



INTERNATIONAL SOCIETY FOR PROSTHETICS AND ORTHOTICS

**CATEGORY I PROFESSIONAL – PROSTHETIST/ORTHOTIST,
ORTHOPAEDIC ENGINEER, ORTHOPAEDIC MEISTER**

INFORMATION PACKAGE

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1. INTRODUCTION

1.1 Summary

This information package is intended to provide guidance for any country or organisation involved in the establishment of a course which will satisfy the standards of the International Society for Prosthetics and Orthotics (ISPO) in respect of the training of the Category I professional worker (Prosthetist/Orthotist).

It contains a description of the professional profile of the Category I worker (Prosthetist/Orthotist). For comparison it also contains at *Appendix A* the Professional Profile of the Category II worker (Orthopaedic Technologist). It gives an example of an appropriate Code of Ethics. It describes the learning objectives of a course for Category I workers and at *Appendix C* gives an example of an acceptable syllabus. It describes appropriate arrangements for final examinations for a Category I course.

It also outlines arrangements for recognition by ISPO of training programmes and for registration of those who qualify through attendance at such programmes or otherwise meet the same educational and training standards.

1.2 ISPO categorisation

A major difficulty encountered in this field is that of nomenclature. Different titles are used in different areas for the same kind of worker and this confusion is made worse by differences introduced by language and translation. This led ISPO to develop a categorisation system which would be based on the levels of education and training provided and would avoid dependence on titles.

The categories may be displayed as follows :

Category I Prosthetist/Orthotist (or equivalent term)
Entry requirement: University entry level (or equivalent, 12/13 years schooling)
Training: 3/4 years formal structured leading to University Degree (or equivalent)

Category II Orthopaedic Technologist (or equivalent term)
Entry requirement: 'O' level (or equivalent - the usual requirement for paramedical education in developing countries – normally 11 years schooling)
Training: 3 years formal structured - lower than degree level

Category III Prosthetic/Orthotic Technician (or equivalent term)
Entry requirement: Elementary school diploma
Training: On the job

The Society's education philosophy encompasses these three categories and has been concentrated on Category I and II professionals who take part in patient care activities as opposed to Category III workers who are only concerned with manufacture and assembly.

It must be emphasised that this is not an attempt to describe all of those who work in this field throughout the world. It is a description of the levels of education and training which the society believes meantime represent the desirable levels for those involved in patient care in the developed and the developing world respectively and in the support function of manufacture and assembly.

For the industrial world, the Society believes that the Category I professional prosthetist/orthotist should, for the future, be educated and trained at University Degree level or equivalent. It further believes that although there are many different approaches that can lead to this level of training and education any course must consist of :

- a) teaching of theoretical subjects
- b) closely supervised practical instruction
- c) structured and controlled clinical experience

Many industrial countries do not at present satisfy this goal.

It is recognised that at present training in Category I does not normally exist in the developing countries and is mostly available in the industrial world. Despite this it is felt important that some personnel in developing countries should be trained to this level to provide leadership for the prosthetic/orthotic profession and be responsible for education and training within their own countries. It is anticipated, however, that the majority of the clinical service will be provided by Category II personnel who should work under Category I direction, wherever possible.

The concept of Category II responsibilities is regarded as an interim solution for the developing world although it is recognised that a dynamic situation exists.

It is also considered mandatory that Category I and II training is related to clinical service centres.

The question concerning the extent of instruction to be offered in the fabrication of components to Category I and II practitioners has also been considered. In general, industrial world components are not available in the developing world. Although these components can be made by Category II orthopaedic technologists, they can also be made by Category III individuals and/or a variety of craftsmen. Therefore, it is possible for this time consuming activity to be reduced in the training of the Category I and II practitioner, provided that the products available consistently meet appropriate specifications.

There are clearly different approaches which will satisfy the requirements of Category I education and training. The general aims are identified above. An appropriate course will contain the same essential elements. The duration should normally be three or four years. Such a course would normally be followed by a year's internship.

It is true that many workers involved in patient care in the developed and the developing world do not meantime fall precisely into these categories (i.e. Category I and Category II respectively). The categories do, however, represent a goal for the workers to achieve and an objective for ISPO in providing and fostering training programmes to assist them in doing so.

2. PROFESSIONAL PROFILE FOR CATEGORY I (PROSTHETIST/ORTHOTIST, ORTHOPAEDIC ENGINEER, ORTHOPAEDIC MEISTER ETC.)

The following professional profile has its basis in the Report of the United Nations Inter-Regional Seminar on Standards for the Training of Prosthetists (UN, 1968) - the so-called Holte Report. It has moreover been modified to comply with Guidelines for Training Personnel in Developing Countries for Prosthetic and Orthotic Services (WHO, 1990) and further refined by the Education and Certification Committees of ISPO.

2.1 Patient care

Formulation of treatment

- 2.1.1 Participates as full member of the clinic team; takes part in the examination and prescription; and advises on the design of the prosthetic/orthotic device, including the socket or body/device interface, suspension and selection of proper components.
- 2.1.2 Assists and advises on relevant aspects of pre-surgical, post-surgical, medical and therapeutic management of individuals requiring prosthetic/orthotic devices.
- 2.1.3 Records and reports any pertinent information regarding patients and patients' families, including a determination of expectations and needs.
- 2.1.4 Communicates appropriate information to the patients and their families.

Fitting, fabrication and treatment

- 2.1.5 Supervises and directs the activities of individuals in Category II (orthopaedic technologist) and Category III (orthopaedic technician) in fitting and fabrication.
- 2.1.6 Identifies physical and other relevant characteristics of the patient.
- 2.1.7 Formulates prosthetic or orthotic designs, including selection of materials, components and additional aids.
- 2.1.8 Takes all casts and measurements required for proper fabrication and fitting.
- 2.1.9 Modifies positive and/or negative models and/or layout of design to obtain optimal fit and alignment.
- 2.1.10 Carries out fitting, static and dynamic alignment and, where appropriate, preliminary training and initial check-out.
- 2.1.11 Performs and/or supervises fabrication of the prosthesis or orthosis.

Evaluation and follow-up

- 2.1.12 Advises the team and participates directly in final check-out and evaluation of fit, function and cosmesis.
- 2.1.13 Instructs the patient or family in the use and care of the device.
- 2.1.14 Takes part in follow-up procedures as well as maintenance, repairs and replacement of the appliance.
- 2.1.15 Recognises the need to repeat any of the identified steps in order to optimise fit and function.
- 2.1.16 Collaborates and consults with others engaged in the management of the patient.

2.2 Management and supervision

- 2.2.1 Supervises the activity of supporting staff as appropriate.
- 2.2.2 Manages clinical and laboratory/workshop activities assigned to him, including :
 - use and maintenance of tools and equipment
 - maintenance of safe working environment and procedures
 - inventory and stock control
 - personnel matters
 - financial matters
 - appropriate record keeping
 - total quality management
- 2.2.3 Devises improved job methods for increasing efficiency.
- 2.2.4 Interacts with professional groups and, where appropriate, governmental and non-governmental agencies.
- 2.2.5 Takes part in planning and implementation of technical orthopaedic care systems.

2.3 Training and education

- 2.3.1 Supervises and conducts the education and training of individuals in Category I (prosthetists/orthotists), Category II (orthopaedic technologists) and Category III (technicians).
- 2.3.2 Lectures and demonstrates to colleagues in his profession and other professionals concerned with prosthetics/orthotics and also to other interested groups.
- 2.3.3 Is required to take part in and contribute to the process of continuing professional development.
- 2.3.4 Keeps abreast of new developments concerning prosthetics/orthotics.

2.4 Community services

- 2.4.1 Makes a professional contribution to and takes part in community rehabilitation programmes.

2.5 Research and development

- 2.5.1 Conducts continuing evaluation of his activities.
- 2.5.2 Participates in formal evaluation and research programmes.
- 2.5.3 Participates in scientific/professional meetings and contributes papers to scientific/professional journals.

2.6 Medical, legal and ethical requirements

2.6.1 Provides patient care within a recognised prosthetics/orthotics code of ethics.

2.6.2 Provides patient care which complies with medical/legal requirements.

3. CODE OF ETHICS

An appropriate code of ethical behaviour is an essential framework for the activities of any professional responsible for the treatment of patients. The following is the code of ethics suggested in the Report of the United Nations Inter-regional Seminar on Standards for the Training of Prosthetists (UN, 1969).

This is, however, only given as an example which satisfies the minimal requirements of such a code. It may require elaboration in different cultural, ethnic or religious settings.

Ethical code for the prosthetists/orthotist

- i) He/she shall observe loyal relations with his/her colleagues and with other members of the clinic team without assuming roles outside his/her own profession.
- ii) He/she shall practise absolute discretion regarding personal matters or knowledge he/she might acquire in his/her professional work.
- iii) He/she, like all other members of the clinic team, should supply service only as a member of that team and respect its conclusions.
- iv) He/she shall collaborate freely in the necessary exchange of information between colleagues and others in the different but related disciplines.
- v) He/she shall strive to perform to the highest possible standard of his/her professional skill.
- vi) He/she shall provide services to patients in a professional manner; personal, financial or commercial interests shall be secondary.
- vii) He/she shall always honestly represent himself/herself as well as his/her services to the patient and all others concerned.
- viii) He/she shall observe similar restrictions in his/her personal relations with patients as are normally accepted by the medical profession.

4. LEARNING OBJECTIVES OF COURSE FOR CATEGORY I

The following outlines the learning objectives of a course for Category I workers in respect of theoretical subjects (4.1 to 4.12), closely supervised practical instruction (4.13) and clinical practice (4.14). It should be emphasised that this is a guideline and local variations may still produce an acceptable course. In respect of the supervised practical instruction, regional requirements may influence the emphasis in areas of patient treatment.

It is also noted again that the course which encompasses these learning objectives will normally be of three or four years duration full-time study and the entrants will have satisfied University entrance requirements (12/13 years schooling). This provides guidance as to the expected level of the course and its place within the national educational framework.

An example of a detailed syllabus of an appropriate course is given in *Appendix C*. This is not intended to be a model but only a useful guide as to detailed content and subject breakdown for those involved in course construction.

4.1 Anatomy and physiology

In the area of anatomy and physiology the student should have knowledge of the following:

- gross anatomy;
- structure and properties of biological substances;
- cell biology;
- basic tissues;
- physiology of body symptoms;
- locomotor system;
- detailed anatomy of lower limb, upper limb, spine and trunk;
- human development;
- body fluids and defence mechanisms;
- cardiovascular and respiratory systems;
- skin;
- nervous systems;
- proprioceptive system;

The student should have an understanding of the function of individual joints and muscles and be proficient in explaining their interaction. He/she should be knowledgeable in the area of pathological deviations and be able to analyse them by means of appropriate measuring instruments as well as by applying his/her knowledge of range of motion in order to be able to identify a viable prosthetic/orthotic treatment. The student should recognise that biomechanical as well as pathological factors must be viewed concurrently with anatomical factors.

4.2 Pathology

The student will have knowledge of the following areas particularly as they relate to prosthetics and orthotics:

- general pathological processes;
- pathology of the locomotor system;
- pathology of the cardiovascular and respiratory systems;
- pathology of skin;
- pathology of the nervous system;
- abnormalities present at birth (congenital deformities).

The student should be able to comment on the aetiology and progression of the disease in question, as well as on its care and treatment. He/she must demonstrate proficiency in anatomy, physiology, biomechanics and pathology as well as the ability to coordinate these factors and arrive at the appropriate end result in his/her role as a prosthetist/orthotist.

4.3 Mechanics and biomechanics

The student will understand the following subjects:

- mechanics
 - forces and force effects;
 - resolution and summation of forces and moments;
 - free body diagrams;
 - linear and angular motion
 - stress and strain;
 - shear force and bending moment diagrams;
 - bending and torsion;
 - beams;
 - theories of failure;
 - connections;
 - fluid mechanics;
 - control systems.
-
- biomechanics
 - human tissue mechanics;
 - human movement;
 - joint force analysis
 - lower limb;
 - upper limb;
 - spine;
 - lower limb prosthetics;
 - upper limb prosthetics;
 - lower limb orthotics;
 - upper limb orthotics;
 - spinal orthotics;
 - prosthetic/orthotic design applications.

The student will have a thorough grounding in basic mechanical principles. He/she will be capable of applying these principles to relevant aspects of the human body system and prosthetic/orthotic applications.

4.4 Mathematics and statistics

The student will have a knowledge of the following areas of mathematics and their application to mechanics, biomechanics and prosthetics and orthotics:

- mathematics
- algebraic manipulation;
- trigonometry;
- functions, polynomial, rational, exponential, logarithmic;
- differentiation;
- integration;
- differential equations.
- statistics
- organisation of data;
- probability;
- probability models;
- estimation;
- regression.

4.5 Materials technology

The student will have an understanding of the characteristics, properties and the processing of the following commonly used materials with particular reference to their applications in prosthetics and orthotics:

- steel and its alloys;
- non-ferrous metals and their alloys;
- plastics: thermoforming, thermosetting, composites;
- wood;
- leather;
- textiles;
- plaster of Paris;
- adhesives.

4.6 Workshop technology

The student will understand and be able to apply, in the field of orthopaedic technology, the following areas of knowledge:

- hand tools: their selection, use and maintenance;
- measuring instruments: use and methods of application;
- machine tools: selection, installation, use and maintenance;
- welding processes and equipment for metals and plastics;
- sewing machines: selection, use and maintenance;
- general equipment: ovens, compressors, vacuum pumps, fume and dust extraction apparatus;
- workshop layout;
- health and safety regulations and practice.

4.7 Clinic, workshop and business management

The student will have knowledge of the theory and application of:

- materials acquisition, handling and stock control;
- workforce management;
- production cost calculations;
- budgeting, invoicing, receipting and accounting;
- clinic management, appointment systems, record keeping;
- property management, care and maintenance;
- environmental/ecological considerations;
- quality management;
- health systems;
- ethical considerations.

4.8 Graphical communication

The student will have basic knowledge and practice in the following:

- isometric sketching and three-dimensional visualisation;
- first and third angle projection;
- auxiliary views and sections;
- use of drawing standards;
- application of machining tolerances;
- simple assembly drawings;
- applications in orthopaedic technology.

4.9 Prosthetics and Orthotics Science

The student will understand the biomechanics, anatomy, related pathology, available prosthetic and orthotic devices, patient/device matching and fitting and alignment principles for the following areas of prosthetic and orthotic provision:

- partial foot prosthetics;
- ankle disarticulation prosthetics;
- trans-tibial prosthetics;
- knee disarticulation prosthetics;
- trans-femoral prosthetics;
- hip disarticulation and hemipelvectomy prosthetics;

- partial hand prosthetics;
- wrist disarticulation prosthetics;
- trans-radial prosthetics;
- elbow disarticulation prosthetics;
- trans-humeral prosthetics;
- shoulder disarticulation and forequarter prosthetics;

- foot orthotics;
- ankle-foot orthotics;
- knee orthotics;
- knee-ankle-foot orthotics;
- hip orthotics;
- hip-knee-ankle-foot orthotics;

- hand orthotics;
- wrist-hand orthotics;
- elbow orthotics;
- elbow-wrist-hand orthotics;
- shoulder orthotics;
- shoulder-elbow-wrist-hand orthotics;

- sacro-iliac orthotics;
- lumbo-sacral orthotics;
- thoraco-lumbar orthotics;
- thoraco-lumbo-sacral orthotics;
- cervical orthotics;
- cervico-thoraco-lumbo-sacral orthotics;

- orthopaedic footwear and shoe modifications;
- fracture bracing.

4.10 Clinical Studies

The student will gain an appreciation of relevant diseases and their treatment including prosthetic

or orthotic provision. He will have knowledge of patient management in respect of physical, social, psychological and ethical considerations. The subject will particularly relate to prosthetics and orthotics provision and areas covered will include:

- the clinic team;
- amputation surgery;
- rehabilitation;
- psychology of loss and disability;
- demyelination disorders;
- skin disorders;
- foot disorders and chiropody;
- upper motor neurone disorders;
- lower motor neurone disorders;
- abnormalities present at birth;
- peripheral vascular disease;
- age related disabilities;
- spinal injuries;
- fracture treatment;
- joint and skeletal disorders;
- X-rays interpretation;
- patient handling and safe movement;
- research methodology.

4.11 Electrotechnology

The student will have knowledge of the following principles of electricity with particular reference to applications in prosthetics, orthotics and workshop practice:

- basic concepts;
- DC circuits;
- inductance and capacitance;
- AC circuits;
- power supplies;
- amplifiers;
- feedback;
- interference rejection techniques;
- measurement;
- myoelectrodes;
- safety.

4.12 Computer studies

The student will have basic knowledge of the use of Personal Computers and an introduction to the following areas of computer application:

- computer aided measurement and device manufacture;
- commercially available systems for device design;
- internet communication;

4.13 Prosthetics and Orthotics Practice

The basis of prosthetics and orthotics practice is the closely supervised practical instruction of the student in manufacturing and fitting devices to patients. The student will then practise manufacturing and fitting under supervision and demonstrate his or her capability of attaining satisfactory results. The following areas of practice will be addressed:-

- partial foot prosthetics;

- ankle disarticulation prosthetics;
- trans-tibial prosthetics;
- knee disarticulation prosthetics;
- trans-femoral prosthetics;
- hip disarticulation and hemipelvectomy prosthetics;

- partial hand prosthetics;
- wrist disarticulation prosthetics;
- trans-radial prosthetics;
- elbow disarticulation prosthetics;
- trans-humeral prosthetics;
- shoulder disarticulation and forequarter prosthetics;

- foot orthotics;
- ankle-foot orthotics;
- knee orthotics;
- knee-ankle-foot orthotics;
- hip orthotics;
- hip-knee-ankle-foot orthotics;

- hand orthotics;
- wrist-hand orthotics;
- elbow orthotics;
- elbow-wrist-hand orthotics;
- shoulder orthotics;
- shoulder-elbow-wrist-hand orthotics;

- sacro-iliac orthotics;
- lumbo-sacral orthotics;
- thoraco-lumbar orthotics;
- thoraco-lumbo-sacral orthotics;
- cervical orthotics;
- cervico-thoraco-lumbo-sacral orthotics;

- orthopaedic footwear and shoe modifications;
- fracture bracing.

4.14 Clinical Practice

The student will have experience in the clinical environment of supplying prostheses and orthoses to patients undergoing treatment. This experience should cover as wide a range as possible but with emphasis on the major levels of provision. The aim is to develop skills in:

- assessment and prescription;
- clinical provision of prostheses and orthoses;
- manufacture of prostheses and orthoses;
- interpersonal relationships;
- professional activity;
- communication;
- organisation and management;
- clinical research.

Where the clinical practice takes place in centres other than the main teaching institution such clinical placement centres must satisfy specified standards of the teaching institution and the student's work must be supervised by a Category I professional.

5. EXAMINATION FOR CATEGORY I

The following provides guidelines to the essential features of the examination for a Category I training course. National or institutional practices or regulations may impose constraints on the procedures. However normally the essential features must be incorporated by those institutions seeking ISPO recognition.

5.1 Scope of examination

All courses will have three elements: theoretical, prosthetics and orthotics practice (closely supervised practical instruction) and clinical practice. Each of these elements must be assessed and each must be completed successfully in order for the candidate to pass.

5.2 Board of Examiners

5.2.1 For each examination a Board of Examiners must be formed whose role is to oversee the documentation, ensure that the examination is representative of the syllabus and certify the examination results.

5.2.2 The Examiners shall be appointed and the Examination Board constituted in accordance with national or institutional regulations but normally shall include at least one appropriate medical specialist and one Category I professional. Where possible, a qualified international assessor should be integrated into the local board.

5.3 Examination procedures

5.3.1 Theoretical section

The theoretical assessment will examine the candidates' knowledge of the following subjects:

- * - Anatomy and Physiology
- * - Pathology
- * - Mechanics and Biomechanics
- Mathematics and Statistics
- Materials Technology
- Workshop Technology
- Clinic, Workshop and Business Management
- Graphical Communication
- * - Prosthetics and Orthotics Science
- Clinical Studies
- Electrotechnology
- Computer Studies

It is expected that there will be greatest emphasis on successful completion of those subjects marked *.

5.3.2 Prosthetics and orthotics practice (closely supervised practical instruction).

The practical assessment will examine the candidates' technical, workshop and clinical skills. It will be representative of the clinical content of the curriculum, balanced in complexity between prosthetics and orthotics and both prosthetics and orthotics must be successfully completed.

5.3.3 Clinical practice

The clinical practice assessment will examine the candidates' skills in the clinical environment in the treatment of people requiring prosthetic and orthotic provision. The assessment will examine the candidate in respect of:

- * - patient assessment and prescription;
- manufacture;
- * - clinical provision of prostheses and orthoses;
- interpersonal relationships;
- professional activity;
- * - communication;
- organisation and management;
- * - clinical research.

The emphasis of assessment and successful completion will be in those areas marked *. Performance in both prosthetics and orthotics must be satisfactory. The clinical practice assessment will be representative of the whole range of clinical provision but with emphasis on the major levels of provision.

Where the clinical practice is carried out in centres other than the main teaching institution, if assessment is carried out by clinical staff not belonging to the institution, the clinical staff involved in assessment must be Category I professionals and must carry out the assessment within the framework specified by the teaching institution.

6. ISPO RECOGNITION OF CATEGORY I COURSES

Courses which satisfy the requirements of ISPO with respect to this information package may apply for ISPO Recognition. This recognition by ISPO is an assurance that any such approved course of training for prosthetist/orthotists meets the accepted international standard.

An applying institution would be asked to complete a questionnaire which seeks detailed information on the course itself and the framework in which it operates. The current questionnaire is attached as *Appendix B*.

If the response displays that the course appears to meet the minimal requirements, ISPO would arrange an inspection, funded by the applying institution and preferably coinciding with a final examination. The inspection would concentrate on such issues as:

- i) entry level to course
- ii) content of course with regards theoretical subjects, workshop practice, clinical practice
- iii) duration of course with regard overall time and hours available for instruction
- iv) recognition of course by the Education and Health authorities
- v) level of training compared with other paramedical professionals
- vi) teaching staff available for theoretical subjects
- vii) staff available for prosthetic and orthotic teaching
- viii) proper examination of all subjects
- ix) high standard of practical and clinical work
- x) failure rates
- xi) access to patients
- xii) access to medical and other paramedical personnel
- xiii) teaching materials
- xiv) facilities such as classrooms, workshops, equipment, clinic areas
- xv) employment prospects of graduates
- xvi) internship arrangements
- xvii) certification of course
- xviii) permanency of course
- xix) national recognition

If the inspection displays that the course meets the requirements in respect of Category I education and training it will be recognised by ISPO for a period of three years. Maintenance of recognition requires a triennial inspection by ISPO.

7. ISPO REGISTRATION

A Category I professional who completes a course which has ISPO recognition will be registered by the institution with ISPO and will thereafter be entitled to describe him or herself as

*ISPO Registered Prosthetist/Orthotist
(Category I)*

8. REFERENCES AND BIBLIOGRAPHY

United Nations (1969). Report of the United Nations inter-regional seminar on standards for the training of prosthetists, Holte, Denmark 1-9 July 1969 - New York: UN.

International study week on prosthetic/orthotic education (1976). / edited by J Hughes. - Edinburgh: Scottish Home & Health Department.

ISPO (1985). Report of ISPO Workshop on prosthetics and orthotics in the developing world with respect to training and education and clinical services, Moshi, Tanzania 6-12 May 1984. / edited by NA Jacobs, G Murdoch. - Copenhagen, Denmark: ISPO.

ISPO (1987). Report of ISPO Workshop on training and education in prosthetics and orthotics for developing countries, Jönköping, Sweden 12-16 August 1985. / edited by K Öberg, G Murdoch, NA Jacobs. - Copenhagen, Denmark: ISPO.

ISPO (1988). Report of ISPO Workshop on up-grading in prosthetics and orthotics for technicians from developing countries trained on short courses, Glasgow, Scotland 19-25 July 1987. / edited by G Murdoch, NA Jacobs. - Copenhagen, Denmark: ISPO.

Guidelines for training personnel in developing countries for prosthetic and orthotic services (1990). WHO/RHS/90.1 - Geneva: WHO.

A. PROFESSIONAL PROFILE FOR CATEGORY II (ORTHOPAEDIC TECHNOLOGIST)

Appendix A

This professional profile is specific to workers in the developing world. Its origin is in the Guidelines for Training Personnel in Developing Countries for Prosthetic and Orthotic Services (WHO, 1990) and it has been further refined by ISPO to ensure compliance with its categorization system.

A.1 Patient care

Formulation of treatment

- A.1.1 In the absence of a Category I professional, participates as full member of the clinic team; takes part in the examination and prescription: and advises on the design of the prosthetic/orthotic device interface, suspension and selection of the proper components.
- A.1.2 Assists and advises on relevant aspects of pre-surgical, post-surgical, medical and therapeutic management of individuals requiring prosthetic/orthotic devices.
- A.1.3 Records and reports any pertinent information regarding patients and their families, including a determination of expectations and needs.
- A.1.4 Communicates appropriate information to patients and their families.

Fitting, fabrication and treatment

- A.1.5 Identifies physical and other relevant characteristics of the patient.
- A.1.6 Formulates a range of prosthetic or orthotic designs as specified in the curriculum guidelines. This includes selection of materials, components and additional aids.
- A.1.7 Takes all casts and measurement required for proper fabrication and fitting.
- A.1.8 Modifies positive and/or negative models and/or layouts of design to obtain optimal fit and alignment.
- A.1.9 Carries out fitting, static and dynamic alignment and, where appropriate, preliminary training and initial check-out.
- A.1.10 Performs and/or supervises fabrication of the prosthesis or orthosis.

Evaluation and follow-up

- A.1.11 Advises the team and participates directly in final check-out and evaluation of fit, function and cosmesis.
- A.1.12 Instructs the patient or family in the use and care of the device.
- A.1.13 Takes part in follow-up procedures as well as maintenance, repair and replacement of the appliance.

A.1.14 Recognises the need to repeat any of the identified steps in order to optimise fit and function.

A.1.15 Collaborates and consults with others engaged in the management of the patient.

A.2 Management and supervision

A.2.1 Supervises the activity of supporting staff as appropriate.

A.2.2 Manages clinical and laboratory/workshop activities assigned to him, including :

- use and maintenance of tools and equipment
- maintenance of safe working environment and procedures
- inventory and stock control
- personnel matters
- financial matters
- appropriate record keeping
- total quality management

A.2.3 Devises improved job methods for increasing efficiency.

A.2.4 Interacts with professional groups as well as governmental and non-governmental agencies.

A.2.5 Takes part in planning and implementation of technical orthopaedic care systems.

A.3 Training and education

A.3.1 May supervise and take part in the training of individuals in Category II (orthopaedic technologists) and Category III (technicians).

A.3.2 May lecture and demonstrate to colleagues in his profession and other professionals concerned with prosthetics/orthotics and also to community and other interested groups.

A.3.3 Is required to take part in and contribute to the process of continuing professional development.

A.3.4 Keeps abreast of new developments concerning prosthetics/orthotics.

A.4 Community services

A.4.1 Makes a professional contribution to and takes part in community rehabilitation programmes.

A.5 Medical, legal and ethical requirements

A.5.1 Provides patient care within a recognised prosthetics/orthotics code of ethics.

A.5.2 Provides patient care which complies with medical/legal requirements.



**QUESTIONNAIRE TO BE COMPLETED BY EDUCATION AND TRAINING ESTABLISHMENTS
SEEKING ISPO RECOGNITION**

General:

Title of Institution _____

Address _____

Name of Director _____

Institution funded by: (✓ please tick)

Government

University

Charitable source

Private source

Affiliation to: (✓ please tick)

Government

University

Other educational establishments

Hospitals

Size of population in geographic region of the Institute or
Prosthetic/Orthotic School Number _____

Estimated number of disabled requiring prosthetic, orthotic
or other technical aids in that region Number _____

Main causes of disability (both injury and disease) _____

Outline the nature of any prosthetic/orthotic service you offer _____

How many patients who attend for prosthetic care are available for teaching purposes?

Hemipelvectomy Number _____

Hip disarticulation Number _____

Trans-femoral Number _____

Knee disarticulation Number _____

Trans-tibial Number _____

Ankle disarticulation Number _____

Partial foot Number _____

Upper limb Number _____

How many patients who attend for orthotic services are available
for teaching purposes? Number _____

Knee-ankle-foot orthoses (leg braces, splints, etc) Number _____

Ankle-foot orthoses (short leg braces, etc) Number _____

Spinal orthoses Number _____

Orthopaedic footwear Number _____

Other aids - crutches, sticks, walking aids, wheelchairs Number _____

Upper limb orthoses Number _____

Are the patients who are fitted by students in the course of their education and training:

solely used as models? Yes/No

or
are they being fitted as part of their treatment? Yes/No

Student Entry Requirements:

Schooling Years _____

Required Subjects _____

Curriculum Content:

Life Science (including anatomy, physiology, etc) Hours _____

Mechanics Hours _____

Biomechanics Hours _____

Technology (inc electrotechnology, materials science, etc) Hours _____

Mathematics (and statistics) Hours _____

Technical Drawing Hours _____

Prosthetics and Orthotics Science Hours _____

Workshop Management Hours _____

Clinical Studies Hours _____

Other _____ Hours _____

Total hours of classroom teaching Hours _____

Total hours of laboratory (workshop) practice Hours _____

Total hours of clinical (patient contact) work Hours _____

Teaching/instruction hours per day Number _____

Days per week Number _____

Weeks per year Number _____

Years to completion of course Number _____

What languages are used in the course of education and training? _____

Assessment and award:

Methods of assessment: (✓ please tick)

- Continuous assessment
- Written examination
- Oral examination (viva voce)
- Practical tests
- Projects

Describe final examination procedure _____

In the event of failure by candidate what arrangements are there for re-sitting examinations or repeating part of the course

Nature of qualification awarded at the end of education and training _____

Title given to successful candidate _____

In the view of the Institution is that title related to : (✓ please tick)

- Prosthetist/Orthotist
- Orthopaedic meister
- Orthopaedic technologist
- Other

Facilities:

Class Rooms	Number _____	Dimensions _____
Instructional Laboratories/Workshops	Number _____	Dimensions _____
Consulting Rooms	Number _____	Dimensions _____
Measuring and Casting Rooms	Number _____	Dimensions _____
Plaster Rooms	Number _____	Dimensions _____
Orthotics Workshops	Number _____	Dimensions _____
Prosthetics Workshops	Number _____	Dimensions _____
Plastics Workshops	Number _____	Dimensions _____
Engineering Workshops	Number _____	Dimensions _____
Other Fabrication Workshops	Number _____	Dimensions _____

Description _____

Library facilities (describe) _____

Research facilities (describe) _____

Education and Training Staff

Instructors:

Prosthetists (orthopaedic meisters) Category I Number _____
Orthotists (orthopaedic meisters) Category I Number _____
Orthopaedic technologists Category II Number _____
Instructors in fabrication Category III Number _____
Physicians/Surgeons Number _____
Therapists (physical and occupational) Number _____
Bioengineers Number _____
Engineers Number _____

External Lecturers:

Physicians Number _____
Surgeons Number _____
Therapists Number _____
Orthotists Number _____
Prosthetists Number _____
Bioengineers Number _____
Engineers Number _____

Students:

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Number of students starting in each of these years										
Number qualifying										

Describe the nature and duration of any internship arrangement _____

Employment:

What is known of the professional placement of your graduates in your own country?
Please specify: (e.g. in government institutions or hospital, in Universities or private facilities?)

What is their salary and status equivalent to? (✓ please tick)

- Doctor
- Therapist
- Nurse
- Bench worker

What is known of the professional placement of your graduates in other countries?

Please specify here

What is their salary and status equivalent to? (✓ please tick)

- | | |
|--------------|--------------------------|
| Doctor | <input type="checkbox"/> |
| Therapist | <input type="checkbox"/> |
| Nurse | <input type="checkbox"/> |
| Bench worker | <input type="checkbox"/> |

Fees:

Annual fee for course of education and training _____ for _____ years

Paid by: (✓ please tick)

- | | |
|------------|--------------------------|
| Student | <input type="checkbox"/> |
| Government | <input type="checkbox"/> |
| Charity | <input type="checkbox"/> |
| Other | |

Appendix C

GUIDELINE FOR SYLLABUS OF FOUR YEAR UNIVERSITY COURSE LEADING TO QUALIFICATION AT CATEGORY I LEVEL (PROSTHETISTS/ORTHOTIST)

It should be noted that this is only a guideline intended to assist those involved in the construction of a University or College based course. It is constructed on three campus based years, each of 42 weeks and one clinically based year of 46 weeks. However the basis of any course should be the Learning Objectives specified in Section 4.

This course is intended for students who have successfully completed science based schooling of twelve or thirteen years.

COURSE SUMMARY

FIRST YEAR

Theoretical Subjects	Allocated hours
Life sciences I	120
Mechanics and Biomechanics I	96
Prosthetics and orthotics science I	48
Clinical studies I	72
Mathematics and statistics	72
Graphical communication	72
Electrotechnology	72
Total	<hr/> 552
Practical Instruction	
Introductory workshop practice	174
Trans-tibial prostheses	120
Foot-orthoses	90
Ankle-foot-orthoses	60
Total	<hr/> 444

SECOND YEAR

Theoretical Subjects	Allocated hours
Life sciences II	120
Mechanics and biomechanics II	120
Prosthetics and orthotics science II	48
Clinical studies II	72
Computer studies	24
Total	<hr/> 384
Practical Instruction	
Ankle-foot-orthoses	114
Trans-femoral prostheses	108
Knee and ankle disarticulation prostheses	120
Upper limb prostheses	120

Upper limb orthoses	60
Spinal orthoses	60
	<hr/>
	582

THIRD YEAR

Theoretical Subjects	Allocated hours
Life sciences III	120
Mechanics and biomechanics III	108
Prosthetics and orthotics science III	48
Clinical studies III	72
Materials technology	72
	<hr/>
Total	420
Practical Instruction	
Hip disarticulation prostheses	66
Knee-ankle-foot-orthoses	162
Spinal orthoses	60
Upper limb prostheses	144
<i>Revision</i>	
Lower limb prostheses	30
Lower limb orthoses	30
Spinal orthoses	30
Upper limb orthoses	30
Ankle-foot-orthoses	30
	<hr/>
Total	582

FOURTH YEAR

CLINICAL PRACTICE

Structured and Controlled Clinical Experience	
Prosthetics	805
Orthotics	805

FIRST YEAR

Content of theoretical subjects

Life Sciences I

The aim of the introductory section of the course is to provide a background in cell biology, anatomy and physiology. The more detailed structure and functioning of the locomotor system are studied before examining the detailed anatomy of the lower limb. Laboratory work includes demonstrations and microscopic work to facilitate understanding of the relationship between structure and function in living systems. Experimental physiology is also used to illustrate the lecture course. Practical work in anatomy consists of demonstrations.

Content	Allocated hours
<u>Gross Anatomy</u> definition of anatomical terms; regions of the body; body cavities and their contents; functional arrangement of organs into systems – related to the properties of life.	Lectures 6 hours Tutorials/Laboratories 4 hours
<u>Chemicals of Life</u> structure and properties of important biological substances; functions.	Lectures 8 hours Tutorials/Laboratories 4 hours
<u>Cell Biology</u> cell ultrastructure and cell biochemistry.	Lectures 8 hours Tutorials/Laboratories 4 hours
<u>Basic Tissues</u> structure and functions; arrangement in organs.	Lectures 7 hours Tutorials/Laboratories 8 hours
<u>Review of Physiology of Body Systems</u> alimentary, respiratory, circulatory (to include body fluids) renal, reproductive, integumentary, endocrine and nervous.	Lectures 7 hours Tutorials/Laboratories 6 hours
<u>Locomotor System</u> structure and function of bones, joints and muscles; arrangement and function of the somatic nervous system.	Lectures 14 hours Tutorials/Laboratories 6 hours
<u>Anatomy of Lower Limb</u> survey of structure and function of lower limb; detailed structure and function of bones and joints of lower limb; blood supply to lower limb; lumbo-sacral plexus and main nerves to lower limb; origins, insertions, actions and nerve supply of musculature of lower limb; surface anatomy of lower limb.	Lectures 22 hours Tutorials/Laboratories 16 hours <hr/> Total Lectures 72 hours Total Tutorials/Labs. 48 hours

Mechanics and Biomechanics I

The mechanical properties and behaviour of materials and devices which are used in treating patients, and the interaction between device and patient. The course comprises a series of lectures, supported by supervised tutorial periods and practical laboratory sessions.

Content	Allocated hours	
<u>Foundation Material</u> Units, dimensional homogeneity, scalar/vector quantities, co-ordinate systems, Newton's laws. Resolution and summation of forces and moments in two and three dimension, equivalent force systems, free body diagrams, equations of equilibrium, plane and space frame analysis. Linear/angular motion, uniform acceleration, friction, inertia, moment of inertia, dynamic equilibrium (translation/rotation), energy, momentum. Stress and strain (graphic solution), constitutive equations.	Lectures	30
<u>Human Movement</u> Ranges of movement (lower/upper limbs and spine), normal gait (introduction to kinematics, kinetics and EMG studies), introduction to amputee and pathological gait. Kinematic analysis of limbs.	Lectures	7
<u>Tissue Mechanics</u> Introduction to relevant biological tissues and their mechanical properties.	Lectures	3
<u>Lower Limb Prosthetics</u> General socket biomechanics/biomechanical principles of cast rectification, BK socket biomechanics, trans-tibial alignment biomechanics, trans-femoral socket biomechanics, trans-femoral alignment biomechanics.	Lectures	5
<u>Lower Limb Orthotics</u> Foot biomechanics – analysis of joint forces (normal, pathological, effects of footwear).	Lectures	3
	Total Lectures	48
	Total Tutorials/Labs.	48

Prosthetics and Orthotics Science I

General note to Prosthetics and Orthotics Science I, II and III:

The course is divided into sections as indicated. Each section comprises relevant biomechanics, together with anatomy and pathology of disability, description of prosthetic, orthotic devices, patient/device matching and fitting principles. Each section is followed by practical instruction in the same subject.

Content	Allocated hours
Introductory workshop practice	18
Trans-tibial prosthetics	12
Foot and foot-orthotics	10
Ankle-foot-orthotics	8
Total	<hr/> 48

Clinical Studies I

General note to Clinical Studies I, II and III: the clinical studies programmes comprise the following four sections:

1. Lectures

These lectures are intended to present new material, which the student will not receive during other teaching modules.

2. Lectures/Clinical Demonstrations

These lectures/clinical demonstrations are intended to link the Life Sciences and Prosthetic/Orthotic (P/O) teaching modules. The same topics may be covered in the Life Science programme but only from a body-systems point of view. Within this programme a clinician will be asked to speak about the clinical manifestations of the condition under consideration, of the prognosis, associated problems, the role of P/O devices in the management of the patient, the objectives and expected outcome of P/O treatment, and selection of P/O devices.

Each session will comprise a one-hour lecture to cover the above material followed by a two-hour presentation of patients to illustrate the problems discussed in a clinical situation. The topics to be covered have been selected following discussion with the team teaching the Life Science module and with due regard to the P/O programme.

3. Patient Contact Session

These introductory sessions will familiarise the student with the protocol and techniques of patient contact and assessment of the patient's functional loss and residual capabilities.

For each of the conditions listed the student will examine patients under the supervision and guidance of members of clinical staff. It may be necessary for the students to receive additional instruction on assessing patients with particular conditions. Within each session each student will examine at least three patients.

4. Hospital Clinics

Attendance at appropriate clinics in local hospitals will enable the student to become aware of the routine problems with which patients present and the role of the prosthetist/orthotist in their management.

Lectures

Introduction to prosthetics	
Introduction to orthotics	
Role of the prosthetist/orthotist	
The clinic team	
Written communication	
Introduction to reasons for amputation	
Introduction to amputation surgery	
Rehabilitation of the lower limb amputee	
Introduction to library information systems	
Introduction to computer software	
Introduction to psychology of loss/disability	
History and organisational structure of the health services	
Verbal communication	
Skin disorders	
Introduction to x-ray and scanning techniques (therapy)	
Patient handling and safe movement	45

Lectures/Clinical Demonstrations

Practical demonstration – rehabilitation of the lower limb amputee	
Patient assessment	6

Hospital Clinics

Lower limb prosthetic clinics	
Lower limb orthotic clinics	
Chiropody/foot clinics	21
Total	72

Mathematics and Statistics

An introduction to a variety of mathematical and statistical concepts which are of use in biologically related disciplines. Simple examples will be employed to show the uses of the mathematical and statistical concepts described. The course will be illustrated throughout by applications in the fields of biology, chemistry and physics.

Content

Allocated hours

Mathematics

Elementary mathematics: simple algebraic manipulation, indices, logarithms, solution of equations, trigonometric functions, standard trigonometric identities, solution of simple trigonometric equations.

Functions: polynomial, rational, exponential, logarithmic.

Differentiation: simple techniques, use in optimisation and curve sketching.

Integration: simple techniques, evaluation of areas, use of approximation procedures.

Differential equations: first order equations, uses in biological modelling.

Statistics

Organisation of data: population, samples, data collection, measures of location and dispersion, skewness.

Probability: sample space, events, laws of probability, independent events.

Probability models: discrete and continuous random variables, expected values, Binomial, Poisson and Normal models, illustration of situations modelled by these distributions.

Estimation: sampling, distribution of sample proportion and sample mean, confidence limits for population proportion and mean (large and small samples), minimum sample size for given precision.

Regression: product moment correlation coefficient, least squares estimation for linear model.

Total

 72

Graphical Communication

An introduction to concepts of communication and the basic elements of technical drawing.

Content	Allocated hours
Isometric sketching and 3D visualisation	
First and third angle projections	
Auxiliary views and sections	
Use of drawing standards	
Application of machine tolerances	
Simple assembly drawings	
Total	<hr style="display: inline-block; width: 200px; vertical-align: middle;"/> 72

Electrotechnology

An introduction to the principles of electricity applicable to the practice of prosthetics and orthotics. These principles are applied to a programme of laboratory experiments which enable the student to become familiar with current electronic measurement practice.

Content	Allocated hours
<u>Basic concepts</u> The SI system of units. Charge, current, potential, potential difference, resistance, electromotive force, energy, power. Circuit symbols.#	Lectures 4
<u>DC Circuits</u> Kirchhoff's laws. Resistors in series and parallel. Resistivity and conductivity. Temperature coefficient of resistance. Measurement of resistance.	Lectures 4
<u>Inductance and Capacitance</u> The inductor: voltage/current relationship, time response for current and voltage, energy storage, definition of the Henry. The capacitor: current/voltage relationship, time response for voltage and current, energy storage, definition of the Farad.	Lectures 6
<u>AC Circuits</u> The sine wave: frequency, period, phase, peak value, instantaneous value, mean half-cycle value, rms value. Inductive and capacitive reactance, impedance, phase angle. RL, RC and RLC series circuits: complexor diagrams, apparent and active power, power factors.	Lectures 6
<u>Transformers</u>	

The principle of the transformer. The ideal transformer: voltage, turns and current ratios. The transformer as a matching device.	Lectures	3
<u>Power Supplies</u>		
The diode: ideal and practical current/voltage characteristics. Half-wave and full-wave rectifier circuits. Waveforms with and without smoothing circuits. Mean output voltage for purely resistive load.	Lectures	3
<u>Amplifiers</u>		
The amplifier as a system element. Small-signal equivalent circuits: voltage, current and power gains, the decibel, input and output impedances. Frequency response of different types of amplifier. Operational amplifiers: ideal characteristics, parameter values in typical amplifiers. Noise in amplifiers.	Lectures	6
<u>Feedback</u>		
Series voltage negative feedback. The general feedback equation. Open-loop gain. Effect of negative feedback on input and output impedances, bandwidth, distortion and noise. Operational amplifier circuits. Positive feedback: instability and self-oscillation in amplifiers, oscillators.	Lectures	4
<u>Interface Rejection Techniques</u>		
Filters, screened leads, differential amplification, avoidance of earth loops, dummy sources (e.g. strain gauges in a bridge layout). Carrier-wave modulation and multiplexing. (The last item refers to implanted transmitters). Use of optical fibres in place of conductors.	Lectures	4
<u>Measurements</u>		
The cathode-ray oscilloscope. Summary of recording instruments. Concepts of resolution and accuracy applied to digital and analogue instruments. Transducers for temperature, pressure, light, sound; description, specification and use in circuit.	Lectures	4
<u>Myoelectrodes</u>		
Technology of metal and metal-paste electrodes; the equivalent circuit between electrodes; stability; sources of unwanted voltages in electrode systems. Other types of myoelectrodes: micro-electrodes, implanted electrodes; comparison with surface electrodes.	Lectures	2
<u>Safety</u>		
Description of single-phase and three-phase supply systems and voltages involved. Function of line, neutral and earth in single-phase systems. Pin connections and colour codes. Effect on safety of fault conditions. Fuses, miniature circuit breakers (MCB) and residual current devices (RCD).	Lectures	2
	Total Lectures	48
	Total Tutorials/Labs	24

FIRST YEAR

Content of practical instruction

Topic	Allocated hours
Introductory workshop practice	
Use of machinery and equipment e.g. sewing machines, routers etc. and hand tools.	174
General note to practical instruction, years I, II and III:	
The following sections are preceded by theoretical teaching, illustrated by demonstration and followed by closely supervised practical instruction in the manufacture and fitting of prosthetic and orthotic devices to selected patients acting as models for teaching purposes. Each device involves casting, rectification, manufacture and fitting/alignment.	
Trans-tibial prostheses	120
Foot and foot-orthoses	90
Ankle-foot-orthoses	60
Total	444

SECOND YEAR

Content of theoretical subjects

Life Sciences II

The course continues from Life Sciences I to examine the structure and functioning of body systems. Emphasis is placed on areas which are of particular relevance to prosthetic and orthotic practice.

Laboratory work includes demonstrations and microscopic work to facilitate understanding of the relationship between structure and function in living systems. Experimental physiology is used to illustrate topics covered in the lecture course.

Detailed anatomy of the upper limb and spine is examined. The practical work will consist of demonstrations.

Content	Allocated hours	
<u>Detailed Anatomy of Upper Limb and Spine:</u>		
survey of structure and function of upper limb; detailed structure and function of bones and joints of upper limb; blood supply to limb; brachial plexus and main nerves to upper limb; cutaneous nerve supply; origins, insertions, actions and nerve supply of musculature of upper limb; surface anatomy. Outline of structure and function of vertebral column; detailed structure of vertebrae throughout vertebral column; structure and function of atlanto-occipital, atlanto-axial and all other intervertebral joints; musculature producing movements of vertebral column. Gross structure of spinal cord; spinal nerves; transverse section of spinal cord and nerve roots at various levels; meninges and cerebrospinal fluid.	Lectures	30 hours
	Tutorials/Laboratories	20 hours
<u>Development:</u>		
mitosis; cytokinesis; meiosis; gametogenesis; fertilisation; differentiation; embryology; basic theories of genetics with particular reference to inheritance in humans; inheritance of physical abnormalities.	Lectures	21 hours
	Tutorials/Laboratories	14 hours
<u>Body Fluids and Defence Mechanisms</u>		
body fluid compartments; functions of cellular and plasma components of blood; diversity and behaviour of micro-organisms; opportunistic pathogens and their control; body response to infection and injury, including role of skin, mucous membranes, phagocytes, serum and tissue proteins, inflammatory response; specific immune response; development of abnormal cells.	Lectures	21 hours
	Tutorials/Laboratories	14 hours
	Total Lectures	72 hours
	Total Tutorials/Labs.	48 hours

Mechanics and Biomechanics II

Application of the principles of the Foundation Material course developed in Mechanics and Biomechanics I, to the human body. The students should be capable of calculating the stress levels applied to various prosthetic/orthotic components for given loaded conditions.

Students will apply the concept of static and dynamic equilibrium to analyse joint forces during walking. The walking patterns of normal subjects, amputees and orthotic patients will be analysed and the concept of static equilibrium will be applied to lower limb prostheses and orthoses to calculate patient/device interface forces and pressures.

Content	Allocated hours	
<u>Design Concepts 1</u>		
Shear force and bending moment diagrams. Centroids, 2 nd moment of area and mass, theorem of parallel axes. Bending stress, torsional stress of circular shafts, combined axial and bending stresses, combined bending and torsional stresses, combined axial/bending/torsional stresses. Open and closed helical springs. Beam deflection.	Lectures	24
<u>Joint Force Analysis</u>		
Body segment parameters. Joint force during swing. During stance phase, foot/ankle joint forces, knee joint force, hip joint force.	Lectures	10
<u>Human Movement Analysis</u>		
Normal gait: force plate/TV analysis/electromyography studies, energy studies, gait repeatability, variation due to age, variation due to footwear. Amputee gait: force plate/TV analysis emg studies, energy studies, comparison with normal gait, gait variation due to alignment, amputation level, reason for amputation, prosthetic components. Orthotic gait: force plate/TV analysis/emg studies, energy studies, comparison with normal gait, gait variation due to pathological condition, orthoses, orthotic components.	Lectures	17
<u>Lower Limb Prosthetics</u>		
Socket and alignment biomechanics plus gait deviations of the following prostheses: partial foot, Syme, trans-tibial, knee disarticulation, trans-femoral, hip disarticulation/hemi-pelvectomy. Analysis of socket forces, analysis of prosthetic components.	Lectures	12
<u>Lower Limb Orthotics</u>		
General introduction, biomechanical principles, cast rectification, 3 point force system. Analysis of patient/device interface forces and calculation of force magnitudes for orthoses covering the following joints: ankle, knee, hip.		
	Lectures	12
	Total Lectures	75
	Total Tutorials/Labs.	45

Prosthetics and Orthotics Science II

(See general note at Prosthetics and Orthotics Science I)

Content	Allocated hours
Ankle-foot-orthoses	8
Trans-femoral prostheses	9
Knee and ankle disarticulation prostheses	10
Upper limb prostheses	9
Upper limb orthoses	6
Spinal orthoses	6
Total	48

Clinical Studies II

(See general note at Clinical Studies I).

Content	Allocated hours
Lectures/Clinical Demonstration	
Hospital Administration	
Prosthetic/Orthotic/Wheelchair supply	
Upper Motor Neurone disorder	
Lower Motor Neurone disorder	
Demyelination disorders	
X-Rays interpretation	
Congenital deformities	
P.V.D.	
Geriatric medicine	
Rehabilitation of upper limb amputees	
Spinal injuries	36
Patient Contact Sessions	
Amputees (Prosthetics)	
Orthotic patients	
Arthritic patients	12
Hospital Clinics	
Lower Limb Prosthetic Clinic	
Lower Limb Orthotic Clinic	
Vascular Clinic	12
Computer Software	6
Private Study/Tutorial	6
Total	72

Computer Studies

Information technology is increasingly being used in the design and manufacture of prosthetic and orthotic devices. Techniques of computer-aided patient measurement and device design and manufacture are emerging from research and development efforts and increasingly being applied in clinical practice. In addition, the Internet is increasingly useful as a source of multimedia information for the profession. The nature and extent of its impact will be of increasing importance.

This course aims to introduce students to these application areas through a series of lectures, demonstrations and practical work.

Content	Allocated hours
The course will consist of lectures to provide general information followed by approximately twenty hours of demonstration and practical work.	
Techniques of computer-aided patient measurement and device manufacture, which are relevant to prosthetics and orthotics will be examined.	
Commercially available systems for prosthesis socket design will be demonstrated and practical exercises shall be carried out.	
Internet exercises will be carried out on modem multimedia computers.	
Total	24

SECOND YEAR

Content of practical instruction

(See general note at FIRST YEAR practical instruction)

Topic	Allocated hours
Ankle-foot-orthoses	114
Trans-femoral prostheses	108
Knee and ankle disarticulation prostheses	120
Upper limb prostheses	120
Upper limb orthoses	60
Spinal orthoses	60
Total	<hr/> 582

THIRD YEAR

Content of theoretical subjects

Life Sciences III

The structure and functioning of body systems, which are of particular relevance to prosthetic and orthotic practice, are studied in depth. At the same time, the related pathophysiology and pathology of each system is examined.

Laboratory work includes microscopy, demonstrations, and experimental work to illustrate topics covered in the lecture course.

Content	Allocated hours
<u>Introduction to Pathophysiology:</u> an outline of the basic mechanisms of disease processes: cellular adaptation and injury, neoplasia, inflammation and repair, infections	Lectures Tutorials/Labs. 8 hours
<u>Pathophysiology of Locomotor System:</u> pathophysiology of bones; infection; trauma; disuse effects; growth disturbance. Pathophysiology of joints: arthritis; response to injury and deformity. Pathology of muscles: muscular diseases; response to injury; ischaemia; paralysis.	Lectures 9 hours Tutorials/Labs. 6 hours
<u>Cardiovascular and Respiratory Systems:</u> structure, function and control of heart and blood vessels; formation, composition and fate of blood; transport functions of blood, including blood gas transport, and exchange with tissues; structure and function of lungs and respiratory adaptations to exercise. Pathophysiology: survey of pathophysiological states affecting heart and lung function and their effects on cardiovascular and respiratory physiology; peripheral vascular disease; abnormalities of blood and their effects.	Lectures 18 hours Tutorials/Labs. 12 hours
<u>Skin:</u> structure of skin; function of skin: protection, heat regulation, sensation, elasticity.	Lectures 3 hours Tutorials/Laboratories 2 hours
<u>Pathophysiology of Skin:</u> wound repair, response to irritants, response to pressure, ischaemia.	Lectures 3 hours Tutorials/Labs. 2 hours
<u>Nervous System:</u> structure and properties of neurones and their processes; resting membrane potential; action potential; conduction of nerve impulse; receptor mechanisms; chemical transmission; review of anatomy and function of brain, spinal cord, sensory nerves, somatic motor nerves and autonomic nerves. Pain: function, receptors, transmission pathways, interpretation of pain.	Lectures 18 hours Tutorials/Labs. 12 hours
<u>Pathophysiology of Nervous System:</u> malformations; infections; effects of trauma on brain and spinal cord; cerebral vascular disease; tumours of brain and spinal cord; disorders of peripheral nerves; demyelinating diseases; degenerative diseases; metabolic disorders.	Lectures 9 hours Tutorials/Labs. 6 hours
	Total Lectures 72 hours Total Tutorials/Labs. 48 hours

Mechanics and Biomechanics III

The application of the principles of biomechanics to the upper limb and spine. Consideration of the mechanical characteristics of body tissues and the effect of the patient/device interface forces on those

tissues. Consideration of the effect of the same patient/device interface forces on devices and the design of the devices.

Content	Allocated hours
<p><u>Tissue Mechanics</u> Study of the mechanical characteristics of bone, skin, ligaments, cartilage and muscles. Patient/device interface forces and the effects of prosthetic and orthotic devices on such forces.</p>	Lectures 6
<p><u>Spinal Biomechanics</u> Cervical orthosis patient/device interface forces; thoracic orthosis buckling; scoliosis patient/device interface forces. Lumbar spine loading during normal activities/effect of orthoses on these loads.</p>	Lectures 7
<p><u>Upper Limb Biomechanics</u> Grasp patterns, grasp forces, mechanical replacement of hand function, augmentation of deficient hand function, prosthetic socket biomechanics, orthosis biomechanics, application of external power, myoelectric control of external power and usage of devices.</p>	Lectures 7
<p><u>Control Systems</u> Introduction to control theory. Application in prosthetics/orthotics of functional electrical stimulation, hybrid orthoses, myoelectrics and biofeedback. Computer aided design/computer-aided manufacture.</p>	Lectures 6
<p><u>Manufacturing Technology</u> Design methods within a commercial company.</p>	Lectures 1.5
<p><u>Design Concepts</u> Buckling, theories of failure/fatigue/stress concentrations, connections, fluid mechanics and beam deflection.</p>	Lectures 22
<p><u>Design Applications</u> Design test standards/materials. Design calculations for prosthetic/orthotic devices.</p>	Lectures 22.5
	Total Lectures 72 Total Tutorials/Labs. 36

Prosthetics and Orthotics Science III

(See general note at Prosthetics and Orthotics Science I).

Content	Allocated hours
Hip disarticulation prostheses	6
Knee-ankle-foot-orthoses	12
Spinal orthoses	6
Upper limb prostheses	12
Revision	12
	<hr/>
Total	48

Clinical Studies III

(See general note at Clinical Studies I)

Content	Allocated hours
<u>Lectures</u>	
Community care act 1990	
New models in community health and community care	
Information retrieval	
Communication skills	
Role of the social worker in rehabilitation	
Psychology of loss/disability	
Business awareness	
Quality assurance	
First aid	51
<u>Lectures/Clinical Demonstrations</u>	
Rehabilitation of the bilateral amputee	
Mobility aids	6
<u>Hospital Clinics</u>	
Prosthetic clinics	
Orthotic clinics	15
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Total	72

Materials Technology

Content	Allocated hours
METALS	
<u>Introduction</u>	
Production and refining of metals	
Crystal structure of metals	
Phase equilibrium diagrams, solid solubility	
Relationship of properties to micro/crystal-structure	
<u>Tailoring Metals for Service</u>	
Alloying	
Effects of work/age hardening. Theory of solid solution hardening, phase transformations, heat treatment, quenching, surface hardening, annealing, normalising, tempering, corrosion and oxidation.	
In depth illustration of the effects of the above when applied to elements e.g. iron-carbon or aluminium alloys with their diagrams, structures and related mechanical properties of steels.	
<u>Fabrication</u>	
Methods and effects on properties e.g. cold/hot working, rolling extrusion, panel beating, spinning and machining.	
<u>Joining Metals</u>	
Welding, brazing, soldering techniques and their effects on structure and properties.	Lectures 25 hours Laboratories/Tutorials 13 hours
PLASTICS	
<u>Introduction</u>	
Viscoelastic behaviour	
Types of plastics and molecular structures	
Composite materials	
relationship of properties to structures	
<u>Thermoforming Plastics and their Fabrication Processes</u>	
Monomers, polymers, additives	
Microstructures and mechanical properties effect on properties of method of production	
Fabrication processes	
Effects of fabrication process; microstructural changes, shrinkage and distortion, residual stresses, molecule orientation, effect of overheating and other degradation during processing.	
Environmental effects	
<u>Thermosetting Plastics, Composite Materials and Fabrication</u>	
Resins and foams	
Reinforcing fibres	
Casting tapes and other water setting resins	
Lay-ups and mechanical properties	
Fabrication processes and their effects on the materials.	
<u>Joining of Plastics</u>	
Welding, adhesives and their effect on structure and properties.	Lectures 21 hours Laboratories/Tutorials 13 hours
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	Total Lectures 46 hours
	Total Laboratories/Tutorials 26 hours

THIRD YEAR

Content of practical instruction

(See general note at FIRST YEAR practical instruction)

Topic	Allocated hours
Hip disarticulation prostheses	66
Knee-ankle-foot-orthoses	162
Spinal orthoses	60
Upper limb prostheses	144
Revision	
Lower limb prostheses	30
Lower limb orthoses	30
Spinal orthoses	30
Upper limb orthoses	30
Ankle-foot-orthoses	30
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Total	582

FOURTH YEAR

Clinical Practice

Course Aims and Teaching Strategies

The object of the clinical practice is to provide the student with experience of clinical management and to produce a prosthetist/orthotist of professional standing who can play a full part in the clinical team. The clinical practice will comprise two six-month placements, one in prosthetics and the other in orthotics and will be carried out in approved centres attached to the hospital service. At each centre a doctor and a prosthetist or orthotist will be designated as the students' supervisors. The student will be responsible to the prosthetic/orthotic supervisor for the performance of his or her duties during the placement.

The holiday entitlement during each six-month placement is three weeks. This includes statutory holidays.

During each period of clinical practice the student is required to keep a record of clinical activities and a log-book will be supplied for this purpose. The work carried out by the student will be assessed by his or her supervisor and reports will be made of the student's progress after four weeks, three months and six months. These reports will be discussed with the student and the student will be asked to countersign the report. The supervisor will report on the student's performance under the following headings:

Clinical prosthetics/orthotics;
Technical prosthetics/orthotics;
Professional development;
Interpersonal relationships;
Communication skills;
Organisation and management

In addition the supervisor will recommend any remedial action required to improve the performance or correct deficiencies in any of the above aspects of the student's work.

Clinical Essays

As part of the assessment of the clinical placements in the 4th year, each student must submit one essay for each 6 months of the clinical placement.

The bulk of each essay should be the student's original work based on some aspect of prosthetic/orthotic management relating to the work done during the six months. Typical examples might be:

- a) The effect of age on the rehabilitation of the trans-femoral amputee
- b) The influence of stump length on the prosthetic fitting of the trans-tibial amputee
- c) The orthotic treatment of hemiplegia
- d) The orthotic management of idiopathic scoliosis

Students should select a topic for each essay such that the caseload of the clinical placement centre offers sufficient experience to allow the completion of the task.

ALLOCATED HOURS
Prosthetics 805
Orthotics 805