adviser will normally either approve the training plan as it stands or suggest modifications to improve it, informing the IPEM Office accordingly. Exceptionally, the External Adviser may recommend that the training plan is wholly unsuitable and should be rejected, in which case the application would be referred to the Part II Registrar for review and decision on further action.

**Non-standard applications** are sent by the IPEM Office for initial scrutiny to the Part II Registrar or Assistant Registrar, who will inform the Office whether the application is approved for allocation to an External Adviser, possibly subject to comments or conditions. For applicants who have not completed Part I training, the Part II Registrar or Assistant Registrar will give particular consideration to the suitability of the applicant's previous education, training and experience and to whether that, taken together with the proposed training plan, allows for Part I equivalence to be achieved. Approved applications are then allocated by the Office to an External Adviser following the same process as for standard applications, subject to specific recommendations from the Part II Registrar or Assistant Registrar.

In all cases, the IPEM Office notifies the applicant of the outcome, including contact details of the External Adviser (for successful applicants).

## **7.6 Specialist Subject Areas**

The specialist subject areas are as described as "sub-modalities" of Medical Physics & Clinical Engineering by the Association of Clinical Scientists.

Generic competences are included in Section 8. It is emphasised that the competencies listed in Section 8 are such as to comply with the Institute's Corporate Membership requirements but the ACS's requirements in relation to seeking the Certificate of Attainment should also be adhered to if the trainee is to seek both of these endpoint outcomes. For those who wish to seek Corporate Membership only, then the competencies listed in Section 8 are the only appropriate set to achieve Corporate Membership.

## **7.7 Local Part II Supervisor**

The Part II Supervisor should be a Clinical Scientist employed at Band 8 on Agenda for Change or equivalent status in the advanced trainee's department. To supervise a pre-Registrant, the supervisor must also satisfy the ACS requirements. S/he is normally an expert in the advanced trainee's subject area. For advanced trainees aiming for Chartered Engineer registration in addition to Corporate Membership on completion of Part II, the Part II Supervisor must him/herself be a Chartered Engineer. In some departments, therefore it may be appropriate to have more than one Part II Supervisor.

The Part II Supervisor will

- develop a structured plan of advanced training over a minimum period of 2 years with the advanced trainee, aimed at both the ACS competencies and Corporate Membership competencies (or only the latter if Registration is not being sought),
- appraise the progress of the advanced trainee every six months and modify the programme as necessary,
- make written reports of appraisal meetings for the information of the External Adviser and subsequent audit,
- confirm to the advanced trainee the competences achieved,
- indicate to the advanced trainee instances where the achievement of competences has fallen behind programme,
- provide additional support for areas of difficulty,
- provide a reference for the advanced trainee's Corporate Membership application (if required) and, where applicable, the advanced trainee's Chartered Engineer registration interview – both these being based upon an assessment of the advanced trainee's Part II performance,
- send copies of all documentation relating to assessment, including Part II bi-annual appraisal reports, to the External Adviser.

## **7.8 External Advisers**

For each advanced trainee, an External Adviser will be appointed by the Institute. The External Adviser is available for consultation by telephone, or in person, if the advanced trainee wishes to make the journey for a face-to-face meeting.

The External Adviser will give advice to the advanced trainee and the Part II Supervisor on the implementation and progress of the Part II programme.

The External Adviser will also review the reports of the Part II Supervisor after appraisals of progress and will normally be consulted at the end of the Part II training when applications (as applicable) to (i) ACS for the Certificate of Attainment and to (ii) IPEM for Corporate Membership (and Chartered Engineer registration, if appropriate) is being considered.

## **7.9 The Role of Mentor**

A mentor should be sought and valued by all professional staff, whatever their experience and level in the organisation. Senior staff are likely to have peer-level mentors in other departments. Less experienced staff, including staff undertaking Part II, should have more senior physicists or engineers as mentors who may work in the same department but, preferably, are not in a line management relationship. The role of mentor is that of wise counsellor, who is committed to developing and maintaining an ongoing relationship of advice and support with mentees. To be effective in the role, a mentor should not attempt to be mentor to more than four individuals at any one time. The mentor is identified as holding a key role in the Institute's Continuing Professional Development Scheme and is seen as crucial for staff undertaking Part II as it is for staff who have attained full professional competence and seek to maintain it.

## **7.10 Assessment for Corporate Membership and Chartered Engineer Registration**

For those advanced trainees who have undertaken Part I Training, assessment for Corporate Membership and possible Chartered Engineer registration cannot take place earlier than two years from enrolment onto Part II.

The Institute ensures that each application for Corporate Membership is scrutinised by at least one of its team of assessors. For those who apply for Corporate Membership having been awarded the Certificate of Attainment, then a second interview would normally not be necessary. The assessor(s) can recommend acceptance for Corporate Membership immediately but, if there is a question as to whether the required standard for Corporate Membership has been reached, then another opinion will be sought. In some cases, an interview may be arranged.

If an advanced trainee wishes to apply for Corporate Membership without having gained the ACS Certificate of Attainment, then a formal interview with two assessors will be arranged at the completion of Part II Training.

For advanced trainees who apply for Chartered Engineer registration concurrently with an

application for Corporate Membership, a Professional Review Interview will be undertaken by a panel of Chartered Engineers from the Institute.

### 7.11 Corporate Membership and Certification

Candidates successful at interview are awarded Corporate Membership of the Institute (MIPEM) and, where applicable, awarded Chartered Scientist (CSci.) and registered as Chartered Engineers (CEng) only when all admission fees and current annual subscriptions have been paid.

The Certificate of Corporate Membership, when issued, remains the property of the Institute and must be returned when membership of the Institute ceases for whatever reason.

### 7.12 Guidelines for preparation of the submission to ACS or a direct submission to IPEM

The ACS publishes guidance notes on its website to help applicants wishing to apply for its Certificate of Attainment. These guidelines should be adopted by those seeking the Certificate of Attainment but **for those who seek Corporate Membership only, the following gives guidance on the preparation of information during the Part II training.** Clearly, there will be a great deal of overlap between these two sets of guidance and it is sensible to take notice of both sets of advice.

1. *Assembly of Material:* Throughout the Programme you should be assembling a *Record of Achievement*. This is a collection of documents that evidence the training and experience you have acquired, together with examples of your work. This record should become the basis of your Part II Report.
2. *Size:* The Report should not normally exceed 5,000 words in the main text. Additionally it is permissible to include or append illustrations and examples of documents (which might include publications); such inclusions or appendices need not be subjected to a word count.
3. *Presentation:* the Report should be physically presented so that the pages can be read like a book. The Report must be spiral bound. Assessors do NOT recommend the use of plastic pockets with inserted pages; it is much more convenient if the original papers are hole-punched and assembled in a spiral binder. Index cards or markers are useful to separate sections.
4. The Report should begin with a *Table of Contents*.
5. The first item should be a *brief CV* (1 or 2 pages), summarising your higher education and professional career to date.
6. The next items should be your agreed *Training Plan* and your *Job Description*. A department structure diagram, showing your place in it is also helpful.
7. The Report should contain *evidence of activities* that have led to your development of the required competences. Examples of the kind of things to include are protocols you have written, procedures you have helped to develop, designs, internal reports, published papers, and any other outputs of your work.
8. *Projects* are a good way of attaining and demonstrating many competences, particularly the core competences, and you should try to include at least one project

- report.
9. A *list of courses, meetings, seminars* attended is also valuable, even more so if you include a brief critique of each and point out its value to you.
  10. Remember that your aim is to assemble a body of evidence that demonstrates you have acquired the relevant competences and have worked well in a position of responsibility in the field. Try to include summaries of instances where you have taken a leading role in dealing with scientific and/or clinical problems.
  11. There is no particular merit in documenting the fact that you have had the opportunity to acquire a particular competence several times. Keep the Report concise and focused and do not, in any event, let it run to more than one binder.
  12. Pay attention to thoughtful selection and classification of material to include: the way you put it together and present it is itself an indicator of some of the desired competences.
  13. If you have developed a particular interest (e.g. have embarked upon a research project) then draw attention to it even if the work is incomplete.
  14. The Report should be your own work. Any supporting pages that contain work of which you are not the author or co-author should be clearly marked "N.O.W." (meaning "not own work") in the top right-hand corner. Sources must be quoted. In some circumstances it may be appropriate to include an "acknowledgements" section.
  15. You should consult your local Part II Supervisor for advice during the preparation of the Report. Your External Advisor may also be consulted.
  16. You will be required to submit **two copies** of the Report to the assessors, and you should also keep a copy for yourself.
  17. Finally, please *number all the pages*, and check that the Table of Contents indicates the correct page numbers.

### **7.13 Additional guidelines for the report when Part II Training is also the route to Chartered Engineer Registration.**

A detailed set of notes is provided by the Institute to help those seeking CEng registration and this includes those undertaking Part II Training. Please refer to these notes (Chartered Engineer Registration Guidance Notes, August, 2004).

## **8. Achieving Competence during Part II Training**

Part II competence implies the ability in many, but not all, instances to perform without supervision, to make independent professional calculations and judgements, to supervise junior staff and to provide a service in a specified area of work. Training at this level will emphasise the need to recognise and define situations where measurements, calculations or conclusions may need to be developed independently using initiative, but with feedback to Head of Section or other immediate line manager.

Advanced trainees at this level will be working under a senior colleague in a major section of Medical Physics and Clinical Engineering (with possibly some time in other sections) for a minimum of 2 years. As such they are likely to be involved in the provision of a service according to established procedures and protocols and have a part to play in supervising the work of junior staff and helping to provide Part I Training. They will take some responsibility for checking the quality and accuracy of routine work performed by these staff. They will also take a full part in quality control procedures, calibrations etc. and in record keeping. If possible, the advanced trainees should be asked, under supervision, to develop and introduce new procedures into the work of the section. These should include providing full departmental protocols.

In addition, it would be desirable for the advanced trainee to develop, as a project, a particular area of endeavour to be written up and published.

**Throughout Part II Training, there should be a strong emphasis on innovation and critical thinking. It is essential that the future medical physicist or clinical engineer develops a deep sense of investigation in his/her work. This philosophy should underpin all the training elements. Approaching the competencies in a "tick box" manner will not be sufficient to satisfy the assessors who will be looking for a scientific rather than a technical approach to the subject matter.**

During Part II Training, it is expected that the advanced trainees will be able, and indeed encouraged, to broaden their knowledge base not just in physics, but also in all aspects of the chosen subject area, particularly the clinical. This will be achieved by the normal processes of reading relevant journals, and also by attending specialised lectures and conferences. The advanced trainees should provide evidence of this and any other relevant material.

In the context of training, these Part II competencies are only applicable to those applicants for Corporate Membership who do not hold the ACS Certificate of Attainment

**8.1 Scientific.** The advanced trainee shall be able to:

- HC 1.1 perform and advise on more complex procedures, measurements and calibrations;
- HC 1.2 critically appraise current procedures, applications and strategies within a particular discipline;
- HC 1.3 demonstrate an awareness and understanding of new developments and techniques;
- HC 1.4 specify, evaluate and commission an item of equipment, system or facility and produce protocols for its safe and effective introduction into service;
- HC 1.5 design and supervise construction of equipment not commercially available
- HC 1.6 undertake research and development programmes using a range of skills to enable critical review of literature, formulation of hypothesis design and conduct of appropriate experiments and critical appraisal and dissemination of results.

**8.2 Clinical.** The advanced trainee shall be able to:

- HC 2.1 understand the significance of diagnostic results and other data and be able to advise on the application of diagnostic or therapeutic techniques.
- HC 2.2 maintain an up-to-date knowledge of clinical practice within a particular discipline.
- HC 2.3 design, introduce and evaluate new or improved methods used in diagnosis, treatment and rehabilitation.

**8.3 Management.** The advanced trainee shall be able to:

- HC 3.1 understand the principles of management and demonstrate an involvement in managing staff and resources.
- HC 3.2 manage research and development projects including grant application and ethical committee approval.
- HC 3.3 understand the principles of quality assurance, audit, safety and accreditation relevant to a particular discipline.
- HC 3.4 critically appraise the safety, security and legal aspects of computer based patient information.

**8.4 Communication Skills.** The advanced trainee shall be able to:

- HC 4.1 present material effectively in scientific publications and lectures.
- HC 4.2 contribute at a professional level to clinical teams.
- HC 4.3 demonstrate an ability to communicate and explain complex or sensitive issues to patients, relatives and staff.
- HC 4.4 demonstrate an involvement in the training, supervision and education of other staff.

**8.5 Quality and Safety** . The advanced trainee shall be able to:

- HC 5.1 interpret and apply current legislation, codes of practice, guidance notes and related documents appropriate to a particular discipline.
- HC 5.2 interpret and apply appropriate standards, in particular British and European standards.
- HC 5.3 organise and conduct appropriate audits and surveys and demonstrate the consequence of such procedures.
- HC 5.4 review and analyse the results of quality control procedures and demonstrate an ability to discuss with others the findings, implications and actions required.
- HC 5.5 take appropriate action in the case of incidents and accidents.
- HC 5.6 analyse and advise on health and safety issues within a particular discipline.

## **9. Requirements for Structured Engineering Training**

### **9.1 Introduction**

In order to attain Chartered Engineer registration, candidates need to meet standards published by the Engineering Council UK which can be satisfied by meeting the Institute's requirements for education, training and responsible experience.

There are currently two routes to achieve this.

The Part I and Part II Training is one route, which has been described earlier in this Prospectus. Through this route, trainees and advanced trainees who wish ultimately to seek CEng registration are advised to pursue a training scheme with a significant engineering emphasis. The engineering competences are intended to make this possible, without sacrificing the important requirement for broad based training at this early stage in a candidate's career. Advanced trainees will be required to demonstrate that, as they progressed through the Part II Training, they assumed an increasing degree of responsibility for their work.

The alternative route is by direct application to the Institute.

### **9.2 Detailed requirements**

There is little benefit in reproducing the existing documentation relating to engineering training leading to CEng. Readers are advised to refer to *Chartered Engineer Registration Guidance Notes* (available from the IPEM office) and the Engineering Council's booklet entitled *Chartered Engineer and Incorporated Engineer Standard*.

## 10. The Associate Physicists & Engineers Network (APEN)

The Associate Physicists and Engineers Network (APEN) exists to promote communication amongst Associate physicist and engineer members of the IPEM, and the wider IPEM community. APEN is run by a Panel of seven elected Associate Members of IPEM. They represent the interests of Associate members hoping to achieve Registration as a Clinical Scientist, including Part I and Part II Trainees, within the Institute. To ensure that trainees' voices are heard, panel members sit on the following standing committees: Council, Professional Committee, Professional and Standards Board, Clinical Scientists' Education & Training Panel (CSETP), Professional Development Panel (PDP) and the Engineering Advisory Group.

The APEN Panel organises various events that are designed to facilitate its members' progression through the training schemes. These include Presentation and Communication Skills Workshops and Induction Days for new Part I and Part II Trainees. Attendance at these meetings, particularly the Induction Days, is not mandatory but does provide valuable information for the trainee. It also helps to foster links within the trainees' networks. The Panel also organises trainee presentation sessions at the Institute's annual Medical Physics and Engineering Conference (MPEC), which provide a less daunting forum for Associate physicists and engineers to talk about their work to an audience of peers. There are APEN social events throughout the year to provide an informal atmosphere to meet other trainees from centres across the UK.

Communication between the APEN Panel and APEN members is primarily via the IPEM Newsletter. Articles for publication in the newsletter are always welcome and should be sent to the address below. APEN also have pages on the IPEM website (you need to be logged in to see these) and it is hoped that in the future this will be another useful means of communication.

APEN Panel members sit for a maximum of three years and vacancies are advertised in the IPEM Newsletter in June/July each year. New APEN Panel members are elected by the current Panel and take up their post in September following the MPEC.

If there is anything you feel that the Panel can do for you in your training then feel free to get in touch with questions, complaints, suggestions or articles for the Newsletter. The Panel are also happy to offer advice on a one-to-one basis as appropriate. You can contact the panel:

By Post: APEN  
c/o IPEM Office  
Fairmount House  
230 Tadcaster Road  
York  
YO24 1ES

By e-mail: APEN@IPEM.ac.uk

## **11. Contacts:**

Should you have any queries regarding the information in this Prospectus, please do not hesitate to contact the Membership & Training Manager at the Institute's Office in the first instance. If unable to deal with your query, she will be able to put you in contact with the relevant member of the Institute's Professional and Standards Board or the Clinical Scientists' Education & Training Panel.