

# **SYLLABUS FOR DEGREE COURSE IN PROSTHETICS AND ORTHOTICS (Bachelor in Prosthetics and Orthotics – B.P.O.)**

## **1. INTRODUCTION:**

Rehabilitation of persons with locomotor disabilities or neuromuscular disorder is a team work, where Centre of attention is the person with disabilities. The team usually comprises of the Physical medicine and Rehabilitation Specialist (Physiatrist) who is usually the leader, Prosthetist and Orthotist, Physiotherapist, Occupational therapist, Social worker and Rehabilitation Nurse. Depending upon the need, other professionals like orthopedics surgeon, engineer, psychologist, geriatrist and other related professionals are also included in the team.

General planning of the total rehabilitation of the disabled is usually done by the Physiatrist. The role of Prosthetist and Orthotist is important. It is s/he, who fabricates and fits the prosthesis or orthosis to the persons with disabilities both temporary and permanent often referred as “patient” and thus helps make the patient independent, confident and useful member of the society.

## **2. PROFESSIONAL PROFILE OF PROSTHETICS & ORTHOTICS GRADUATE OR PROSTHETIST / ORTHOTIST.**

The following professional profile has its basis in the Report of the United Nations Inter-Regional Seminar on Standards for the Training of Prosthetist (UN, 1968) – the so called Holte Report. It has moreover been modified to comply with Guidelines for Training of Personnel in Developing Countries for Prosthetics & Orthotics Services (WHO, 1990).

Care of Persons with disabilities

### Formulation of treatment:

Participates as full member of the clinic team; take part in the designing of the prosthetics / orthotics device, including the socket or body/ device interface, suspension and selection of proper components.

Records and reports any pertinent information regarding patient and patient’s families, including a determination of expectations and needs regarding prosthetic and orthotic aids and communicates appropriate information to the patients and their families about these.

### Fitting and fabrication:

Takes all casts and measurements required for proper fabrication and fitting.

Formulates prosthetics or orthotics designs, including selection of materials, components and additional aids.

Modifies positive and / or negative models and / or layout of design to obtain optimal fit and alignment.

Fabricates prostheses and orthoses with or without assistance.

Carries out fitting, static and dynamic alignment and, where appropriate, preliminary training and initial check-out.

## Evaluation and follow-up

Participates in final check-out and evaluation of fit, function and cosmesis.

Instructs the patient or family in the use and care of the device.

Takes part in follow-up procedures as well as maintenance, repairs and replacement of the appliance.

Recognises the need to repeat any of the identified steps in order to optimize fit and function and alters accordingly.

Collaborates with other rehabilitation team.

Management and supervision

Supervises the activity of supporting staff as appropriate.

Manages prosthetics and orthotics workshop activities assigned to him/her, 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

Devises improved job methods for increasing efficiency.

Interacts with professional groups and, where appropriate, Governmental and non-governmental organizations.

Training and Education

Supervises and conducts the education and training of Prosthetics & Orthotics students of upto undergraduate level.

Lectures and demonstrates to colleagues in his/her profession and other professionals concerned with prosthetic/ orthotics and also the other interested groups.

To take part in and contribute to the process of continuing professional development which also includes further upgradation of training programmes and continuous upgradation of knowledge and skill especially with latest trends in the field of prosthetics & orthotics and also its allied field.

To train CBR workers how to assist P&O Professionals in need.

To make people aware and especially persons with disabilities and the family members about the need for and benefit of good quality prosthetics and orthotics service.

Community services

Makes a professional contribution to and take part in community rehabilitation programmes.

Research and development

To promote research work in the field of prosthetics and orthotics especially to suit the all sections of people.

To introduce new technologies and new materials to ensure persons with disabilities lead to better quality of life.

Conducts continuing evaluation of his/her activities.

Participates in formal evaluation and research programmes.

Participates in scientific/professional meetings and contributes papers to scientific / professional journals.

To actively support legal and ethical requirements in prosthetics and orthotics when needed.

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

### **3. CODE OF ETHICS:**

An appropriate code of ethical behavior is an essential framework for the activities of any professional responsible for the treatment of patients. All P&O professionals need to follow the code of ethics formulated by Rehabilitation Council of India (RCI).

#### Ethical code of the Prosthetist / Orthotist

She/he shall observe loyal relations with her/his colleagues and with other members of the clinic team without assuming roles outside his/her own profession.

She/he shall practice absolute discretion regarding personal matters or knowledge about patients he/she might acquire in her/his professional work.

She/he, like all other members of the clinic team, should supply service only as a member of that team and respect its conclusions.

She/he shall collaborate freely in the necessary exchange of information between colleagues and others in the different but related disciplines.

She/he shall strive to perform to the highest possible standard of his/her professional skill.

She/he shall provide services to patients / clients in a professional manner, personal, financial or commercial interests shall be secondary.

She/he shall always honestly represent herself / himself as well as his / her services to the patient and all other concerned.

### **4. COURSE DESIGNATION:**

The duration of Bachelors Degree Course in science of all the Universities of the country is three years however all the professional courses are usually of four years. As per the recommendations of the 18<sup>th</sup> meeting of the Sub-Committee of the RCI dealing with the Professionals in the Field of Leprosy Cured, Locomotor and Associated Disabilities and subsequent meeting on 19<sup>th</sup> and 20<sup>th</sup> of October at Bangalore, it was proposed that present degree programme of three years to be upgraded to four years with six months internship. The nomenclature of this course shall be Bachelor of Prosthetics and Orthotics (BPO). It would help

P & O professionals to acquire more knowledge and skill besides greater amount of P & O Practice.

#### **5. ENTRANCE:**

A candidate who has passed 10+2 in science or equivalent with physics, chemistry and mathematics / biology (with aggregate of 50% marks) will be eligible for admission to this course.

#### **6. DURATION OF COURSE:**

The total duration of course will be of 4 years with 6 months internship. Candidates who are declared successful in final examination will have to undergo a compulsory internship of six months (3 months in prosthetics and 3 months in orthotics) in a recognized P&O Institute or under RCI recognized individuals before the award of the degree.

#### **7. ATTENDANCE:**

No students will be allowed to appear in the examination unless she/he has attended at least 75% of total number of classes including practices.

#### **8. EXAMINATION:**

There will be University examination every year that means at the end of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> year. The examination should finish by June. Results of annual examinations will be declared before commencement of the new session. Minimum passing marks for every subject will be 50% both in theory and practical. The total aggregate should be minim 50%. The divisions will be awarded as per university norms.

#### **9. DEGREE AWARD:**

After successful completion of all examinations and completion of six months internship, candidate will be awarded with the degree of Bachelor of Prosthetics and Orthotics ( B.P.O.). The said degree will be classified by its class such as "First Division, Second Division, or 'Pass' according to the University norms.

#### **10. COURSE CURRICULUM:**

Year wise distribution of the above course curriculum is as following:

In first year the main emphasis is on basic life sciences, basic engineering, prosthetics and orthotics workshop technology and part of lower limb prosthetics and orthotics. Besides theory, P&O practice also has been introduced in the first year which is little more than 50% of total available time.

In the second year, besides remaining part of lower limb prosthetics and orthotics, major emphasis was given to orthopaedics, computer studies, Physical Medicine and rehabilitation and.

In third year, major components would be rehabilitation / mobility aid, upper limb prosthetics and orthotics besides computer studies and workshop management.

In fourth year major focus is on spinal orthotics, prosthetics and orthotics management of bilateral amputees especially of higher level and other complicated ones. Besides, adequate time has been given to Clinical Practice, Computer application in Prosthetics and Orthotics, to do project work as well as study tour.

#### **11. STUDY TOUR:**

Study Tour to various recognized Rehabilitation Institutes and manufacturing plants will be done after completing final year examination or as per the convenience of the training Institutes but Study Tour is compulsory. Every students has to prepare a tour report at the end of study tour which also would be evaluated by the examiner.

#### **12. INTERNSHIP:**

After successful completion of final year examinations there will be six months Internship comprising of clinical practice, case presentation and fabrication of all kinds of complicated Prostheses and Orthoses.

#### **14 SCHEDULE:**

Total time available for training in a year could be as follows:

##### Non working days in a year

Sundays	52 days
Saturdays (half days)	26 days
Summer vacation	30 days
Winter vacation	15 days
Preparatory leave	10 days
Gazette holidays	17 days
Examination	10 days

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Total non-teaching days      160 days, so, actual teaching days  $364 - 160 = 204$  days

So obviously, total teaching hours in a year would be approximately on basis of 6 hours per day  $204 \times 06 = 1224$  hours in a year.

These 1224 hrs have been distributed to each year of study as indicated in the outline programme as following:

**14.1 I st year :**

<b>Subjects</b>	<b>Hours Theor y</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
ANATOMY	216	36	252	200
PHYSIOLOGY & PATHOLOGY				
MATERIALS, TOOLS, EQUIPMENT & P&O WORKSHOP TECHNOLOGY	72	36	108	100
MECHANICS, APPLIED MECHANICS & STRENGTH OF MATERIALS	72	36	108	100
ENGINEERING DRAWING	72	36	108	100
BIOMECHANICS – I	72	36	108	100
PROTHETICS – I	96	444	540	400
ORTHOTICS – I	96	444	540	400
TOTAL				

**14.2 II nd year :**

<b>Subjects</b>	<b>Hours Theory</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
PHYSICAL MEDICINE & REHABILITATION	192	72	264	200
ORTHOPAEDICS & AMPUTATION SURGERY	96		96	100
BASIC ELECTRONICS AND ELECTRO TECHNOLOGY	96		96	100
COMPUTER STUDIES – I	36	72	108	100
BIOMECHANICS - II	72	36	108	100
PROSTHETICS AND ORTHOTICS SCIENCE – II	108	444	552	400
TOTAL			1224	1000

**14.3 III<sup>rd</sup> year :**

<b>Subjects</b>	<b>Hours Theory</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
P & O WORKSHOP MANAGEMENT	72	24	96	100
COMPUTER STUDIES – II	72	144	216	200
BIOMECHANICS – III	72	36	108	100
MOBILITY & REHABILITATION AIDS	76	176	252	200
PROSTHETICS AND ORTHOTICS– III	108	444	552	400
TOTAL			1224	1000

**14.4 IVth year :**

<b>Subjects</b>	<b>Hours Theory</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
PROSTHETICS CLINICAL PRACTICE	00	224	224	200
ORTHOTICS CLINICAL PRACTICE	00	224	224	200
PROJECT WORK		104	104	100
STUDY TOUR		120	120	
PROSTHETICS AND ORTHOTICS– IV	108	444	552	400
TOTAL			1224	1000
GRAND TOTAL IN FOUR YEAR			4896	4000

## FIRST YEAR SYLLABUS OF BPO

Subjects	Hours Theory	Hours Practical	Hours Total	Marks Exam.
ANATOMY	216	36	252	200
PHYSIOLOGY & PATHOLOGY				
MATERIALS, TOOLS, EQUIPMENT & P&O WORKSHOP TECHNOLOGY	72	36	108	100
MECHANICS, APPLIED MECHANICS & STRENGTH OF MATERIALS	72	36	108	100
ENGINEERING DRAWING	72	36	108	100
BIOMECHANICS – I	72	36	108	100
PROTHETICS – I	96	444	540	400
ORTHOTICS – I	96	444	540	400

### **ANATOMY**

**Total 252 hours**  
[Theory 216 hours  
Practical 36 hours]  
Examination 200 marks.

#### **Anatomy Theory:**

**General:** Introduction and definition, Anatomical terms, Regions of body, cavities and their contents. Cell structure, arrangement into organs and systems.

**Osteology:** Structure and function of bones and joints, Skull, Vertebrae, Upper extremity and Lower extremity.

**Systemic:** Outline and Gross Anatomy of cardiovascular system, respiratory system, integumentary system, Genito-urinary System, Gastro-intestinal system.

**Lower Extremity:** Survey of structure and function of Lower Limb, detailed structure and function of bones and joints of lower limb, blood supply to lower limb, main nerves to lower limb, cutaneous nerve supply, origins, insertions, actions and nerve supply of muscles of lower limb and surface anatomy.

**Upper Extremity:** 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, major nerves to upper limb, cutaneous nerve supply, origins, insertions, actions and nerve supply of muscles of Upper Limb and surface anatomy.

**Spine:** 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, origins, insertions, actions and nerve supply of major muscles of vertebral column.

**Applied Anatomy:** Surface anatomy, locomotion and movements. Anthropometry.

**Anatomy Practical :** Demonstration of various tissues and cells and Dissection – Demonstration of Lower limbs, upper limbs, spine, surface anatomy and marking.

## SCHEME OF EXAMINATION

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **PHYSIOLOGY & PATHOLOGY**

**General:** Introduction and definition of various terms, cell structure and function including cell division, Body water and body fluid, oedema.

**Musculo-Skeletal:** Voluntary and involuntary muscles and their function, various types of joints, skeletal system, weight bearing and Gait analysis.

**Nervous System:** Reflex action, the regulation of posture, General survey of voluntary movement, Pain, Reflex action, Autonomic Nervous System.

**The Blood:** Outline of Coagulation of the blood, red blood corpuscles, white blood corpuscles, Immunity reactions and inflammation.

**Cardio-Vascular:** General consideration, Heart rate, Regulation of blood pressure, peripheral circulation, Capillaries vascular responses of the skin.

**Respiratory System:** General considerations, Carriage of oxygen by the blood, Carbon dioxide transport in the body, Cyanosis, Dyspnoea, Regulation of body temperature.

### **Physiology Practical**

**Demonstration :** Muscle testing, sensations testing, blood pressure and pulse recording etc.

## **PATHOLOGY**

**General** : General aims and objectives of study of pathology common terminology, An outline of the basic mechanism of disease processes. Inflammation – Outline of Various changes in acute and chronic inflammation & infections: Repair of tissues. Outline of Viral, bacterial and fungal infections.

**Degeneration**: Outline of Ischemia, necrosis, gangrene, thrombosis, embolism and infarction, Thrombo-angiitis obliterans.

**Neoplasia** : Outline of Benign and malignant neoplasms, principles of their spread.

**Pathology**: Outline of pathology of Bones infection, trauma, growth disturbances, Diseases of bones, muscles and Joint Malformations. Healing of fractures.

**Neuro – Vascular**: Outline of Cerebro-vascular disorders, trauma to brain and spinal cord. Disorders of peripheral nerves.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Sr. No. 1 to 10 based on Physiology --- 10 x 1 --	} 20 marks
			Sr. No. 11 to 20 based on Pathology – 10 x 1 --	
Section B	SAQ		Based on Physiology	
		Q.2	Answer any five out of six ----- 5 x 3 -----	15 marks
		Q.3	Answer any three out of four ----- 3 x 5 -----	15 marks
Section C	SAQ		Based on Pathology	
		Q.4	Answer any five out of six ----- 5 x 3 -----	15 marks
		Q.5	Answer any three out of four ----- 3 x 5 -----	15 marks

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## **MATERIALS, TOOLS, EQUIPMENTS & P&O WORKSHOP TECHNOLOGY**

**Total 108 hours**  
Theory 72 hours,  
Practical 36 hours  
Examination 100 marks.

### **MATERIALS:**

**Metal work:** Mechanical working of metals especially steel and aluminum. Fundamentals of riveting, soldering, brazing and welding. Power metallurgy, Surface coating of metals.

**Metal & Alloys :** Fundamentals of metals and alloys both ferrous and nonferrous. Properties, testing and inspection of metals and alloys, heat treatment of metals.

**Wood utilization :** Wood, types, seasoning, preservation, lamination properties and adhesives for wood.

**Wood work:** Introduction to Wood, wood work and wood working tools. Pattern making and making of various kinds of joints.

**Leather utilization:** Leather, types, tanning, preservation, lamination, properties and adhesives for leather.

**Fabric:** Fabric types, properties, utilization, selection and quality control.

**Plastics:** Introduction to Plastics, type of plastics and molecular structures. Relationship of properties to structures. Monomers, polymers, additives, Mechanical properties, effect on properties of method of production.

**Fabrication:** Fabrication processes, Effects of fabrication, process, micro structural changes, shrinkage and other degradation during processing, environmental effects. Thermoforming plastics, their fabrication process, thermosetting plastics and fabrication process Composite materials and their uses. Elastomers, H.D.P.E. PP, PP-CP Visoelastic behavior of plastics. Introduction to fiber reinforced plastics Introduction to and their processing especially various techniques of moulding and lamination.

**Joining:** Joining of plastics, welding, adhesives and their effect on structure and plastics properties.

**Foams:** Different types of foams used in P&O especially Latex, polyurethane, poluthelene and other kind of rigid/semi rigid/flexible foams.

### **TOOLS, EQUIPMENT & P & O WORKSHOP TECHNOLOGY :**

**General :** Introduction to bench work, hand tools, measuring tools and instruments. Equipment for mass production introduction to lathe machine and its operation, milling machine and its

operations, tooling, attachment. Shaping machine and its uses. Grinding machine. Abrasive machine. Special tools and equipment use in fabrication of orthoses and prostheses.

### **WORKSHOP TECHNOLOGY PRACTICAL**

**Practice** : Practical work on workshop practices, Practical training on lathes Drilling Machine (Bench and Pedestal) Grinding Machine, Router, hot air oven, sanding machine, heat gun, pneumatic machines and Other machines. Practical work on various materials and tools and its use in prosthetics and orthotics.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 -----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 -----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **MECHANICS, APPLIED MECHANICS AND STRENGTH OF MATERIALS**

**Total 108 hours**

[Theory 72 hours

Practical 36 hours]

Examination 100 marks

#### **Mechanics and Applied Mechanics:**

**General Mechanics:** Definition of Mechanics, Foundation materials on Units, dimensional homogeneity, scalar and vector quantities, Co-ordinate systems, Newton's laws. Resolution and summation of forces and moments in two and three Dimensions, equivalent force systems, free body diagrams, equations of Equilibrium, plans and space frame analysis. Parallel and non-parallel Forces, torque. Linear and angular motion, uniform acceleration, friction, inertia, moment of inertia, dynamic equilibrium (translation / rotation). Energy, momentum.

**Simple stress & Strain** : Definition of stress and strains, factor of safety stress, modulus of elasticity, longitudinal strain and internal strains. Poisson's ratio etc. stress and strain curve, statement of formulae relating between different modules, simple problems to understand the above principles of composite bars-formula relating to loads and strains in individual members simple to understand the above relations.

## **Mechanics Practical (25 hours)**

**General** : Practices on parallel and non-parallel forces, torque, Linear and angular motion, uniform acceleration, friction, inertia.

**Design concept:** Buckling, theories in failure, fatigue and stress concentrations, connections, Shear force and bending moment diagrams, centroids, 2<sup>nd</sup> moment of area and mass, theorem of parallel axes, bending stress, torsional stress of circular shafts, combined axial and bending stresses. Combined and torsional stresses, combined axial bending torsional stresses. Open and closed helical springs and beam deflection.

**Control Systems:** Introduction to control theory and its applications in Prosthetics and Orthotics.

Economics with applied mechanics

**General:** Introduction to definition and scope in modern industrial social studies on Machine or man oriented topics. Displays devices for transmitting information from machine to man. Controls in information from man to machine. Safety factors, Pollution, noise fumes, atmospheric pollution if motion study in relation to Ergonomics principles.

Mechanics, Applied Mechanics and Strength of Materials

## **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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## **ENGINEERING DRAWING**

Theory 36 hours, Practical hours 72 (Total 108 hours) and Examination 100 marks.

**Introduction** : Drawing instruments and their uses. Sizes and layout of drawing sheets. Item references on Drawings and item lists. Planning on assembly.

**General Principles:** Folding of Drawing prints Scales. Plain and diagonal, Lines, Letterings. General Principles of Presentations. Section and other conventions Conventional representations circle, Tangent Ellipse. Cycloised Involute of circle.

**Fundamentals:** Dimensions on technical drawings. Indications of linear and angular tolerance on technical drawings. Methods of dimensioning & tolerancing. Cone methods of indicating Surface textureon. Technical Drawings for structural Metal Work.

Orthographic projections of points, lines, simples objects and combinations. Isometric views, Auxillary view, Drawing of screw thread form Bolts Screws and Screw joints, weld and welded joint dimentioning and sketching of P & O components / parts, pulley shaft, coupling, etc.

**Design :** Design calculations and its applications for Prosthetics & calculation Orthotics devices.

**General Sketching:** Sketching for preparing assembly, workshop drawing. Various parts and Components used in prosthetics and orthotics, Basic idea of design analysis, itemisation empiricism, approximation and synthesis. Detail diagrams of all kind orthoses, prostheses and mobility aids.

**Practical:** All kinds of engineering drawing practice.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **BIOMECHANICS – I**

**Total 108 hours**  
Theory 72 hours,  
Practical 36 hours  
Examination 100 marks.

**General:** Introduction to terminology, Definitions, Planes and directions, Regions and landmarks of the body, Centre of Gravity – Line of Gravity, Types of levers, levers arms. Body Mass, forces equilibrium. Floor reaction. Axes of rotation, Speed, acceleration, velocity, (scalar and vector) Kinetics and Kinematics, Human weight bearing system – weight bearing line, Normal human locomotion definition, characteristics of normal gait, Characteristics of pathological gait.

Biomechanics of normal foot, pathological foot, foot arches normal and surgical foot wear.

**Tissue Mechanics:** Introduction to relevant biological tissues and their mechanical properties.

**Human Movements:** Range of movement of lower/ upper limbs and spine. Normal and Pathological gait- introduction to EMG studies.

Biomechanics of Symes prosthesis, partial foot prosthesis, below knee (trans tibial) prosthesis.

**Gait deviation:** Gait deviation while using Foot Ortheses (FO), Ankle Foot Ortheses (AFO) and trans-tibial prostheses.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **PROSTHETICS -I**

**Total 540hours**

[Theory 96 hours,

Practical 444 hours]

Examination 400 marks

**Introduction:** Introduction to Prosthetics, definitions of various terminologies, Historical development in Lower Extremity Prosthetics in India and abroad.

**Prosthetic Feet:** Various types of Prosthetic feet. Conventional foot. Rocker, SACH foot, Modified SACH Foot. Jaipur Foot, Seattle foot, Flex foot, Quantum foot, Peg Roelite foot, Carbon copy foot, Comparatives studies of prosthetic feet. Single axis, Double axis, Multi-axial foot, other kinds of feet etc. Heel Height adjustment, Adjustable ankle, various kinds of ankle mechanisms.

**Partial foot:** Various types of Partial foot prosthesis. Biomechanics of Partial foot prosthesis, Prescription Principles, Materials used for partial foot prosthesis,

Various cast techniques of Partial foot prosthesis, Fabrication Techniques for partial foot prosthesis.

**Syme's:** Various types of Symes Prosthesis, Prosthetic components, Prescription criteria, Principles. Materials used for Symes prosthesis, Casting techniques. Cast modification. Fabrication Technique for Symes (P.T.B. type) prosthesis. Fabrication Technique for Conventional Symes Prosthesis.

**Below Knee:** Various types of below knee (trans – tibial) prosthesis with a focus on endoskeletal prostheses. All types of Below knee Prosthetics Components – both conventional and modular. Below knee Prescription Criteria and principles. Materials used for Below knee Prosthesis. Measurement and Casting techniques for PTB prosthesis. Cast modification Fabrication Techniques for PTB prosthesis. Fabrication Technique for BK Conventional Prosthesis – both Open and close ended socket, Different types of socket designs – PTB , PTS, PTBSC, PTB-SCSP, Different types of suspension.

Different Technology: Conventional below knee prosthesis with local components, ALIMCO components, Jaipur limb (using HDPE), ICRC technology, Endoskeleton / modular – all common types.

**Gait Deviations and Analysis:** Person with Chopart, Symes, Below knee prosthesis. Check-Out Procedure for Person with Chopart, Symes, Below knee prosthesis.

**Prosthetics Practical:** Fabrication of Partial foot prosthesis, Chopart Prosthesis, Symes and various types of Below knee prosthesis using different technology.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

TERM WORK 50 MARKS + PRACTICAL / ORAL 50 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 -----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 -----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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## **ORTHOTICS**

**General:** Introduction to Orthotics, definitions, of various terminologies, History of orthoses in India and abroad. Various materials used in orthotics.

**Different types of Orthoses:** Users/Clinient's assessment and prescription criteria, Measuring and casting, cast modification, three point force system, fabrication, fitting, aligning, checking out and finishing of the following devices:

**Shoe Modification :** Medial / Lateral raise (Inside / outside shoe), M.T. Bar (Inside / Outside shoe), Arch support, Meta tarsal pad, Calcaneal heel wedge, Heel raise, Thomas Heel, Heel pad for Calcaneal spur, 'T' strap (Medial and lateral) Fixaiton of stirrup plate in shoes/ Sandal, Various types of Arch Supports – flexible / semi rigid / rigid / custom moulded, SMO-Custom moulded Supra malleolar orthosis. Various types of Foot Orthoses for diabetic feet and other sensory deficiencies.

AFO (Ankle foot orthosis) Conventional AFO-Limited / Foot drop (using ALIMCO Components), Plastics AFO (custom moulded) Using metal hinges, plastic hinges, different trim lines, Plastic AFO for Calcaneal deformity, AFO with soft insert, Prefabricated AFO, AFO with inside/outside posting, AFO with built in compensation.

**Club foot orthosis (CTEV):** Denis brown splint (night splint), Ankle support, Prefabricated CTEV splint, Custom moulded FO/AFO/KAFO, POP Splint, Shoes modification.

**Fracture:** Tibial guard and other kinds of foot and ankle fracture orthoses.

**Practical: Different types of foot orthoses, Shoe modifications, and all types of Ankle foot orthoses (A.F.O.) especially Plastic A.F.O. and fracture orthoses.**

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

TERM WORK 50 MARKS + PRACTICAL / ORAL 50 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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## **SECOND YEAR**

<b>Subjects</b>	<b>Hours Theory</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
PHYSICAL MEDICINE & REHABILITATION –I	192	72	264	200
PHYSICAL MEDICINE & REHABILITATION –II				
ORTHOPAEDICS & AMPUTATION SURGERY	96		96	100
BASIC ELECTRONICS AND ELECTRO TECHNOLOGY	96		96	100
COMPUTER STUDIES – I	36	72	108	100
BIOMECHANICS - II	72	36	108	100
PROSTHETICS – II	108	444	552	400
ORTHOTICS SCIENCE – II				
<b>TOTAL</b>			<b>1224</b>	<b>1000</b>

### **PHYSICAL MEDICINE & REHABILITATION**

**Total 264 hours**

[Theory 192 hours

Practical 72 hours]

Examination 200 marks

#### **Disability & Development:**

Background to social, political and economic issues in India and other Low Income countries, Affect on poor who live in rural and urban areas. Disability and women Introduction to community based rehabilitation as compared to the existing medical model and its function. Introduction to impairment, disability and handicap. Introduction to disability issues, Government schemes and initiatives, legislation, Local resources available and referral. Income generation schemes, Purpose of Sangha / group of PWDs. Access, adaptations and change of environment where people live or work PWD Act.

**Psychology:** Introduction to psychology, outline of Psychology and the individual, Behaviour Intelligence and abilities, Learning and Remembering, Psychological Development, Cognitive, Processes, Personality, Moral Development, Psychological aspect of disability. The role of the Family, Child with the disability, parents of the disabled child. Acceptance of Severely disabled persons. Social-Sexual Relationships Independent Living.

**Sociology:** Introduction to Sociology and outline of Society, definitions, Outline of Social works, Nature of Social Organization, types of organizations, Non governmental organization and its role in prosthetics & orthotics. Structure and functions of Social Institutions. Village as a community Social Changes. Social problems, Social Welfare, Vocational Rehabilitation, Employment, Self-Employment Removing, Environment Barriers, Recreation for the Disabled Community Welfare organizations, Social welfare programmes. Professional and social work in medical setup. M.S.W. in rehabilitation, Practical and environment difficulties of patient in use of appliances. Outline of Educational aspects, Job analysis, Job placement.

**General :** Introduction to Health care System, Rehabilitation in Health care, rehabilitation under various ministries, introduction to Institute based rehabilitation (IBR) and Community Based Rehabilitation (CBR). Prosthetics & Orthotics in CBR and Role of CBR workers in P&O. Introduction to general medicine and diseases. Chemical and physical agents causing diseases. Outline of metabolic disorders e.g. Diabetes Mellitus, deficiency diseases e.g. Vit. D. deficiency and Vit. C deficiency.

**Community Based Rehabilitation:** What is CBR and its need what way it is different than IBR, Simple knowledge about other disabilities, its prevention and its management, To understand the role of Key Players in CBR, Referral facilities where to refer when to refer, Role of other professional in CBR, Role of P&O Professional in CBR, Early identification and early Intervention, How to work as team in CBR / IBR structure, simple techniques to make CBR activities more purposeful.

**Specific Disorders :** Peripheral nerve injuries. Polimoyelitis, Cerebral palsy, Muscular Dystrophy, Club foot (CTEV), Spina Bifida, Hemiplegia, Spinal Cord injuries. (Paraplegia / Quadriplegia), Tuberculosis & Perthes Disease, Leprosy, Burns, Erb's Palsy, Tumours – malignant and benign.

**Sport Injuries:** Introduction to sport injuries, common sport injuries and there management, Mechanism of injuries to hip, knee, ankle, shoulder, elbow, wrist and hand in various sports and outline of their orthotics management.

**Rehabilitation therapy :** Introduction to Physiotherapy & Occupational Therapy, Child development in brief – milestone and delayed milestone, Assessment procedure, Evaluation of muscle power, range of motion, Checking of joint stability, Checking of Pelvic tilt, Use of Goniometer, Checking of muscular atrophy / dystrophy, Functional Assessment which includes ADL, Stretching, strengthening, breathing exercise Therapy at post – surgical stage (re-educating the muscles, maintaining ROM, preventing)

Stump care and care of non amputated limb, Exercise through games involving parents or guardians, POP bandage application for temporary splinting and correction of simple deformity, Stump bandaging application etc.

**Physical Medicine & Rehabilitation:** Concept of Total Rehabilitation, Rehabilitation team and role of each member of the team. Introduction to Physical Medicine, Principles of clinical examination, diagnosis and treatment. Different aspects of physical medicine and rehabilitation. Rehabilitation aspects of visually handicapped, hearing handicapped and Mentally retarded.

**Practical:** Practical aspects of physiotherapy, occupational therapy, Physical Medicine and Rehabilitation

## Physical Medicine & Rehabilitation – I

### SCHEME OF EXAMINATION

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	-----	20 x 1	----	20 marks	Sr.
							No. 1 to 10 based on Social Work & Community Based Rehabilitation
							Sr. No. 11 to 20 based on Psychology & Vocational Rehabilitation
Section B	SAQ						Based on Social Work & Community Based Rehabilitation
		Q.2	Answer any five out of six	-----	5 x 3	----	15 marks
		Q.3	Answer any three out of four	-----	3 x 5	----	15 marks
Section C	SAQ						Based on Psychology & Vocational Rehabilitation
		Q.4	Answer any five out of six	-----	5 x 3	----	15 marks
		Q.5	Answer any three out of four	-----	3 x 5	----	15 marks

**Section C will also be dedicated to SAQ to provide equal weightage to both the topics of Section B and Section C**

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## Physical Medicine & Rehabilitation - II

### SCHEME OF EXAMINATION

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	-----	20 x 1	----	20 marks	Sr.
							No. 1 to 10 based on Physical Medicine & Rehabilitation
							Sr. No. 11 to 15 based on Physiotherapy in Rehabilitation
							Sr. No. 16 to 20 based on Occupational Therapy in Rehabilitation
Section B	SAQ						Based on Physical Medicine & Rehabilitation
		Q.2	Answer any five out of six	-----	5 x 3	----	15 marks
		Q.3	Answer any three out of four	-----	3 x 5	----	15 marks
Section C	SAQ	Q.4	Based on Physiotherapy in Rehabilitation				
			Answer any five out of six	-----	5 x 3	----	15 marks
		Q.5	Based on Occupational Therapy in Rehabilitation				
			Answer any five out of six	-----	3 x 5	----	15 marks

**Section C will also be dedicated to SAQ to provide equal weightage to topics included in the syllabus**

# **ORTHOPAEDICS AND AMPUTATION SURGERY**

**Total 96 hours**

[Theory 96 hours]  
Examination 100 marks.

## **ORTHOPAEDICS:**

**General:** Introduction, Principles of Orthopaedics, Fracture, types and management.

**Inflammation:** Outline of Inflammation, Osteomyelitis, inflammation of Joints, Rheumatoid Arthritis, infective arthritis, tuberculosis arthritis, Osteoarthritis, Ankylosing spondylitis, arthritis of hemophilic joints, Neuropathic joints. Inflammation of Tendon sheath and bursae, Contractures, Posture etc. Metabolic diseases of bones, e.g. rickets, osteomalacia, gout, scurvy etc. Poliomyelitis and all its effect.

**Spine:** Outline of Tortocolies, cervical rib, spina bifida, spondylolistheis, scoliosis – all types, kyphosis, Lordosis, spondylosis, prolapse of intervertebral disc.

**Hip:** Outline of Dislocation (congenital, traumatic, pathological, paralytic and spastic), Coxa-vara, coxa-valga.

**Knee:** Outline of Meniscal tears, dislocation of patella, genu valgus, genu varum, genu recurvatum, Ligamentous injuries.

**Ankle & foot:** Outline of Sprain (acute and chronic), C.T.E.V., Calcaneo varus and Pes Valgus, Hallux Valgus and varus, Calcaneal Spur, Metatarsalgia, plantar fasciitis, Anaesthetic feet, Bunion.

**Shoulder :** Outline of Recurrent dislocation, Bicipital tendinitis and peri-arthritis.

**Elbow:** Outline of Cubitus varus and valgus, Madelung's deformity, Tennis elbow, Volkmann's contracture, Dupuytren's disease, claw hand, De Quervain's disease and claw hand.

**Wrist & Hand:** Tenosynovitis, mallet finger, carpal tunnel syndrome.

## **Amputation Surgery:**

**General:** Indications/causes, General Principles, Types of amputation, i.e. Guillotine, Flap, Osteoplastic Myoplastic, Osteo-myoplastic. Individual's Preparation for prosthesis. Ideal stump, Preoperative, operative and postoperative prosthetic management techniques in general.

**Amputation:** Amputation surgery in lower and upper limbs.

Amputation in special circumstances, like in infants and children, Congenital limb deficiencies and its universal classification, ischemic limbs, elderly persons and malignancy.

## Orthopaedics Practical:

**General:** Demonstration of different conditions & relevant x-ray films, how to read from x-ray, how to measure the deformity from x-ray, its simple assessment and P &O management technique.

### SCHEME OF EXAMINATION

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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## BASIC ELECTRICITY AND ELECTRONICS

**Theory 96 hours**  
(Total 96 hours)  
Examination 100 marks.

### Electricity

**Basic Concepts:** Introduction to SI System of units, charge, current resistance, potential differences, electromotive force, Energy power, Voltage and current Relationship, energy storage, DC circuits, AC circuits, sine wave, Frequency, Period, phase, RMS value, inductive and capacitive reactance.

**Resistors:** Resistors sensitive to temperature, strain and light, Resistors in series and in parallel.

**Transformers:** Principles of the transformer, voltage, turns and current ratios.

**Semi Conductors:** Outline Concepts of semiconductors and insulators. Conduction in intrinsic and extrinsic semi conductors.

**Amplifiers:** Amplifiers as a system element. Operational amplifiers and their ideal characteristics. The small single equivalent circuit having a controlled source. Voltage and current gain, the decibel power gain, Noise and drift voltages, Source in amplifiers and bio-systems.

**Feed Back:** The general Feedback equation, Feedback Voltage series, negative feedback and loop gain, loop gain Accuracy, input resistance, output resistance, band width of noise.

Feedback as a control mechanism in the wider sense, Positive feedback – instability and self-oscillation in amplifiers and oscillators.

**Measurements** : Electronics measuring instruments. The cathode ray oscilloscope. Summary of recording instruments. Concepts of resolution and accuracy applied to digital and analogue instruments. Transducers for temperature, light, pressure, sounds, description, specification and use in circuit.

**Myoelectrodes** : Technology of metal and metal paste electrodes, the equivalent circuit between electrodes stability, source of unwanted voltage electrode systems. Other types of myoelectrodes micro electrodes, implanted electrodes, comparison with surface electrodes.

**Electrical Safety:** Description of single phase and three phase supply system and voltage involved. Function of line, neutral and earth in single phase system. Current practice in pin connection and colour codes. Simple safety procedure to be taken when servicing equipment. Effect on safety of fault conditions. Fuses, conductors and earth leakage detectors - miniature circuit breakers (MCB). Voltage regulators integrated circuits.

**Bio-Electricity:** Biological potentials, Muscle action potentials, Electro-myography and Myo-electricity.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **COMPUTER STUDIES – I**

**Total 108 hours**  
[Theory 36 hours,  
Practical 72 hours]  
Examination 100 marks

#### **Introduction to computers and components of computers:**

Physical Composition, Central Processing Unit, Main Memory, Input and Output units and also all kinds of common types of computer peripherals.

**Hardware:** Various Configurations, Specification of peripherals and computer system. Various types of storage facilities and its advantages and also disadvantages.

**Computing environments:** Introduction to types of computers - Personal computers, Main frame and super computers, Networks E-mail Internet. Introduction to operating systems, e.g. DOS, Windows, Linux, Unix commands and introduction to General file systems.

**Software:** The current operating softwares, Word Processor, spreadsheet, database and presentation software e.g. Windows XP or Windows 2000 Professional, Microsoft Office XP or 2000 Professional etc., upgraded as used currently.

**Practical:** Trainees has to be thorough in all branches of MS Office especially WORD and POWERPOINT. In addition to that it would be better if trainee also learn one additional drawing and imaging software among e.g. Corel Draw. PageMaker, Photoshop or similar kind of softwares.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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## **BIOMECHANICS – II**

**Total 108 hours**

[Theory 72 hours,

Practical 36 hours]

Examination 100 marks.

**Joint Force Analysis:** Body segment parameters, joint forces during swing and stance phase, force analysis on foot and ankle joint, knee joint and Hip joint.

Human locomotion and Gait analysis. Introduction to different ways to do gait analysis by using force plate / TV analysis/ electromyography studies energy studies, gait repeatability, variation due to age, variation due to footwear, orthoses/ prostheses. Common types of pathological gait. Above knee Amputee gait analysis and deviations, gait variations due to alignment or pathological conditions.

**Through knee Biomechanics:** Through knee Prescription Principles, socket biomechanics and alignment techniques.

**Above knee prosthetics Biomechanics:** General Socket biomechanics, above knee socket biomechanics and analysis of socket forces. Analysis of Above knee Prosthetics components. Biomechanics of AK prosthesis alignment.

**Above knee Orthotics Biomechanics:** Biomechanical principals of various kinds of above knee orthosis especially knee Ankle Foot Orthosis and Floor Reaction Orthosis. Biomechanics of HKAFO especially to prevent scissoring. Three/four/five point force system. KAFO AND HKAFO Gait deviations – variations due to alignment or pathological conditions. Gait analysis of KAFOs and HAKAFOs with various types of crutches.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

## **PROSTHETICS & ORTHOTICS SCIENCE – II**

**Total 552 hours**

[Theory 108 hours

Practical 444 hours]

Examination 400

(100+100 theory and 100 + 100 Practical)

### **PROSTHETICS:**

**Knee Joints:** All types of Endoskeletal and exoskeletal knee joints – Single axis knee joints, Polycentric knee joints, Free knee, Constant friction knee joints, Variable friction knee joint, microchip control knee, hydraulic knee joint, swing phase control knee joints, Stance Phase control knee joints etc.

**Hip Joints:** For above knee as well as for hip disarticulation / hemi pelvectomy – all types of hip joints especially Single axis and Swivel type.

**Through Knee Prosthesis:** Various types of Through knee prosthesis – Through knee prosthetic Components. Materials used for Through knee prosthesis. Casting techniques for Through knee prosthesis, Cast modification, Fabrication Techniques of Through hip prosthesis, Through knee Gait analysis and deviations, Through knee Check-out Procedures.

**Above Knee Prosthesis:** Types of above knee Prosthesis. Above knee Prosthetic Components. Above knee Socket Shape and Clinical Considerations. Casting and measurement techniques, Cast modification, Fabrication techniques of Above knee socket. Various types of suspension systems especially suction and silicon type.

**Different Technology :** Conventional above knee prosthesis with local components, ALIMCO components, Jaipur limb (using HDPE) ICRC technology, Endoskeleton / modular – all common types. Above Knee Gait Analysis. Above knee Check-out Procedure.

Hip Disarticulation Prosthesis: Various types of Through hip prosthesis. Different types, Prescription principles, Materials and components to be used, Casting and measurement techniques, Cast modification, alignment, suspension, Fitting, donning and doffing techniques. Check out procedures, Testing and Training. Through hip Gait analysis and deviations.

**Prosthetics Practical:** Fabrication of all types of Above knee prosthesis and through knee prosthesis and one Hip disarticulation prosthesis.

### **SCHEME OF EXAMINATION**

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

TERM WORK 50 MARKS + PRACTICAL / ORAL 50 MARKS = TOTAL 100 MARKS

Model question paper

Section A	MCQ	Q.1	Based on Single Best answer -----	20 x 1 ----	20 marks
Section B	SAQ	Q.2	Answer any five out of six -----	5 x 3 ----	15 marks
		Q.3	Answer any three out of four -----	3 x 5 ----	15 marks
Section C	LAQ	Q.4	-----	1 x 15 ---	15 marks
		Q.5	Answer any one out of two -----	1 x 15 ---	15 marks

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### **ORTHOTICS-II**

**Above knee orthotics :** All types of K.A.F.O. H.K.A.F.O. and also orthoses for C.D.H., C.P., Paralytics, Legg Calve perthes diseases. Spina Bifida, Leprosy and Hemiplegia.

**Orthotics Components :** Prescription principles of various types of knee Ankle foot Orthoses (KAFO), Knee Orthoses (KO) and Hip Knee Ankle foot Orthoses (HKAFO).

**Fabrication :** Cast and measurement techniques, choosing right kind of materials and components, cast modification, fabrication and alignment technique, using of different technologies – its advantages and disadvantages, Accommodation of limb length discrepancy while designing orthosis, Gait analysis and check out procedures.

**Practical:** Orthoses in Lower Motor Neuron Disorders, Orthoses in Upper Motor Neuron Disorders, various types of knee orthoses, Weight relieving orthosis, Floor reaction orthosis, Toronto Brace, Low cost Orthoses, Bilateral H.K.A.F.O. Orthoses in Arthritis, Orthoses in Fractures, Orthoses in Hemophilia, Orthoses in Progressive Muscular Dystrophy, Orthoses in Juvenile Disorders etc.

## SCHEME OF EXAMINATION

THEORY 80 MARKS + INTERNAL ASSESSMENT 20 MARKS = TOTAL 100 MARKS

TERM WORK 50 MARKS + PRACTICAL / ORAL 50 MARKS = TOTAL 100 MARKS

Model question paper

Section A    MCQ    Q.1    Based on Single Best answer ----- 20 x 1 ---- 20 marks

Section B    SAQ    Q.2    Answer any five out of six ----- 5 x 3 ----- 15 marks

Q.3    Answer any three out of four ----- 3 x 5 ----- 15 marks

Section C    LAQ    Q.4    ----- 1 x 15 --- 15 marks

Q.5    Answer any one out of two ----- 1 x 15 --- 15 marks

### SCHEME OF EXAMINATION FOR II BPO

SN	Subjects	Theory	Internal Assessment	Term Work	Practical / Oral	Time
01	Physical Medicine & Rehabilitation – I	80	20	--	--	3 hrs
02	Physical Medicine & Rehabilitation – II	80	20	--	--	3 hrs
03	Orthopedics & Amputation Surgery	80	20	--	--	3 hrs
04	Basic Electronics & Electro Technology	80	20	--	--	3 hrs
05	Computer Studies – I	80	20	--	--	3 hrs
06	Biomechanics – II	80	20	--	--	3 hrs
07	Prosthetics – II	80	20	50*	50	3 hrs
08	Orthotics – II	80	20	50**	50	3 hrs
<b>Total Marks</b>		<b>640</b>	<b>160</b>	<b>100</b>	<b>100</b>	<b>1000</b>

\* Above Knee, Knee Disartic & Hip Disartic Prostheses

\*\* KAFO / HKAFO Different anomalies

## **THIRD YEAR**

### **14.3**

<b>Subjects</b>	<b>Hours Theory</b>	<b>Hours Practical</b>	<b>Hours Total</b>	<b>Marks Exam.</b>
P & O Workshop Management	72	24	96	100
Computer Studies – II	72	144	216	200
Biomechanics – III	72	36	108	100
Mobility and Rehabilitation AIDS	76	176	252	200
Prosthetics & Orthotics – III	108	444	552	400

#### **14.3.1 WORKSHOP MANAGEMENT**

Theory 72 hours, practical 24 hours (Total 96 hours) examination 100 marks)

**Introduction:** Principles of Administrative and Management structure, Industrial Management, Definition of Organization. Principles of good organization, type of Organisational setup Workshop Administration and management.

Man management: Introduction, Discipline, Security, distribution of work, work sheet, Time sheet and staff Welfare.

Store purchase: Store and store organization. Inventory Control. Purchase organization. Introduction to Cost Accounting. Use of computer for effective store management.

**Safety: Industrial accidents, safety and hazards**

**Planning:** Planning of Prosthetics and Orthotics Workshop all types of various scales. Workshop layout, plant layout Costing, billing, documentation especially development of recording system to manage individual's records.

**Construction:** Construction ventilation electrification colour scheme lighting, Sanitary convenience, Further expansion and accessibility of Prosthetic and Orthotic Workshop and fittings.

Practical: Either to desing and develop a workshop or to carry out a project for layout of a workshop for prosthetics and orthotics work or workshop of similar nature.

#### **14.3.2 COMPUTER STUDIES – II**

Theory 72 hours, examination 100 marks (Theory only)

To bring the course to the international level, it is envisaged that the facilities to train the students in CAD CAM should be made available at all centers immediately but latest within the next five years. After that practical training consisting of 144 hours in this subject would be compulsory. The practical examination of 100 marks would be added after the facilities are available. This is done keeping in view that most centers would not have CAD CAM facility at present.

Computer Aided Design & Manufacturing (CAD & CAM)

**Basics of CAD:** Introduction, Definition, History, Current status, Product Cycle, Automation, Designing, Application and Benefits.

**Computer Graphics:** Introduction of software, Function of graphic package, Application Software.

**AutoCad 2002:** Introduction, Foundation of AutoCad Commands, Execution of Simple 2D Drawings, Understanding 3D Commands, Executing 3D commands, Creating 3D objects. Rendering and Image attach to an object Starting New Projects, Creating, Editing, Saving Drawing, Annotation, Dimension, Plotting, Customisation, Auto Lisp.

**Basics of CAM:** Introduction of CNC machine, basics of Computer Aided Designing and Manufacturing (CAD/CAM) and its use in P&O. Other kinds of Computer use in Prosthetics and Orthotics. CAD/CAM Technology in socket making and also making of different kinds of orthosis and prosthesis.

**Practical:** Trainees has to be thorough in all branches CAD/CAM especially AUTOCAD. Trainees should make design of all common types of P&O components which are regularly in use by using AutoCAD software.

### **14.3.3 BIOMECHANICS – III**

Theory 72 hours, Practical 36 hours (Total 108 hours) examination 100 marks.

**Tissue Mechanics :** Study of mechanical characteristics and function of Bones, skin, ligaments, cartilage and muscles.

**Spinal Biomechanics:** Motions of the spine, Biomechanics of different region in spinal column, Biomechanics Inter vertebral disk, Lumbar Spine loading during normal activities and effects of orthosis on this loads, Biomechanical Principles of spinal orthosis, Biomechanics of Corsets Cervical / thoraco / Lumbar / sacral spinal orthosis. Biomechanics of scoliosis correction using different technologies and especially using Spinal orthosis.

**Upper Limb:** Grasp patterns, grasp forces, mechanical replacement of hand function, augmentation of deficient hand function, upper limb prosthetic socket biomechanics – all types, Orthosis biomechanics, application of external power, myoelectric control of external power and usage of devices.

**Control systems:** Introduction to control theory. Application in Prosthetics and Orthotics of functional electrical stimulation (FES), hybrid orthosis, myoelectrics and biofeedback.

Design concept part-I : Buckling theories in failure / fatigue / stress concentrations, connections, fluid mechanics and beam deflection.

Design concept part – II: Shear force and bending moment diagrams, centroids, 2<sup>nd</sup> moment of area and mass, theorem of parallel axes, bending stress, torsional stress of circular shafts, combined axial and bending stresses. Combined and torsional stresses, combined axial bending torsional stresses. Open and closed helical springs, beam deflection. Design test standards / materials/ Philadelphia Loads / ISO. Design calculations for P&O devices.

Practical: Different ways of design tests, use of FES and myoelectric control system in P&O devices.

#### 14.3.4 MOBILITY AND REHABILITATION AIDS

Theory 76 hours, Practical 176 hours (Total 252 hours) examination 200 marks.

**Mobility and walking aids:** Canes, walking sticks, Crutches axillary, elbow and forearm support. Different types of walking Frame, Walker and their attachments. Parapodium and David Hart Walker.

**Developmental aids :** Biomechanics of various kinds of developmental aids, Normal milestone and delayed milestone, measurement techniques, fabrication of Box seat, Special Chair with or without table/tray, Standing/tilting frame, Low-level cart, Prone board and various developmental and educational toys. Maximum use of Appropriate Technology while making developmental aids.

**Moulded seats:** Biomechanics of various kinds of moulded seats, prescription criteria, cast and measurement techniques, Cast modifications, fabrication of moulded seats with inside or outside posting, use of different materials and technologies to fabricate the same, suspension or right kinds of strapping.

**Wheelchair:** Different types, prescription criteria, measurement techniques, wheelchair modification and maintenance according to individual's needs. Various attachments of a wheelchair, Motorized wheel chair, tricycle and motorized tricycle, Scootys. Different types of cushions and its fabrication technique.

**Gait Training with crutches:** Training with various walking aids and that too different ways. Installation / fabrication of Parallel bars and transition from Parallel bars to walkers then to crutches or sticks.

Self help devices: Special gadgets for prehension and to assist in activities of daily living (A.D.L.)

#### **14.3.5 PROSTHETICS & ORTHOTICS – III**

Theory 108 hours practical 444 hours total 552 hours and examination 400 (100+100 theory and 100 + 100 practical)

**Upper limb prosthetics :** Historical development in Upper Limb Prostheses – India and abroad, Upper Extremity Prosthetics Components – Terminal devices, Wrist units, Elbow units, Shoulder units, Harnessing systems in Upper extremity prosthesis.

**Partial Hand:** Both cosmetics and functional types which also includes silicon prostheses. Cosmetic hand gloves and fingers. Devices for augmentation of function and cosmesis for partial hand amputation and finger amputation.

**Wrist Disarticulation:** Prescription Criteria, Types of Through wrist prosthesis – Components, Socket Shape, Clinical Considerations, Casting and measurement techniques, Cast modifications, Fabrication techniques, alignment techniques, Harnessing and suspension mechanisms, Fitting, donning and doffing techniques. Check out procedures, Testing and Training.

**Below Elbow:** Prescription Criteria, Types of Below Elbow prosthesis – Components, Types of Sockets which includes Self suspending, flexible / rigid socket or combination of both, Clinical Considerations, Casting and measurement techniques, Cast modifications, Fabrication techniques – single wall and double wall, alignment techniques, Harnessing and suspension mechanisms, Control system – body powered and externally powered, Fitting, donning and doffing techniques. Check out procedure, Testing and Training.

**Above Elbow:** Prescription Criteria, Types of Above Elbow prosthesis which also includes Elbow Disarticulation prostheses – Components, Different types of Elbow Mechanisms. Types of Socket which included self suspending, flexible / rigid socket or combination of both, Clinical Considerations Casting and measurement techniques, Cast modifications, Fabrication techniques – single wall and double wall, alignment techniques, Harnessing and suspension mechanisms, Control system – body powered and externally powered, Fitting donning and doffing techniques. Check out procedure, Testing and Training.

**Shoulder Disarticulation:** Prescription Criteria, Types of Shoulder disarticulation prosthesis both cosmetics and functional, Components, Different types of Elbow and Shoulder Mechanisms. Types of Socket, flexible / rigid Socket or combination of both, Clinical Considerations Casting and measurement techniques, Cast modifications, Fabrication techniques, alignment techniques, Harnessing and suspension mechanisms, Control system – body powered and externally powered, Fitting donning and doffing techniques. Check out procedures, Testing and Training.

**Prosthetics Practical:** Fabrication of prosthesis for partial hand amputation or congenital absence, through wrist prosthesis, Below Elbow prosthesis, Above Elbow prosthesis, Shoulder Disarticulation prosthesis, Elbow Disarticulation prosthesis – preferably using various available technologies.

### **Orthotics – III**

**Upper Limb orthotics:** Objectives of splinting and principles. Biomechanical principal of all types of upper limb Orthotics. Material used and its advantages and disadvantages. Basic opponens spints, all types of hand / finger orthosis, Writs Hand orthosis which includes - Flexor hinge splint finger driven, Flexor hinge splint wrist driven, Flexor hinge splint shoulder driven. Measurement / casting and Fabrication of Elbow Orthoses, Elbow Wrist and Hand Orthoses, Elbow braces appliances to allow immobilization / mobilization, Appliances for flail elbows. Measurement / casting and Fabrication of Shoulder Orthoses, The shoulder joint braces and splints, Abduction splints and braces, Traction splint of humerus, All types of Shoulder Elbow Wrist and Hand Orthoses which also includes both body powered and externally powered. All types of fracture orthoses, Temporary splinting, Feeder and other assistive appliances.

**Orthotics Practical:** Fabrication of at least 5 types of splints belonging to each group.

## FOURTH YEAR

Subjects	Hours Theory	Hours Practical	Hours Total	Marks Exam.
<b>14.4 IVth year</b>				
PROSTHETICS	00	224	224	200
ORTHOTICS	00	224	224	200
PROJECT WORK		104	104	100
STUDY TOUR		120	120	
PROSTHETICS AND ORTHOTICS– IV	108	444	552	400
TOTAL			1224	1000

Add 144 hours saved from 14.3.2 Computer studies for Practical training.

### 14.4.1 PROSTHETICS CLINICAL PRACTICE –

Practical 224 hours total 224 hours and examination 200 (100 + 100 term work and Practical)

**Direct Service:** In this period each trainee will be in touch directly with the persons with disabilities under supervision of the Instructor / Demonstrator. She/he would do all the necessary work from start to the finish for fittings of suitable prostheses. Each person fitted with prostheses has to be documented / recorded well and to be presented in the clinics in front of Rehabilitation team and other trainees.

Besides fitting, trainee would also work with other rehabilitation team members to understand “Total Rehabilitation”.

### 14.4.2 ORTHOTICS CLINICAL PRACTICE –

Practical 224 hours total 224 hours and examination 200 (100+100 term work and Practical)

**Direct Service :** In this period each trainee will be in touch directly with the persons with disabilities under supervision of the Instructor/Demonstrator. She/he would do all the necessary work start to finish for fittings of suitable orthoses. Each person fitted with orthoses has to be documented / recorded well and to be presented in the clinics in front of Rehabilitation team and other trainees.

Besides fitting, trainee would also work with other rehabilitation team members to ensure “Total Rehabilitation”.

### 14.4.3 PROJECT WORK

Practical 104 hours, total 104 hours and examination 100.

Each Trainee shall take a project work under supervision of a guide. Project work has to be well documented and presented in essay form. The major focus will be trainee’s original work which she or he has to present prior to final examination. The subject and the guide to be chosen within four weeks form the day of admission to the fourth year.

#### **14.4.4 STUDY TOUR**

total 120 hours

It is a compulsory event for final year students who has to visit at three or four other major P & O Training Institutes and Artificial Limbs Manufacturing Corporation of India (ALIMCO). Trainee has to submit a report certified by the tour guide at the end of the tour latest by four weeks after completion of the study tour.

#### **14.4.5 PROSTHETICS & ORTHOTICS – IV**

Theory 108 hours Practical 444 hours total 552 hours and examination 400 (100 + 100 theory and 100 + 100 Practical)

##### Spinal Orthotics

**Spinal Orthoses:** Historical development of spinal orthoses. Anatomical and Physiological Principles of construction and fitting of spinal orthoses. Biomechanical principle and functions of spinal orthoses.

**Cervical Orthoses :** Principle, material, measurement / casting, fabrication of all types of Cervical Orthoses especially different types of cervical collar, semi-rigid / rigid cervical orthoses both temporary and permanent. Cervical Traction – Various types.

**Thoraco lumbo Sacral Orthoses :** Flexible spinal orthoses. Rigid spinal orthoses. Principle, material, measurement / casting, fabrication of all types of Thoraco lumbo sacral orthoses (TLSO) especially all types of orthoses for scoliosis. All types of Under arm orthoses and variants. Various types of Immobiliser. Fitting, donning and doffing techniques. Check out procedures, Testing and Training.

**Lumbo sacral Orthoses :** Principle, material. Measurement / casting, fabrication of all types of Lumbo Sacral Orthoses (LSO) especially Corsets and all types of Orthoses for lordosis and scoliosis. Pelvic traction and its use.

##### **Special studies:**

Revision of all branches of Orthotics & Prosthetics which are as follows :

**Prosthetics :** Bilateral Stubbies. Bilateral Prosthesis. Trans Lumbar Prosthesis (Sitting and Standing), Prosthesis for Child Amputee, Prosthesis for Congenital anomalies, Prosthesis adaptation for sports and recreation, Immediate post surgical fittings.

**Practical :** Fabrication of Prosthesis for double or multiple amputees, Fitting of Prosthesis in cases and developing and / or adapting new designs.

**Orthotics :** Orthoses for sports injury, Reciprocating Gait Orthoses (RGO), Hip Guidance Orthoses (HGO), Fracture Cast Bracing, Swivel Walker, Orthopodium / Parapodium. Weight relieving orthoses, Extending orthoses or Ortho-prostheses, P.T.B. orthoses, Silicone Cosmetic prosthesis.

**Practical** : Fabrication of orthoses for children with Cerebral palsy as in para above and adapting according to the individual needs.

### **INTERNSHIP PROGRAMME FOR B.P.O. STUDENTS**

This internship programme will be for 6 months after the successful completion of the final year exams by the candidates.

During this internship programme the students will be involved in the day-to-day activities in the Institute mainly concerned with prosthetics and orthotics. They will be participating in the treatment and service programmes which consist of measurement technique of appliances, fabrication of P & O appliances, fitting of appliances, gait training activities, Clinical presentation and follow up. They will be connected with production technology of these devices, which comprises of material selection, processing, planning and control prosthetic and orthotics workshop (management technique) and research methodology in order to develop independent thinking in overall management.

They will be working 3 months each in prosthetic and orthotic field respectively. The type of work that they will have to attend is indicated in the adjoining table.

Regular muster will be maintained to keep attendance record and regularity and punctuality will be observed during this programme.

Weekly assessment should be done. If the performance is unsatisfactory, repetition of the postings should be recommended by the supervisor. The work record of the internship programme is mandatory to be kept in a work book.

The student will maintain "Critique book" Giving Account of all work done during internship which will be certified by the Institute authorities.

### **INTERNSHIP PROGRAMME : ORTHOTICS**

Types of Orthoses	No. needed to be fabricated
Lower Extremity Orthoses	10
Upper Extremity Orthoses	02
Spinal Orthoses	
Cervical	02
TLSO (incl. one for scoliosis)	02
Lumbo-sacral	02
<b>PROSTHETICS</b>	
BK Prosthesis	02 (all socket variants)
Partial Foot / and Symes Protheses	02
AK Prosthesis	02
Hip disarticulation Prosthesis	01 (if available)
BE Prosthesis	02
AE Prosthesis	02 (1 cosmetics & 1 Functional)

Congenital limb length deficiency Prosthesis: 1 type

INFRASTRUCTURAL FACILITIES REQUIRED SPACE REQUIREMENTS

1. Two Lecture Halls  
(To be increased to Four after Two years)
2. One Room for Clinical Meeting
3. Two Trial fitting rooms  
(one for Men & one for women)
4. Two Measurement Rooms  
(One for Men and one for Women)
5. One Plaster Room for casting / modification
6. One Plastic lamination section
7. One Prosthetics Laboratory
8. One Orthotic Laboratory
9. One Leather / Surgical Shoes Section
10. One Faculty Room
11. One Office Room
12. Two Students Room (One for Men & one for women)
13. One Medical Officer's Room
14. One Bio Engineering / Kinesiology Laboratory
15. One Store room
16. One Waiting Hall for the disabled
17. One Drawing Room with drawing boards & drafting machines
18. One Library Room
19. One Computer Room

The space requirement mentioned above are for Prosthetic / Orthotic training only. It is presumed that the centre is having other facilities like Physio / Occupational Therapy and allied departments for Rehabilitation.