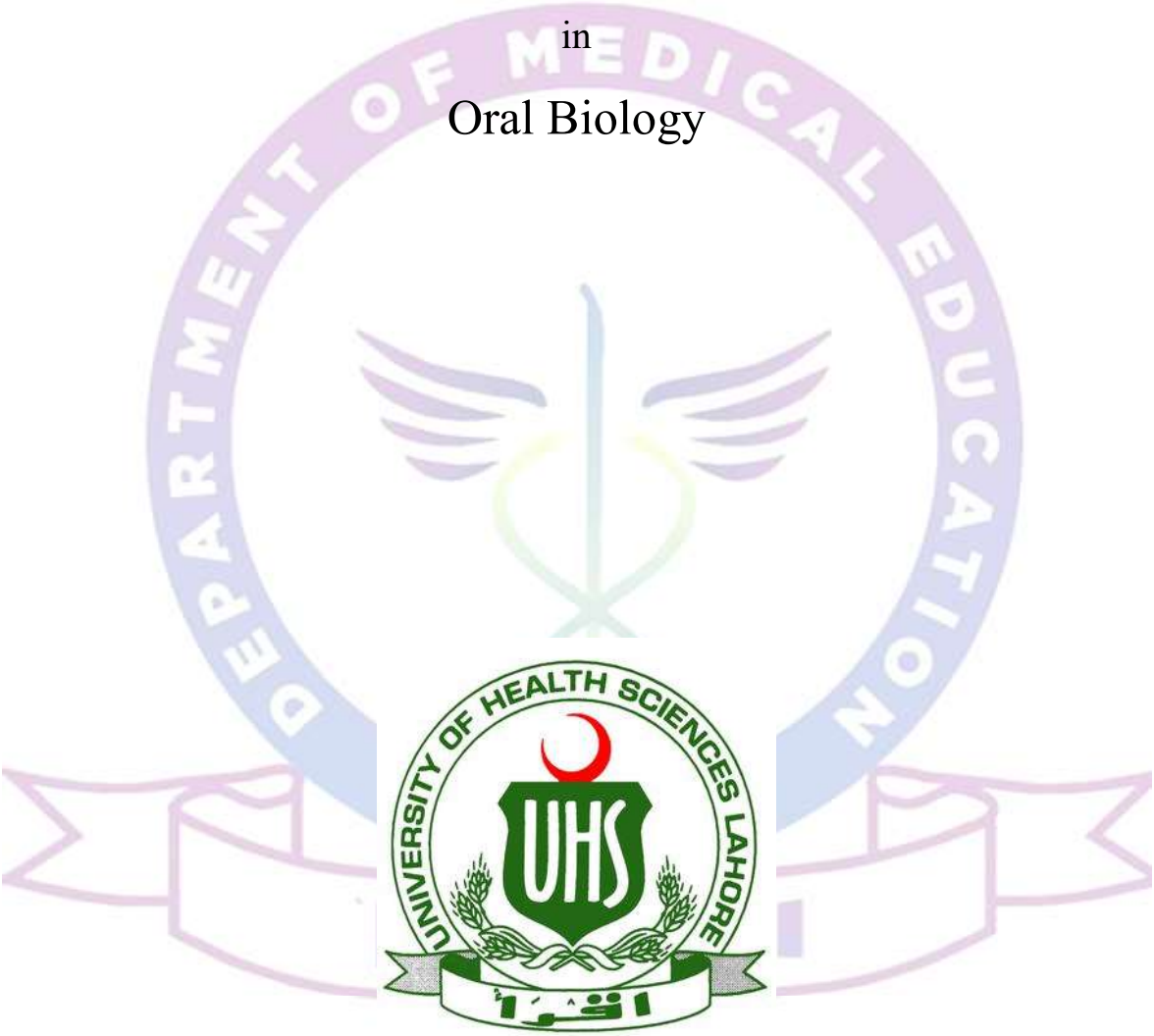
COURSE OF STUDIES

for

Master of Philosophy

in

Oral Biology



UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

To produce knowledgeable and skillful human resource in Oral Biology demonstrating attributes of a good teacher, researcher, assessor, professional and a leader.

Mission Statement:

To produce knowledgeable and skillful human resource in Oral Biology demonstrating attributes of a good teacher, researcher, assessor, professional and a leader.

Program Educational Objectives:

Trainees will require the satisfactory completion of a structured training program in Oral Biology whose program objectives are as follows:

1. Provide strong theoretical and practical base to the learners
2. Enhance learner's critical thinking and analytical skills that will help them become confident researchers and knowledgeable in the field of Oral Biology
3. Enhance learners to transfer their expertise to the future human resources in this field with latest trends as teachers, researchers and supervisors
4. Enable learners to demonstrate attributes of professionalism and leadership at their respective workplaces

Program Learning Outcomes:

By end of the degree program, the students will be able to

1. Demonstrate adequate knowledge of developmental, structural, histological and functional aspects of the biology of craniofacial region relevant to Oral Biology including its sub specializations

a. Demonstrate technical, organizational and analytical skills as a researcher

b. Develop effective scientific writing skills

c. Develop effective teaching and communication skills through class and scientific presentations

d. Become a lifelong learner and a thorough professional

SCHEME OF STUDIES (2-Years)

MS/MPhil: Oral Biology

Semester #	Course code	Course title	Credit hours/week		
			Theory	Practical	Total
1	RM701	Biostatistics and Research Methodology	2	0	2
	OB701	Craniofacial Developmental Biology & Molecular Signaling	0.5	0.5	8
	OB702	Structure, Development and Histology of Dental Hard Tissues	02	01	
	OB703	Structure, Development and Histology of Dental Soft and Supporting Tissues	02	01	
	OB704	Mechanism of Growth, Eruption & Shedding in the Oral Cavity	0.5	0.5	
	GA104	Elective Course General Anatomy	2	0	2
2	OB705	Oral Physiology & Dental Biochemistry	01	00	8
	OB706	Tooth Morphology & Occlusion	02	01	
	OB707	Oral Mucosa & Salivary Glands	01	01	
	OB708	Temporomandibular joint & Growth and development of facial profiles	0.5	0.5	
	OB709	Repair and regeneration of tooth and supporting tissues	0.5	0.5	
		Elective Course	2	0	2
3	Research (thesis)		6		6

4	Professional & Teaching Skills Apprenticeship (PTSA) • Teaching skills • Professional communication skills • Scientific writing skills • Research funding/grants skills • Skills related to Ethical code of conduct	0	2
			(Total: 30)

Course Title: OB701 Craniofacial Developmental Biology & Molecular Signaling

Contact Hours:	Credit Hours:
Theory = 08-hour	Theory = 0.5
Practical = 24	Practical = 0.5
Total = 32-hour	Total = 01

Course Objective:

- The developmental processes of the organs of craniofacial complex
- Molecular mechanism of each developmental process

Learning Outcome:

It will help out the students to learn that how the development of tooth initiates during prenatal development

Course Outline:

a) Neural crest cells and molecular regulation of neural crest cell induction, specification, migration and differentiation. Their role in craniofacial development
b) Pharyngeal arches, pouches, clefts, membrane and their derivatives
c) Development of cranial vault and base
d) Development of face
    i. Formation of facial prominences
    ii. Molecular regulation by Hox genes
    iii. Face and fronto-ectodermal zone

    Clinical correlations of face:
    i. Holoprosencephaly
    ii. First arch syndromes/ sequences (Pierre Robin, Treacher Collin's)
    iii. Crouzan, Apert's and Pfeiffer's syndrome
    iv. Microstomia
e) Development of Palate
    I. Development of primary palate
    II. Development of secondary palate, palatal shelf elevation and fusion and molecular mechanism of its development
    III. Clinical consideration
    i. Cleft lip and palate
    ii. Submucous clefts
    iii. Common syndromes associated with cleft lip and palate

iv. Non neoplastic cysts
v. Hypernasality

f) Development of tongue and clinical correlation
   i. Developmental anomalies of tongue

a) Development of skull (neurocranium, viscerocranium)
b) Development of cranial sutures, newborn skull and clinical consideration
   i. Briefly Craniosynostosis

g) Development and Growth of jaw bones
   I. Development and Growth of maxilla,
   II. Development and Growth of mandibular process, mandible, condylar cartilages and molecular mechanisms involved
   III. Development and role of Meckel's cartilage
   IV. Clinical correlations
      i. Hemifacial microstomia
      ii. Treacher Collin's syndrome
      iii. Pierre Robin sequence
      iv. Crouzan syndrome
      v. Local factors & systemic factors
h) Development of salivary glands and clinical correlations
   i. Developmental anomalies of salivary glands
i) Development of thyroid, parathyroid glands and thymus and clinical correlations
   i. Developmental anomalies related to thyroid, parathyroid and thymus gland
j) Development of craniofacial muscles
k) Development of ectodermal placodes and cranial ganglia relevant to Head and neck region
l) Signaling molecules of craniofacial development

Practicals: N/A

Recommended Books:

i. Oral Anatomy Histology & Embryology-Berkovitz
ii. Ten Cate Oral Histology, Development, Structure and Function
iii. Essentials of Oral Histology and Embryology-Cheigo
iv. Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach
v. Anatomy for Dental Students
vi. Mineralized Tissues in Oral and Craniofacial
vii. Dental Biochemistry
viii. Basic sciences for dental students

Course Title: OB702 Structure, Development and Histology of Dental Hard Tissues

Contact Hours:	Credit Hours:
Theory = 32	Theory = 02
Practical = 48	Practical =01
Total = 80	Total = 03

Course Objective:

a) Explain the structural aspects of dental hard tissues such as teeth, enamel, dentin, cementum & bone

b) Able to describe the chemical and physical properties of each of the above

c) Able to explain the development, structure and function of each of the above

d) Able to explain the common malformations and clinical correlations associated with each of the above

Learning Outcome:

The student will be able to demonstrate adequate basic knowledge along with the clinical correlations related to structure, development and histology of Dental Hard Tissues

Course Outline:

Early Tooth Development

a) Primary Epithelial Band
b) Dental Lamina and its fate
c) Vestibular Lamina
d) Tooth developmental Stages and their histology
   i. Initiation
   ii. Bud stage
   iii. Cap stage
   iv. Outer and inner enamel epithelium
   v. Stellate reticulum
   vi. Dental papilla
   vii. Dental sac (dental follicle)
   viii. Bell stage

ix. Inner enamel epithelium
x. Stratum intermedium
xi. Stellate reticulum
xii. Outer enamel epithelium
xiii. Dental papilla
xiv. Advanced/late bell stage
xv. Hertwig's epithelial root sheath
xvi. Root formation

e) Histophysiology
   i. Initiation
   ii. Proliferation
   iii. Histodifferentiation
   iv. Morpho differentiation
   v. Apposition
f) Molecular mechanisms of tooth shape and tooth type determination (patterning and morphogenesis)
g) Tooth initiation potential
h) Establishment of oral–aboral axis
i) Control of tooth germ position
j) Mechanism of control of tooth number
k) Functional redundancy and their complexities
l) Regulation of ectodermal boundaries
n) Enamel knot–Signaling center for tooth Morphogenesis
o) Breakup of the dental lamina and crown pattern determination
p) Nerve and vascular supply during early development, vascular supply and nerve supply
q) Formation of permanent dentition
r) Tissue engineering and Regeneration of tooth and dental stem cells
n) Clinical consideration (anomalies related to tooth number, size, shape)

Bone---Development/structure/histology

a) Classification of Bones
b) Gross morphology of bone
c) Composition of Bone
   i. Chemical composition of bone
   ii. Organic matrix
d) Histology of bone
   i. Osteoid
   ii. Bone organization
e) Bone Cells types
   i. Osteoblasts
   ii. Osteocytes
   iii. Osteoclasts
   iv. Bone lining cells
   v. Osteoprogenitor cells
   vi.
f) Regulation of bone cell formation
   i. Formation of osteoblasts

ii. Formation of osteoclast

g) Bone Development
   i. Intramembranous formation
   ii. Differences between immature bone and mature bone
   iii. endochondral bone formation
h) Sutural bone growth
i) Bone Resorption
j) Bone Remodeling
k) Alveolar Bone
   i. Development of Alveolar Process
   ii. Structure of the Alveolar Bone
   iii. Internal Reconstruction of Alveolar Bone
l) Age Changes
m) Clinical Considerations and Therapeutic Considerations

Enamel--- Development/ Histology/Structure

a) Development
   i. Epithelial enamel organ
   ii. Outer enamel epithelium
   iii. Stellate reticulum
   iv. Stratum intermedium
   v. Inner enamel epithelium
   vi. Cervical loop
b) Histology
   i. Physical and chemical Characteristics of Enamel
c) Amelogenesis
   i. Light Microscopy of Amelogenesis
   ii. Electron Microscopy of Amelogenesis/ life cycle of the ameloblasts
   iii. Development of Tomes process
d) Ameloblast Secretory Products / enamel proteins
e) Formation of enamel matrix, Mineralization and maturation of the enamel matrix
f) Incremental line formation
g) Molecular elements of ameloblast differentiation (gene transcription, membrane receptors, intracellular receptors)
h) Regulation of pH During Enamel Formation
i) Structural and Organizational Features of Enamel
   i. Rods
   ii. Structure and direction of striations, rod Interrelationships
   iii. Striae of Retzius
   iv. Cross striations
   v. Enamel cuticle
   vi. Bands of Hunter and Schreger
   vii. Gnarled Enamel
   viii. Enamel Tufts and Lamellae
   ix. Dentinoenamel Junction and
   x. Odontoblast process and Enamel Spindles
   xi. Enamel Surface

j) Age Changes
k) Defects of Amelogenesis
l) Clinical Implications

i. Fluoridation
ii. Acid Etching
iii. Enamel pearls

Dentine---Development/Histology/Structure

a) Basic Structure of Dentin
b) Composition, Formation, and Structure of Dentin
c) Types of Dentin
    i. Primary Dentin
    ii. Secondary Dentin
    iii. Tertiary Dentin
d) Pattern of Dentin Formation
e) Dentinogenesis
    i. Odontoblast Differentiation
    ii. Formation of Mantle Dentin
    iii. Vascular Supply
    iv. Control of Mineralization
    v. Pattern of Mineralization
    vi. Formation of Root Dentin
    vii. Secondary and Tertiary Dentinogenesis
f) Histology of Dentin
    i. Dentinal Tubules
    ii. Peritubular Dentin
    iii. Sclerotic Dentin
    iv. Intertubular Dentin
    v. Interglobular Dentin
    vi. Incremental Growth Lines
    vii. Granular Layer of Tomes
g) Pre-dentin
h) Odontoblast process
i) Innervation of Dentin
j) Intratubular nerves
k) Dentin Sensitivity and theories of pain transmission through dentin
l) Permeability of Dentin
m) Age and Functional Changes
n) Vitality of dentin
o) Reparative dentin
p) Dead tracts
q) Clinical Considerations

Practicals:

Histological slides and drawings of dental hard tissues

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB703 Structure, Development and Histology of Dental Soft and Supporting Tissues

Contact Hours:	Credit Hours:
Theory = 32	Theory = 02
Practical = 48	Practical =01
Total = 80	Total = 03

Course Objective:

a) Explain the development, structure and histological features of the dental soft and supporting tissues
b) Explain the molecular basis of the structural formation of the above
c) Describe the clinical correlations associated with the dental soft and supporting tissues

Learning Outcome:

The student will be able to demonstrate adequate basic knowledge along with the clinical correlations related to structure, development and histology of Dental Soft Tissues

Course Outline:

Pulp---Development/Histology/Structure

a) Anatomy
b) General features
c) Coronal pulp
d) Radicular pulp
e) Apical foramen
f) Accessory canals
g) Structural Features
    i. Intercellular substance
    ii. Fibroblasts
    iii. Fibers
    iv. Non fibrous matrix (Glycosaminoglycans, proteoglycans and glycoproteins
    v. Undifferentiated mesenchymal cells
    vi. Odontoblasts of pulp
    vii. Defense cells
    viii. Pulpal stem cells
    ix. Blood vessels
    x. Lymph vessels
    xi. Nerves
    xii. Nerve fiber types
    xiii. Nerve endings
h) Molecular events following pulp injury and repair
i) Functions
    i. Inductive
    ii. Formative
    iii. Nutritive
    iv. Protective
    v. Defensive or reparative
j) Primary pulp
k) Permanent pulp
l) Dental pulp stem cells
m) Regressive Changes (Aging)
    i. Cell changes
    ii. Fibrosis
    iii. Vascular changes
    iv. Pulp stones (denticles)
    v. Diffuse calcifications
n) Development
o) Clinical Considerations
p) Vasculature and Lymphatic Supply
q) Innervation of pulp
r) Response to Environmental Stimuli

Cementum---Development/ structure/ function

a) Physical Characteristics
b) Chemical Composition
c) Cementogenesis
d) Cementoblasts
e) Cementoid tissue
f) Structure
    i. Acellular extrinsic fiber cementum
    ii. Cellular cementum
    iii. Cellular intrinsic fiber cementum (CIFC)
    iv. Cellular mixed fiber cementum (CMFC)
    v. Cellular mixed stratified cementum (CMSC)
    vi. Differences between cementocytes and osteocytes
    vii. Differences between AEFC and cellular intrinsic fiber cementum (CIFC)
g) Cemento-dentinal Junction
h) Cemento-enamel Junction
i) Functions
    i. Anchorage
    ii. Adaptation
    iii. Repair
j) Clinical Considerations
    i. Hypophosphatasia
    ii. Hyper cementosis

Periodontal ligament--- Development/structure/functions

a) Development
b) Development of the principal fibers
c) Development of cells
d) Periodontal ligament collagen fiber attachment to the root surface
e) Periodontal Ligament Homeostasis
f) Cell Biology of Normal Periodontium
g) Cells
    i. Synthetic cells
    ii. Osteoblasts
    iii. Fibroblast
    iv. Fibroblast-matrix adhesion and traction
    v. Functions
    vi. Differences between periodontal ligament fibroblasts and gingival fibroblasts
    vii. Cementoblasts
    viii. Resorptive cells
    ix. Osteoclasts
    x. Fibroblasts
    xi. Intracellular degradation
    xii. Cementoclasts
    xiii. Progenitor cells
    xiv. Origin of the periodontal stem cells

xv. Relationship between cells
xvi. Epithelial rests of Malassez
xvii. Defense cells
xviii. Mast cells
xix. Macrophages
xx. Eosinophils 188

k) Extracellular Substance
   i. Fibers
   ii. Collagen
   iii. Oxytalan
   iv. Sharpey's fibers
   v. Intermediate plexus
   vi. Elastic fibers
   vii. Reticular fibers
   viii. Secondary fibers
   ix. Indifferent fiber plexus
   x. Ground substance
   xi. Interstitial tissue
l) Structures Present in Connective Tissue
   i. Blood vessels
   ii. Lymphatic drainage
   iii. Nerves
   iv. Cementicles
m) Functions
   i. Supportive
   ii. Sensory
   iii. Nutritive
   iv. Homeostatic
   v. Eruptive
   vi. Physical
n) Age Changes in Periodontal Ligament
o) Unique Features of Periodontal Ligament
p) Clinical Considerations

Practicals:

Histological slides and drawings related to the Dental supporting tissues

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB704 Mechanism of Growth, Eruption & Shedding in the Oral Cavity

Contact Hours:	Credit Hours:
Theory = 08	Theory = 0.5
Practical =24	Practical =0.5
Total = 32	Total = 01

Course Objective:

a) Explain the developmental and molecular mechanisms of eruption and shedding of the teeth

b) Describe the clinical correlations associated with eruption and shedding

Learning Outcome:

The student will be able to demonstrate the mechanism of eruption and shedding with relevance to the clinical situations

Course Outline:

<u>Physiological tooth movements, eruption and shedding</u>

a) Pre eruptive Tooth Movement
b) Eruptive Tooth Movements
c) Histology of tooth movements
    i. Pre-eruptive phase
    ii. Eruptive phase
    iii. Post-eruptive phase
d) Mechanisms of Eruptive Tooth Movement
e) Theories of tooth eruption
    i. Bone remodeling theory
    ii. Root formation theory
    iii. Vascular pressure theory

iv. Periodontal ligament traction theory

f) Accommodation for Growth
g) Compensation for Occlusal Wear
h) Accommodation for Interproximal wear
i) Posteruptive tooth movement
j) Cellular and molecular events in eruption
k) Clinical Considerations
l) Shedding of Teeth
m) Pattern of shedding
n) Histology of Shedding
o) Mechanism of Resorption and Shedding
p) Remnants of deciduous teeth
q) Retained deciduous teeth
r) Submerged deciduous teeth
s) Odontoclast
t) Pressure
u) Abnormal Tooth Movement
v) Orthodontic Tooth Movement

Practicals: N/A

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB705 Oral Physiology & Dental Biochemistry

Contact Hours:	Credit Hours:
Theory = 16	Theory = 01
Practical = 00	Practical = 00
Total = 16	Total = 01

Course Objective:

a) Explain the physiological mechanism associated with the oral processes

b) Describe the neuro-physiological pathway of the oral processes

c) Explain the clinical correlation associated with the physiological process

d) Describe the biochemical basis of structures associated with the oral cavity

Learning Outcome:

Students will be able to demonstrate the basic knowledge of oral processes and the effects of malfunctions on oral cavity

Course Outline:

ORAL PHYSIOLOGY

a. Physiology of dental pain transmission through the oral cavity
b. Mechano-reception in oral cavity
c. Physiology and biochemistry of saliva, mechanism of saliva formation, secretion and flow
d. Thermo-reception in oral cavity
e. Physiology and mechanism of swallowing
f. Physiology and mechanism of speech
g. Physiology of vocal cord apparatus
h. Physiology of and mechanism of mastication
i. Physiology and mechanism of taste transduction
j. Physiology of olfaction
k. Types of jaw reflexes
    i. Jaw opening reflex
    ii. Jaw closing reflex
    iii. Unloading reflex
l. Types of salivary reflexes
m. Role and effects of hormones, vitamins and micro-nutrients on oral health and tissues
    i. Effects of sex hormones on periodontal health in puberty, menstruation, pregnancy, menopause and post menopause states

ii. Effects on vitamins and micronutrients on oral and periodontal health

n. Mechanism of calcium homeostasis and calcitropic hormones in the body
   i. Calcium regulation in the body
   ii. Phosphate regulation in the body
   iii. Role of Parathyroid hormone in maintaining calcium homeostasis
   iv. Role of calcitonin and Vitamin D in regulating calcium hemostasis

o. Stephan's curve and Plaque Biochemistry
   i. Definitions of Pellicle, plaque, calculus
   ii. Mechanism of Plaque formation and Climax Community
   iii. Mechanism of calculus formation
   iv. Stephan's curve

p. Physiology of stress and anxiety and its effects on oral cavity
   i. The neural axes of stress response
   ii. The neuro-endocrine axes of stress response
   iii. The endocrine axes of stress response

q. Physiology of oral wound healing
   i. Phases of wound healing in the oral tissues
   ii. Cells involved in wound healing
   iii. Factors affecting wound healing

r. Physiology of repair of oral tissues
   i. Repair after tooth extraction
   ii. Repair of periodontium

Cytoskeleton, cell junction and fibroblasts

a) Cytoskeleton
b) Intercellular Junctions
c) Epithelium–Connective Tissue Interface
d) Fibroblasts
   i. Cellular Organization
   ii. Contraction and Motility
   iii. Junctions
   iv. Heterogeneity
   v. Aging
e) Secretory Products of Fibroblasts
   i. Collagens
   ii. Collagen Synthesis and Assembly
   iii. Elastin
   iv. Proteoglycans
   v. Glycoproteins
   vi. Growth Factors and Cytokines
   vii. Extracellular Matrix Degradation

Practicals: N/A

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB706 Tooth Morphology & Occlusion

Contact Hours:

Theory = 32

Practical = 48

Total = 80

Credit Hours:

Theory = 02

Practical = 01

Total = 03

Course Objective:

a) Describe the morphological features and forms of all deciduous and permanent tooth

b) Explain the occlusal aspects of both dentitions

Learning Outcome:

Students will be able to identify the individual teeth clinically and on tooth models by having basic knowledge of morphological features of the dentition. Also they will be able to identify numerous variations in tooth morphology

Course Outline:

<u>General Aspects of Tooth Morphology</u>:

1. Types of human dentition
2. Arrangement in dental arches
    i. Classes of teeth
    ii. Types of teeth
3. Trait categories of teeth

4. Nomenclature of teeth
5. Dental formulae in humans
6. Tooth Numbering Systems
7. Surfaces of the teeth
8. Divisions of crowns and roots into thirds
9. Line angles and point angles
10. Anatomical land marks on tooth surface
    i. Cusps
    ii. Tubercle
    iii. Cingulum
    iv. Lobe
    v. Memelone
    vi. Fossae
    vii. Sulcus
    viii. Grooves
    ix. Pits
    x. Fissures
    xi. Ridges
    xii. Embrasures
11. Anatomical landmarks on root surface (apex, apical foramen, accessory foramen, root trunk, furcation)
12. Malformations/ tooth anomalies
13. Chronology of Primary Dentition
14. Chronologies of permanent Dentition
15. Differences between primary and permanent teeth
16. Development and sequence of Eruption/Emergence, sequence, shedding of both dentitions
17. Changes in tooth shape after eruption
18. Dental Age
    i. Based on status of tooth emergence /eruption in the oral cavity
    ii. Based on stages of tooth formation observed on radiographs
19. Stages of Tooth Formation
    i. Nolla stages
    ii. Moorreee's 14 stages of permanent tooth formation

Forensic Dentistry, Comparative Anatomy and Geometrics

1. Forensic Dentistry (Odontology)

i. Definitions in forensic dentistry
ii. Civil litigation and dentistry
iii. Identification of human remains
iv. Dental DNA
v. Bite Marks
vi. Role of forensic dentist in mass disaster
vii. Importance to practicing dentists

2. Evolution of teeth
    i. General aspects of evolution of teeth
    ii. Important changes in course of evolution of teeth
    iii. Increase in tooth complexity favored by evolution

3. Comparative Dental Anatomy
    i. General aspects of Fish, amphibian and reptile dentition
    ii. Modern mammals (rodents, herbivorous, carnivorous)
4. Dental Anthropology
    i. Categories of teeth by shape
    ii. Categories of teeth by generation
    iii. Metric and non-metric variations in teeth
    iv. Sexual dimorphism of teeth
5. Tooth forms and jaw movements
6. General facial and lingual aspects of all teeth
7. Summary of Schematic Outlines
8. Form and Function of the Permanent Dentition,

Orofacial Complex: Form and Function

1. General aspects of Form and Function
2. Form Follows Function (Tooth forms and jaw movements)
3. Interproximal spaces and protection of interdental gingival
4. Proximal contact areas
    i. Significance of contact areas
    ii. Position of contact areas
    iii. Contact area location as viewed facially
    iv. Location of proximal contacts as viewed occlusally
    v. Interproximal spaces
5. Embrasures (types, forms, functions)
6. Facial and lingual physiological contours of teeth (anterior teeth , posterior teeth)
7. Curvatures of cervical lines on mesial and distal surfaces
8. Imaginary occlusal planes and curves
9. Contact Areas and Incisal and Occlusal Embrasures from the Labial and Buccal Aspect,
10. Contact Areas and Labial, Buccal, and Lingual Embrasures from the Incisal and Occlusal Aspects,
11. Facial and Lingual Contours at the Cervical Thirds (Cervical Ridges) and Lingual Contours at the Middle Thirds of Crowns,
12. The Height of Epithelial Attachment: Curvatures of the Cervical Lines (Cementoenamel Junction [CEJ]) mesially and Distally

<u>Occlusion, Morphology of Deciduous Dentition and Pulp chambers</u>

Occlusion

1. Arch form, arch length, arch width
2. Characteristics of occlusion in permanent dentition
    i. Overlap of anterior teeth
    ii. Intra arch tooth contact
    iii. Angulations
    iv. Arch curvatures
    v. Incisor relationships
    vi. Molar relationship
3. Types of occlusions

i. Ideal occlusion
ii. Normal occlusion
iii. Physiological occlusion
iv. Functional occlusion
v. Balanced occlusion
vi. Uni and bilateral occlusion
vii. Therapeutic occlusion
viii. Traumatic occlusion
ix. Centric occlusion
x. Centric relation
xi. Vertical relation of occlusion
xii. Deflective occlusion
xiii. Canine protected occlusion

4. Development of the occlusion
   i. Gum pad stage
   ii. Deciduous dentition stage
   iii. Mixed dentition stage
   iv. Permanent dentition stage
5. Primary Dentition

i. Overview of the primary dentition
ii. Interdental spacing
iii. Primary arch form
iv. Occlusion in deciduous dentition (anterior occlusion/ incisor relationship, posterior occlusion, Primary molar relationships- flush terminal plane, mesial and distal step)

6. Mixed (Transitional) Dentition

i. Spacing
ii. Molar relationship
iii. Lee way space
iv. 1st transitional period (emergence of 1st permanent molars, effect of flush terminal plane, early, late mesial shift and effects of mesial and distal steps, eruption of permanent incisors, incisor liability
v. Inter transitional period
vi. Second transitional period (eruption of canine, ugly duckling stage, eruption of canine, premolars and 2nd molars, lee way space of Nance

7. Permanent Dentition

i. Intra arch tooth alignment
ii. Dental arch form
iii. Curvatures of occlusal planes (anteroposterior curve, mediolateral curve
iv. Mesial drift
v. Inclination and angulations of the roots of the teeth/
vi. Orientation of long axis of the tooth
vii. Forms of occluding surfaces of the teeth
viii. Functional forms of teeth at incisal and occlusal thirds

8. Occlusal relationships of upper and lower teeth
   i. Supporting or centric cusps
   ii. guiding or non-supporting cusps
   iii. centric stops (Concept of 138 points of occlusal contact)
   iv. buccolingual occlusal contacts
   v. mesiodistal occlusal contacts
9. Occlusal contacts of posterior teeth

10. Occlusal contacts during centric and eccentric positions of mandible
    i. Centric occlusal contacts (anterior & posterior)
    ii. Centric relation contacts
    iii. Cusp-fossa occlusion
    iv. Cusp-embrasure relationship
    v. Working contacts
    vi. Non-working contacts
    vii. Protrusive contacts
11. Biomechanics of Chewing Function
12. Determinants of occlusal morphology
13. Tooth guidance (canine guidance, group functions, incisal guidance, condylar guidance)
14. Obtaining centric relation
15. Protrusive, retrusive and lateral movements
16. Angle 's classification
    i. Angle's classification of Malocclusion
    ii. Incisor classification (based on incisor relationship)
    iii. Canine classification (based on canine relationship)
17. Neurobehavioral Aspects of Occlusion

i. Determinants of occlusal morphology
ii. Occlusal stability
iii. Guidance of occlusion
iv. Adaptation
v. Occlusal interferences
vi. Vertical dimensions

18. Clinical considerations
    i. Malocclusion
    ii. Parafunctional habits
    iii. Occlusal trauma

Deciduous & Permanent Dentition

1. Importance of Primary Teeth
2. Life cycle of deciduous dentition
3. Differences between deciduous and permanent dentition
4. Morphology of labial, lingual, mesial, distal & incisal/occlusal aspects of anterior and posterior deciduous dentition
5. Morphology of labial, lingual, mesial, distal & incisal/occlusal aspects of anterior and posterior Permanent dentition

Pulp Morphology

1. Pulp cavity
2. Pulp chamber
3. Root canals
4. Classification of root canals (Weine's Classification)
5. Pulp anatomy of permanent maxillary teeth (incisors, canine, premolars, molars)
    i. Pulp chamber
    ii. Root canal
    iii. Cross section
    iv. Access opening
6. Pulp anatomy of permanent mandibular teeth (incisors, canine, premolars, molars)

ii. Pulp chamber
iii. Root canal
iv. Cross section
v. Access opening

7. Clinical considerations
   i. Role of radiographs of pulp chambers and canals
   ii. Crown and root fractures

Practicals:

Demonstration on individual tooth models and on the complete jaw models

Recommended Books:

Tooth Morphology by Fuller's

Wheelar's

Course Title: OB707 Oral Mucosa & Salivary Glands

Contact Hours:	**Credit Hours:**
Theory = 16	Theory = 01
Practical = 48	Practical = 01
Total = 64	Total = 02

Course Objective:

a. Describe types, distribution, development, keratinocytes and non-keratinocytes present in the oral mucosa along with their clinical correlation
b. Illustrate development, types, acini, ducts, histology and clinical consideration of the salivary glands

Learning Outcome:

The students will be able to demonstrate basic knowledge of oral mucosa and salivary glands along with the effects of disorders on both of these structures

Course Outline:

Salivary glands-development, structure & function

a) Functions of Saliva
   i. Protection
   ii. Buffering
   iii. Pellicle Formation
   iv. Maintenance of Tooth
   v. Integrity
   vi. Antimicrobial Action
   vii. Tissue Repair
   viii. Digestion
   ix. Taste perception
   x. Mastication and deglutition
   xi. Speech
   i. Excretion
b) Composition of saliva
c) Anatomy of salivary glands
   ii. Parotid gland
d) Development of salivary glands and its molecular regulation
e) Structure of salivary glands
   i. Secretory Cells (serous, mucous)
   ii. Formation, composition, control and secretion of Saliva
   iii. Myoepithelial Cells
   iv. Ducts
   v. Ductal Modification of Saliva
   vi. Connective Tissue
   vii. Basal cells and lymph nodes
   viii. Nerve Supply
   ix. Blood Supply
f) Classification and histology of the Major Salivary Glands
   i. Parotid Gland
   ii. Submandibular Gland
   iii. Sublingual Gland
g) Histology of the Minor Salivary Glands
   i. Labial and buccal glands
   ii. Glossopalatine glands
   iii. Palatine glands
   iv. Lingual glands
   v. Von Ebner's glands
h) Clinical Considerations
   i. Age Changes
   ii. Diseases
   iii. Dry Mouth (Xerostomia)
   iv. Sialo microliths
   v. Oncocytes
   vi. Staphne's cavity (cyst)
   vii. Mucocele & ranulas
   viii. Sialoliths

ix. Natural sequence of events of chronic sialoliths and sialolithiasis
x. Tissue engineering and salivary gland regeneration

Oral Mucosa---Development/structure/function

a) Classification of Oral Mucosa
b) Functions of Oral Mucosa
   i. Defense
   ii. Lubrication
   iii. Sensory
   iv. Protection
c) Comparison of oral mucosa with skin and intestinal mucosa
d) Basement membrane
e) Lamina propria
f) Submucosa
g) Structure of the Oral Epithelium
   i. Cytokeratin
   ii. Keratinized epithelium
   iii. Stratum Basale
   iv. Stratum spinosum
   v. Stratum granulosum
   vi. Stratum corneum
h) Keratinocytes and nonkeratinocytes
   i. Keratinocytes
   ii. Nonkeratinocytes
   iii. Melanocytes
   iv. Langerhans cell
   v. Merkel cells
   vi. Non-keratinized epithelium
i) Subdivisions of Oral Mucosa (keratinized and non-keratinized areas)
   i. Masticatory mucosa (gingiva and hard palate)
   ii. Hard palate
   iii. Gingiva
   iv. Blood and nerve supply
   v. Vermilion zone
   vi. Lining mucosa
   vii. Lip and cheek
   viii. Vestibular fornix and alveolar mucosa
   ix. Inferior surface of tongue and floor of oral cavity
   x. Soft palate
   xi. Specialized mucosa
   xii. Dorsal lingual mucosa
   xiii. Taste buds
j) Gingival sulcus and Dentogingival junction
   i. Development of dentogingival junction
   ii. Shift of dentogingival junction
   iii. Sulcus and cuticles
   iv. Epithelial attachment
   v. Migration of epithelial attachment
k) Development of Oral Mucosa
l) Oral Epithelium
   i. Epithelial Proliferation

ii. Epithelial Maturation
iii. Ultrastructure of the EpithelialCell
iv. Cellular Events in Maturation
v. Permeability and Absorption

m) Specialized Mucosa
i. Fungiform Papillae
ii. Filiform Papillae
iii. Foliate Papillae
iv. Circumvallate Papillae

n) Junctions in the Oral Mucosa
i. Mucocutaneous Junction
ii. Mucogingival Junction
iii. Dentogingival Junction

o) Age Changes in Oral Mucosa

p) Clinical Considerations

Practicals:

Histological slides related to oral mucosa and salivary glands

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB708 Temporomandibular joint & Growth and development of facial profiles

Contact Hours:	Credit Hours:
Theory = 08	Theory = 0.5
Practical = 24	Practical = 0.5
Total = 32	Total = 01

Course Objective:

a) Describe the gross anatomy of TMJ

b) Explain the histology and clinical correlation associated with TMJ

Learning Outcome:

The students will be able to express adequate knowledge of TMJ along with the clinical relevance of its functions

Course Outline:

<u>Temporomandibular joint</u>

a. Classification of Joints
    i. Fibrous Joints
    ii. Cartilaginous Joints
    iii. Synovial Joints
b. Type of the Joint
c. Development of the Joint
d. Bones of the Joint
e. Cartilage Associated with the Joint
f. Histology of the articular surfaces of the joint
g. Capsule, Ligaments of the Joint
h. Intra articular disk of the joint
    i. Collagen fibers
    ii. Elastin fibers
    iii. Ground substance
    iv. Cells of the disk
i. Synovial Membrane
j. Condyle of the child
k. Primary vs secondary cartilages
l. Muscle Contraction
m. Motor Unit/ muscles involved in TMJ movements
n. Muscle Spindle

o. Golgi Tendon Organ
p. Muscles of Mastication
q. Biomechanics of the Joint/ mandibular positions and movements
r. Innervation of the Joint
s. Blood Supply to the Joint
t. Clinical considerations

Facial growth and development

a) Facial Types
b) Facial Profiles
c) Male and Female Faces
d) Age Changes
e) Basic Concepts of Facial Growth
f) Size Increases and Remodeling
g) Displacement Process
h) Curve of Occlusion
i) Mandibular Condyle and Growth

Practicals: N/A

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: OB709 Repair and regeneration of tooth and supporting tissues

Contact Hours:	Credit Hours:
Theory = 08	Theory = 0.5
Practical = 24	Practical = 0.5
Total = 32	Total = 01

Course Objective:

a. Describe the physiology of wound healing

b. Illustrate the mechanisms of healing in tooth and its supporting tissues

Learning Outcome:

The students will be able to produce repair mechanism in tooth tissues and can devise new perspectives for regeneration of oral cavity and teeth

Course Outline:

<u>Repair and Regeneration of oral tissues</u>

a) Wound Healing in Oral Mucosa
   i. Initial Response to Wounding:
   ii. Hemostasis
   iii. Inflammatory Cell Activation,
   iv. Migration, and Function
   v. Reparative Phase
   vi. Wound Contraction and Scarring
b) Wound Healing at the Dentogingival Junction
c) Repair of Enamel
d) Repair of the Dentin-Pulp Complex
e) Dental Caries
f) Cavity Preparation
g) Repair Following Tooth Extraction
h) Alterations to the Periodontal Connective Tissues with the Development of Periodontal Inflammation
i) Repair of the Periodontium
j) Mechanisms of Repair and Regeneration of Periodontal Connective Tissues
k) Stem Cells
l) New Perspectives

Practicals: N/A

Recommended Books:

Oral Anatomy Histology & Embryology-Berkovitz

Ten Cate Oral Histology, Development, Structure and Function

Essentials of Oral Histology and Embryology-Cheigo

Illustrated Dental Embryology, Histology and Anatomy-Bath Balogh & Fehrenbach

Anatomy for Dental Students

Mineralized Tissues in Oral and Craniofacial

Dental Biochemistry

Basic sciences for dental students

Course Title: Professional & Teaching Skills Apprenticeship (PTSA)

Credit Hours:02

Professional Skills Apprenticeship credit hours: 01

Teaching Skills Apprenticeship credit hours (CMT): 01

Professional Skills Apprenticeship:

Course Objective: To Prepare the students for Histological and Molecular Biology techniques related to Oral Biology

Learning Outcome: Students will be able to learn the practical aspects of histological slide preparation, analysis and skills related to Molecular Biology

Practical Training:

- To learn the process of animal handling and anesthesia, animal sacrifice, preparation of tissue for histology, wax embedding, Image capturing through Microsoft
- Conduction of various histological and IHC techniques
- Conduction of molecular parameters including PCR, q-PCR, ELISA and Cell culture

Assessment: Formative assessment based on hands-on-training and one-to-one feedback

Final Project: As per approved synopsis

Tasks: Students will perform the above-mentioned procedures

Teaching Skills Apprenticeship

All students of M Phil programme will get registered for the CMT Certification in the final semester. Completing the course work and successfully getting certified for CMT, which is a patent of UHS, will be a compulsory integral component of PTSA (Professional and Teaching Skills Apprenticeship) for the 4th semester of all M Phil programs at UHS.