

SYLLABUS

COURSE: DENF 1551 Microbiology and Immunology
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GOAL

The Microbiology and Immunology course is composed of several topics including immunology, bacterial growth, antibiotics, disinfection, sterilization, medical bacteriology, medical mycology, medical virology, and oral microbiology. The purpose of the course is to instill an understanding of the role of microorganisms and the immune response in health and disease, and the ability to apply this knowledge to diagnosis, prevention and treatment of infectious diseases as may be relevant to dental practice. Emphasis is placed on oral infections and oral aspects of systemic infections.

OBJECTIVES

I. BASIC IMMUNOLOGY I

A. Characteristics of the Immune System

1. Define CD antigens.
2. Define primary and secondary lymphoid tissues.
3. Define mucosal-associated lymphoid tissues.
 - 3.1 oral
 - 3.2 nasopharyngeal
 - 3.3 gut-associated
 - 3.4 reproductive
4. Describe blood-lymph circulation and lymphatics.
5. Organization of lymph nodes
 - 5.1 Explain hematopoietic cell distribution in lymph nodes.
 - 5.2 Provide examples and locations of lymph nodes in head and neck.

B. Hematopoiesis

1. Define concept of pluripotent stem cell.
2. Describe the role of bone marrow and bone marrow microenvironment in hematopoiesis.
3. Describe hematopoietic cell lineages.
4. Define and describe myeloid cells.
5. Define and describe lymphoid cells.

C. Innate and Adaptive Immunity

1. Define concepts of specificity and memory.
2. Describe basic properties of innate immune cells.
3. Describe basic properties of adaptive immune cells.

D. Physiochemical properties of innate immunity

1. physiological barriers
2. anatomical barriers
3. phagocytic/endocytic barriers
4. inflammatory barriers

E. Adaptive Immunity

1. Define humoral immunity.
2. Define cell-mediated immunity.
3. Define T cells, T cell subsets, B cells, and plasma cells.

F. Antigens and Immunogens

1. Define antigen and immunogen.
2. Define relative antigenicity of macromolecules.

3. Define and give example of antigenic determinants and epitopes.
4. List types of antigens with examples.
5. Define 'Hapten' and explain how they function in the immune system

G. Regulation of the Innate Immune Response -Toll-Like Receptors (TLRs)

1. List the common misconceptions regarding innate immunity.
2. Describe the discovery of TLRs.
3. Describe how TLRs work.
4. Define pathogen-associated molecular patterns (PAMPs) and pattern recognition receptors (PRRs) and give examples of each.
5. Describe the basic structure of TLRs.
6. Describe, with examples, TLR expression on cells.
7. Describe cellular action and effects of TLR-mediated signaling.
8. Provide an example of TLR-driven immune response in oral mucosa.
9. Describe NF κ B and explain how it works to activate an immune response.

H. List infectious agents with recognition by TLRs.

1. Gram-positive organisms
2. Gram-negative organisms

II. BASIC IMMUNOLOGY II

A. Define immunoglobulins (Igs)/Antibodies (Abs):

1. source from B cells and plasma cells
2. B cell/antibody/specificity relationship

B. Describe structure of immunoglobulins:

1. Molecular components of Igs
 - 1.1 heavy and light chains
 - 1.2 variable and constant regions
 - 1.3 Define allotype, isotype, idiootype.

C. Classification of immunoglobulins

1. Explain differences based on heavy and light chains.
2. Describe functional properties of Ig classes.
3. Describe evidence for number of antigenic determinants recognized by Igs.

D. Genomic and developmental properties of heavy and light chain genes

1. Describe gene rearrangement and Ig diversity.
2. Provide the number of Ig genes and recombination properties leading to Ig diversity.

E. Clonal selection and immunity

1. Define and describe 'Clonal Selection'.
2. Define and describe mechanisms of immunity mediated by Igs (humoral immunity).
3. Describe features of primary and secondary immune responses.
4. Provide examples of impact of vaccination on disease control.

F. T cells

1. Describe classification of T cells (Th1, Th2, $\alpha\beta$ and $\gamma\delta$ T cells).
2. Compare and contrast molecular and cellular features of T cell receptor (TCR) to B cells receptor (Ig molecule).
3. Describe development of T cells in the thymus.
4. Describe the genes' rearrangement in TCR development.
5. T cell-associated molecule - the TCR complex
 - 5.1 CD3 molecules
 - 5.1 T cell signaling by CD3
6. Define $\alpha\beta$ and $\gamma\delta$ T cells, including
 - 6.1 tissue distribution
 - 6.2 differential functions of $\alpha\beta$ and $\gamma\delta$ T cells

G. The Complement System

1. Define the complement system and describe when and how it is used.
2. Provide step-by-step examples of how complement works:
 - 2.1 the classical complement pathway
 - 2.2 the alternate complement pathway
3. List representative infectious agents and products that activate complement.
4. Describe biological effects mediated by complement.
5. Describe the effects of complement on the immune system.
6. Describe the significance of complement at oral mucosal surfaces.

III. BASIC IMMUNOLOGY III

A. Antigen Processing and Presentation

1. Describe use as a function of T cell activation.
2. Describe cells involved in antigen processing and presentation.

B. The Major Histocompatibility Complex (MHC)

1. Describe gene nomenclature for MHC antigens.
2. List the numbers of human MHC genes.
3. Explain the tissue distribution of MHC antigens.
4. Describe the structure of MHC Class-I and Class-II molecules.
5. Describe, with examples, how peptide antigens are processed.

C. Cell-Mediated Immunity (CMI)

1. Describe the cells involved in CMI and the role played in the immune response.
2. Describe the mechanisms of tissue cell destruction by T cells.
3. Describe concept of 'Memory T Cell'.
4. Define Natural Killer (NK) cell.
5. Define 'Super Antigen' and give examples in disease.

D. Cytokines and chemokines

1. Define cytokine.

2. Describe the mode of action of cytokines.
3. List and provide a description of important cytokines with functions.
4. Define chemokine.
5. Describe the mode of action of chemokines and potential uses therapeutically.
6. List and provide a description of important chemokines with functions.
7. Describe the effects of interactions between cytokines/chemokines.
8. Explain the characterization of types of Th1 and Th2 cytokines.

E. Integration of the Immune Response

1. Describe the collaboration of antigen-presenting cells, T cells, and cytokines.
2. Describe the role of T helper (Th) cells in regulating humoral and cell-mediated immunity.
3. Describe the effects of pro-inflammatory cytokines on cell-mediated immunity.
4. Describe the generation of an immune response in a mucosal tissue from the inductive to the effector phase.
5. Describe the integrated immune response during physiological inflammation.

F. Immune defense mechanisms

1. Describe overall defense mechanisms and their relationship.
2. Describe non-specific mechanisms.
 - 2.1 physical and chemical barriers
 - 2.2 complement alternative pathway
 - 2.3 innate immunity: phagocytosis and TLR
 - 2.4 innate immunity: NK cells
 - 2.5 macrophages and dendritic cells as a link between innate and acquired immunity
3. Describe antigen-specific defense mechanism (acquired immunity).
 - 3.1 central roles of CD4+ T cells
 - 3.2 cytotoxic mechanism of CD8+ T cells
 - 3.3 antibody-mediated mechanisms
 - 3.3.1 Define functional structures of antibodies.
 - 3.3.2 neutralization
 - 3.3.3 Fc- γ -mediated mechanism
 - 3.3.4 Fc- ϵ -mediated mechanism
 - 3.3.5 complement receptor-mediated mechanism
4. Describe different defense mechanism during various infections.
5. Describe communication and regulation among immune cells:
 - 5.1 cytokines
 - 5.2 chemokines
 - 5.3 cellular adhesion molecules

G. Tumor immunology

1. Describe immunosurveillance concept and evidence.
2. Describe immunosurveillance mechanisms.
3. Describe tumor antigens.
 - 3.1 tumor-specific antigens

- 3.2 tumor associated antigens
 - 4. Describe potential immunotherapies for cancer.
- H. Manipulation of immune response: *Vaccines*
 - 1. Define different immunities:
 - 1.1 natural active immunity
 - 1.2 artificial active immunity
 - 1.3 natural passive immunity
 - 1.4 artificial passive immunity
 - 2. Describe immune memory and concept of vaccine.
 - 3. Describe materials for vaccines.
 - 3.1 living pathogens
 - 3.1.1 similar pathogens
 - 3.1.2 attenuated pathogens
 - 3.2 killed pathogens
 - 3.3 modified proteins and toxoids
 - 3.4 recombinant proteins
 - 3.5 polysaccharides and protein-conjugated polysaccharides
 - 4. Describe future vaccine development.
 - 4.1 naked DNA vaccine
 - 4.2 peptide vaccine
 - 5. Describe difficulties in development of vaccines.
 - 5.1 malaria vaccine
 - 5.2 HIV vaccine
 - 6. Describe ways to enhance immune response to vaccines.
 - 7. Describe available vaccines.
 - 8. Describe vaccine beyond infectious agents.
- I. Manipulation of immune response: *Transplantation immunology*
 - 1. Describe the following as they relate to immunological rejection of human allografts:
 - 1.1 first set rejection
 - 1.2 second set rejection
 - 1.3 hyperacute rejection
 - 1.4 acute rejection
 - 1.5 chronic rejection
 - 2. List three points of evidence indicating that experimental skin rejection is a cell-mediated immune response.
 - 3. Describe the following human grafts including their chances of success:
 - 3.1 autografts

- 3.2 isografts
- 3.3 allografts
- 3.4 xenografts

4. Describe the following concerning major histocompatibility antigens (MHC):
 - 4.1 the role of red blood cell typing antigens in graft rejection
 - 4.2 the role of HLA antigens in graft rejection
 - 4.3 the genetics involved in HLA antigen matching
 - 4.4 mechanism of recognition of allogeneic MHC
 - 4.5 sensitization of allogeneic MHC-reactive T cells
5. Briefly describe the therapeutic techniques used to enhance survival of human allografts.
 - 5.1 matching MHC and blood type
 - 5.2 immunosuppressive drugs
 - 5.2.1 cyclosporine A and its mechanism
 - 5.2.2 rapamycin
6. Define graft versus host reaction and describe its therapeutic implications.

J. Hypersensitivity reactions and inflammation

1. Describe the importance of allergy in dentistry and list several allergens encountered in dental practice.
2. Describe concept of inflammation and acute inflammation cascade.
3. Describe general pathway of hypersensitivities.
4. Compare and contrast immediate hypersensitivity (Type I to III) and delayed-type hypersensitivity (Type IV) in terms of their initial meaning and their current usage.
5. Describe Type I (anaphylactic) reactions in humans, including the following:
 - 5.1 types of antigens (allergens)
 - 5.2 IgE and IgE receptor
 - 5.3 mechanism of action and cells involved
 - 5.4 the pharmacologically active agents involved in the reactions
 - 5.5 the effects on target cells, tissues, organs and patients
 - 5.6 local and systemic responses
 - 5.7 examples of diseases and allergens, including oral examples
 - 5.8 therapy
6. Describe Type II (cytotoxic) reactions in humans, including the following:
 - 6.1 types of antigens
 - 6.2 cells
 - 6.3 immunoglobulins
 - 6.4 mechanisms of action
 - 6.5 injury site in comparison to other hypersensitivities
 - 6.6 the effects on target cells and tissues
 - 6.7 roles in blood group transfusion reactions, drug-induced reactions, and oral reactions
7. Describe Type III (immune complex) reactions in humans, including the following:
 - 7.1 types of antigens

- 7.2 cells
- 7.3 immunoglobulins
- 7.4 mechanism of activation
- 7.5 the roles of complement and lysosomal enzymes
- 7.6 the effects on target cells and tissues
- 7.7 local and systemic types
- 7.8 examples of diseases

8. Describe Type IV (cell-mediated) reactions in humans, including the following:

- 8.1 the properties and functions of the cytokines and cells involved
- 8.2 the effects on target cells and tissues
- 8.3 examples of diseases
- 8.3 TB test
- 8.4 the role of haptens in contact dermatitis

K. Autoimmune diseases

- 1. Describe concepts of immune tolerance, self-tolerance, and autoimmunity
- 2. Describe self-tolerance mechanisms

- 2.1 Central tolerance
- 2.2 peripheral tolerance: immunoprivileges
- 2.3 peripheral tolerance: antigen ignorance and exhausting
- 2.4 peripheral tolerance: anergy
- 2.5 peripheral tolerance: regulatory T cells

3. Describe mechanisms leading to autoimmunities

- 3.1 genetic factors and MHC
- 3.2 infections: molecular mimicry and superantigens
- 3.2 other environmental factors

4. Describe mechanisms leading to pathogenic autoimmune diseases

- 4.1 antibody-mediated: inflammatory and non-inflammatory
- 4.2 T cell mediated

5. Examples of autoimmune diseases

- 5.1 classification of autoimmune diseases
- 5.2 systemic lupus erythematosus
- 5.3 Sjogren's syndrome
- 5.4 rheumatoid arthritis
- 5.5 Type I diabetes
- 5.6 multiple sclerosis

L. Immunodeficiencies

1. Classification of immunodeficiency

- 1.1 congenital or primary immunodeficiencies
- 1.2 acquired or secondary immunodeficiencies
- 1.3 immunosuppressive drug- and radiation-induced immunodeficiencies

2. Describe characteristics and consequences of cell-mediated immunodeficiencies, specifically:
 - 2.1 DiGeorge syndrome
3. Describe characteristics and consequences of humoral immunodeficiencies, specifically:
 - 3.1 X-linked agammaglobulinemia
 - 3.2 common variable agammaglobulinemias
 - 3.3 selective immunoglobulin deficiencies
4. Describe characteristics and consequences of severe combined immunodeficiency disease (SCID).
5. Other immunodeficiencies
 - 5.1 phagocytic cell deficiencies.
 - 5.2 complement deficiencies.
6. Describe pathogenesis of AIDS
 - 6.1 molecules involved in HIV infection
 - 6.2 cells involved in HIV infection
 - 6.3 potential mechanisms leading to depletion of CD4+ T cells
7. Describe transmission of HIV and consequence of AIDS

IV. BASIC CHARACTERISTICS AND GROWTH OF BACTERIA

1. Describe the structural differences between bacterial cells and eukaryotic cells.
2. Describe the general features of the bacterial genome.
3. Define the following:
 - 3.1 plasmid
 - 3.2 operon
4. Describe the cytoplasmic membrane of bacteria.
5. Describe the structure and function of flagella.
6. Describe the structure and function of pili.
7. List the functions of the bacterial cell wall.
8. Describe the composition of and functions peptidoglycan.
9. Describe the differences between the cell walls of Gram + vs. Gram - bacteria.
10. Describe the structure and function of lipopolysaccharide.
11. Describe the structure and function of the capsule.
12. Describe the processes of bacterial reproduction.

13. Describe the processes of transfer of genetic information in bacteria.
14. Define the following with respect to bacterial growth:
 - 14.1 lag phase
 - 14.2 log phase
 - 14.3 stationary phase
 - 14.4 death phase
15. Describe how to determine the doubling time of a bacterial cell culture.
16. List the four major environmental factors that affect bacterial growth.
17. Define the following:
 - 17.1 phototroph
 - 17.2 chemotroph
 - 17.3 autotroph
 - 17.4 heterotroph
 - 17.5 chemoheterotroph
18. List the chemical requirements for bacterial nutrition.
19. Describe the process of bacterial chemotaxis.
20. Describe the nutrient uptake processes in bacteria.
21. Briefly describe the processes of energy derivation by glycolysis and fermentation.
22. Define the following terms:
 - 22.1 strict anaerobes
 - 22.2 aerotolerant anaerobes
 - 22.3 strict aerobes
 - 22.4 facultative bacteria
 - 22.5 microaerophilic bacteria

V. HOST/PARASITE RELATIONSHIPS

1. List Koch's Postulates and describe the modern day adaptations in Molecular Koch's Postulates.
2. Define the following:
 - 2.1 pathogen
 - 2.2 non-pathogen
 - 2.3 opportunist
 - 2.4. invasion
 - 2.5 infection
 - 2.6 virulence
 - 2.7 portal of entry
3. Describe the normal microbial flora of the body in the following areas, giving specific examples and roles:

- 3.1 skin
 - 3.2 upper respiratory tract
 - 3.3 gastrointestinal tract
 - 3.4 genitourinary tract
4. List the factors necessary for infection to occur.
5. Describe the sources, properties and mechanisms of action of the following microbial virulence factors:
- 5.1 adherence factors
 - 5.2 invasion factors
 - 5.3 exotoxins
 - 5.4 endotoxins
 - 5.5 LPS
 - 5.6 enzymes
 - 5.7 antiphagocytic factors
6. Describe nonspecific and specific mechanisms of host resistance:
- 6.1 skin and mucous membranes
 - 6.2 phagocytosis
 - 6.3 molecules, enzymes
 - 6.4 inflammation and fever
 - 6.6 T cell and antibody

VI. EPIDEMIOLOGY OF INFECTIOUS DISEASE

1. Define:
- 1.1 epidemiology
 - 1.2 incidence
 - 1.3 prevalence
 - 1.4 epidemic
 - 1.5 endemic
 - 1.6 pandemic
2. Describe chain of infection
- 2.1 reservoir of infection
 - 2.2 transmissibility (host's defenses and virulent factors)
 - 2.3 routes of transmission
3. Describe nosocomial infection
4. Describe characteristics of epidemics
- 4.1 type of epidemics
 - 4.2 herd immunity
 - 4.3 epidemic cycle
 - 4.4 attenuation of virulence
 - 4.5 control of epidemic
 - 4.6 origin of new diseases

VII. ANTIBIOTICS

1. Describe the concept of selective toxicity as pertains to antimicrobial drugs.
2. List the three general mechanisms of antibiotic resistance.
3. Describe two common antibiotic susceptibility tests.
4. List the antibiotics that inhibit cell wall synthesis and their specific mechanisms of action.
5. Describe the mechanism of drug resistance in methicillin resistant *Staphylococcus aureus*
6. Describe the antibacterial mechanism each of the following:
 - 6.1 cycloserine
 - 6.2 aminoglycosides
 - 6.3 tetracyclines
 - 6.4 macrolides
 - 6.5 chloramphenicol
 - 6.6 quinolones
 - 6.7 rifamycins
 - 6.8 sulfonamides
 - 6.9 trimethoprim
8. Describe the three basic mechanisms of antifungal drug resistance.
9. Describe the antifungal mechanism and clinical usage of each of the following:
 - 9.1 amphotericin B
 - 9.2 nystatin
 - 9.3 azoles
 - 9.4 capsosungin
10. List the four mechanisms of action of antiviral drugs and an example of each.

VIII. DISINFECTION/STERILIZATION

1. Define the following:
 - 1.1 sterilization
 - 1.2 disinfection
 - 1.3 bacteriostatic
 - 1.4 bacteriocidal
 - 1.5 sepsis
 - 1.6 asepsis
 - 1.7 disinfectant
 - 1.8 antiseptic
 - 1.9 germicide
 - 1.10 sporicide
2. Describe the three levels of disinfection in terms of their effects on endospores, *Mycobacterium tuberculosis*, fungi, lipid (hydrophobic) and non-lipid (hydrophilic) viruses, and other vegetative bacterial cells.
3. Describe five general mechanisms of action of physical and chemical agents, and give examples for each.

4. Describe the effectiveness (sterilizing, disinfecting, etc.), conditions for use (time, temperature, etc.), mechanisms of action, advantages, disadvantages and major uses of the following:
 - 4.1 autoclave
 - 4.2 chemiclave
 - 4.3 pasteurization
 - 4.4 boiling water
 - 4.5 dry heat
 - 4.6 incinerator
 - 4.7 desiccation
 - 4.8 ultraviolet radiation
 - 4.9 gamma radiation
 - 4.10 filtration
 - 4.11 ultrasonic vibrations

5. Describe the following groups of chemical agents and their major derivatives in terms of effectiveness as antimicrobial agents (sterilant, disinfectant, etc.), mechanisms of action and general applications:
 - 5.1 ethylene oxide
 - 5.2 aldehydes
 - 5.3 chlorine
 - 5.4 iodine
 - 5.5 alcohols
 - 5.6 phenols
 - 5.7 biguanides
 - 5.8 surface active agents
 - 5.9 heavy metals

6. Describe the properties of the ideal germicide.

IX. BACTERIOLOGY

- A. Staphylococci and streptococci
 1. Describe the typical morphology and characteristics of staphylococci.
 2. List the three main clinically important species of staphylococci.
 3. Describe the functions of the toxins and enzymes of staphylococci in infection.
 4. Describe the pathogenesis and clinical features of staphylococcal infections of the skin and intestinal tract and toxic shock syndrome.
 5. Describe the treatment and control of staphylococcal infections.
 6. Describe the typical morphology and characteristics of streptococci.
 7. List the four main features used to classify streptococci.
 8. Describe the functions of the toxins and enzymes of streptococci in infection.
 9. Describe the pathogenesis and clinical features of infection with Group A streptococci, including the post-infection sequelae.

10. Describe the treatment and control of streptococcal infections.
 11. Describe the rapid test for identifying and typing *Streptococcus pneumoniae*.
 12. Describe the pathogenesis, treatment and control of pneumococcal pneumonia.
- B. Gram-positive Bacilli
1. List the two genera of spore-forming and two of nonspore-form bacilli.
 2. Describe the clinical syndromes associated with *Bacillus* infection with emphasis on anthrax.
 3. Name four pathogenic species of *Clostridium*, and describe the pathogenesis and treatment of botulism, tetanus, gas gangrene, and pseudomembranous colitis.
 4. Describe the pathogenesis, clinical features, and control of *Corynebacterium diphtheriae* infections.
 5. Describe the pathogenesis and clinical features of *Listeria monocytogenes* infections.
- C. Enterics and Gram-negative Rods
1. Describe the antigenic structure of the enteric gram-negative rods with emphasis on LPS.
 2. Describe the significance of colicins.
 3. Describe the pathogenesis and clinical features of *Escherichia coli* infections including the role of toxins.
 4. Describe the pathogenesis and clinical features of Shigellae infections, including the role of toxins.
 5. Describe the pathogenesis and clinical features of Salmonellae infections, including the most commonly associated species of *Salmonella*.
 6. Describe the pathogenesis and clinical features of *Pseudomonas aeruginosa* infections.
 7. Describe the pathogenesis and clinical features of cholera.
 8. Describe the pathogenesis and clinical features of infection with *Campylobacter jejuni*.
 9. List the clinical conditions associated with *Helicobacter pylori*.
 10. Describe the pathogenesis, clinical features, treatment, and control of *Legionella pneumophila* infection.
 11. Describe the pathogenesis and clinical conditions of *Haemophilus influenzae* infection.
 12. Describe the pathogenesis, epidemiology and treatment of whooping cough.

D. Neisseriae and spirochetes

1. List the two species of neisseriae that are pathogenic for humans.
2. List the surface structures of the gonococcus and describe the significance of antigenic switching.
3. Describe the pathogenesis, clinical features, and treatment of gonorrhea.
4. Describe the antigenic structure of the meningococcus.
5. Describe the pathogenesis, clinical features, and treatment of meningococcal meningitis.
6. Describe the cellular morphology of spirochetes, including axial fibrils and the reason for the use of darkfield microscopy in visualizing the organism.
7. Introduce two spirochetes *Treponema pallidum* as cause of syphilis.
8. Describe the pathogenesis and clinical features of the three stages of acquired syphilis, including oral manifestations.
9. Describe the pathogenesis and clinical features of congenital syphilis.
10. List the laboratory tests used for the diagnosis of syphilis.
11. Name the organism from genus *Borrelia* responsible for Lyme disease and describe the transmission, pathogenesis, and clinical features of Lyme disease.

E. Mycobacteria, mycoplasma, actinomyces, nocardia

1. Describe the role of cell wall lipids in the virulence of mycobacteria.
2. Describe the pathogenesis of tuberculosis.
3. Describe the tests used in diagnosing tuberculosis.
4. Describe the significance of a positive tuberculin test.
5. Describe the treatment, prevention, and control of tuberculosis.
6. Describe the pathogenesis, clinical features, transmission, and control of leprosy.
7. List the characteristics of mycoplasmas.
8. Describe the pathogenesis, clinical features, transmission, and control of mycoplasmal pneumonia.
9. Describe the structure of *Actinomyces* and *Nocardia*.
10. Describe the clinical manifestations of actinomycosis.
11. Describe the clinical features of nocardiosis.

F. Rickettsia and chlamydia

1. List the characteristics of rickettsiae.
2. Describe the clinical syndromes associated with rickettsial infections.
3. List the characteristics of chlamydiae.
4. List the clinical syndromes associated with chlamydial infections.

X. MYCOLOGY

1. Define the following:
 - 1.1 conidia
 - 1.2 dimorphic
 - 1.3 hyphae
 - 1.4 imperfect fungi
 - 1.5 mold
 - 1.6 mycelia
 - 1.7 perfect fungi
 - 1.8 spore
 - 1.9 yeast
2. List the five categories of fungal infections.
3. Describe the pathogenesis and clinical features of the superficial mycoses.
4. Describe the pathogenesis and clinical features of the cutaneous mycoses.
5. Describe the pathogenesis and clinical features of the subcutaneous mycoses.
6. Describe the pathogenesis and clinical features of the deep mycoses.
7. List the pre-disposing factors for *Candida* infection.
8. List the non-oral sites of *Candida* infection and the associated clinical findings.
9. Describe the treatment of *Candida* infections.
10. List three other opportunistic fungal infections and their associated clinical features.

XI. VIROLOGY

- A. Introduction to Virology
 1. List the properties that form the basis for classification of viruses.
 2. List the RNA virus families and DNA virus families that are associated with human disease.
 3. Describe the basic structure of an enveloped virus.
 4. Describe the basic structure of a naked virus.
 5. Describe the three groups of viruses based on capsid symmetry.
 6. List the steps in virus replication.

7. List the steps in viral pathogenesis.
8. List the three most common routes of infection by viruses.
9. Define with respect to viral infection:
 - 9.1 chronic infection
 - 9.2 latent infection
 - 9.3 slow infection
 - 9.4 subclinical infection
10. Describe the six methods for laboratory diagnosis of viral infections.
11. List the names and cellular sources of the three types of interferon.

B. Herpesviruses

1. List the eight human herpesviruses.
2. Describe the basic structure of a herpesvirus.
3. List the two antigenic types of herpes simplex virus (HSV).
4. Describe the clinical manifestations of HSV infection, including the sites of latency.
5. Describe the epidemiology of HSV infections.
6. Describe the immune response to HSV infection.
7. Describe the clinical syndromes associated with varicella-zoster virus (VZV) infection, including the sites of latency.
8. Describe the epidemiologic features of VZV infection.
9. Describe the immune response to VZV infection.
10. Describe the clinical syndromes associated with Epstein-Barr virus (EBV) infection.
11. Describe the epidemiologic features of EBV infection.
12. Describe the immune response to EBV infection.
13. Describe the clinical syndromes associated with cytomegalovirus (CMV) infection.
14. Describe the epidemiologic features of CMV infection.
15. Describe the clinical significance of human herpesvirus 6, human herpesvirus 7, and human herpesvirus 8.
16. Describe the clinical significance of herpes B virus.

C. Retroviruses and Human Immunodeficiency Virus (HIV)

1. Define reverse transcriptase.
2. List the three subfamilies of retroviruses.
3. Describe the replication process of retroviruses.
4. List the major characteristics of the lentiviruses.
5. Describe the pathogenesis of HIV infection.
6. Describe how HIV escapes the immune system.
7. Describe the immune abnormalities in HIV infection.
8. List the routes of transmission of HIV infection.
9. Describe the time course and stages of HIV disease.
10. Describe the methods for laboratory detection of HIV.
11. List the drugs approved for treatment of HIV infection.

D. Respiratory Tract Viruses

1. List the most common viral causes of the following:
 - 1.1 common cold
 - 1.2 pharyngitis
 - 1.3 laryngitis
 - 1.4 bronchitis
 - 1.5 pneumonia
2. Describe the pathogenesis of influenza A virus infection.
3. Describe the clinical syndrome and possible complications of influenza.
4. Describe the epidemiology of influenza.
5. Describe the pathogenesis and clinical findings in parainfluenza virus infections.
6. Describe the pathogenesis and clinical findings in respiratory syncytial virus infections.
7. Describe the clinical syndromes caused by rhinovirus infection.
8. Describe the epidemiology of rhinovirus infection.
9. Describe the clinical findings in coronavirus infection of the respiratory tract.
10. Describe the respiratory diseases associated with adenovirus infection, including important epidemiologic characteristics.

E. Mumps, measles, parvovirus, rubella, papovaviruses, poxviruses

1. Describe the pathogenesis, clinical presentation, and epidemiology of measles virus infection.
2. Describe the pathogenesis, clinical presentation, and epidemiology of mumps.
3. Describe the pathogenesis and clinical findings in human parvovirus infection.
4. Describe the pathogenesis and epidemiology of rubella virus infection.
5. Describe congenital rubella syndrome.
6. Describe the disease mechanisms in papillomavirus infection.
7. List the oral lesions associated with papillomavirus infection.
8. List the two human polyomaviruses and their disease associations.
9. Describe the unique property of poxvirus replication.
10. Describe the human diseases caused by poxviruses.

F. Enteroviruses and gastroenteritis viruses

1. List the human enteroviruses and the commonly associated clinical syndromes.
2. List the four possible outcomes of poliovirus infection.
3. List the viruses associated with acute gastroenteritis and their most important epidemiologic features.

G. Hepatitis Viruses

1. List and describe the structure (type of genome, presence of envelope) of the five recognized hepatitis viruses.
2. Describe the pathogenesis of hepatitis A virus infection.
3. Describe the epidemiology and control of hepatitis A virus infection.
4. Describe the pathogenesis of hepatitis B virus infection.
5. Describe the serology of hepatitis B virus infection.
6. Describe the clinical significance of hepatitis B virus carriers.
7. Describe the association of hepatitis B virus with hepatocellular carcinoma.
8. Describe the pathogenesis, clinical significance and epidemiology of hepatitis C virus infection.
9. Describe the pathogenesis, epidemiology, and control of hepatitis D virus infection.
10. Describe the epidemiology of hepatitis E virus infection.

H. Arboviruses

1. List the characteristics of arboviruses.
2. List the major human arbovirus infections in the United States.
3. Describe the two major epidemiologic cycles of yellow fever.
4. Describe the clinical syndrome and epidemiology of infection with the Marburg and Ebola viruses.

I. Emerging Viruses

1. List the major rodent-borne virus infections in the United States.
2. Describe the clinical syndromes and epidemiology of infections with members of the Hanta virus genus.
3. Describe the clinical syndrome and epidemiology of infection with the Marburg and Ebola viruses.
4. Describe the pathogenesis and epidemiology of rabies.

J. Slow and Unconventional Viruses

1. List four characteristics of slow virus infections.
2. List three conventional viruses and the slow infections caused by each.
3. Compare and contrast conventional viruses and prions.
4. Describe the human diseases linked to prions.

XII. COLONIZATION OF THE ORAL CAVITY

1. Know the total number of microorganisms that inhabit the oral cavity in general and the number that account for the majority of cultivable strains.
2. Describe composition of oral flora
 - 2.1 Gram positive and negative bacteria
 - 2.2 Classification of oral Streptococci
 - 2.3 Protozoans, fungi and viruses
3. Name the predominant (15% or greater) bacteria found on (in) the following sites in the oral cavity:
 - 3.1 gingival crevice
 - 3.2 coronal plaque
 - 3.3 tongue dorsum
 - 3.4 buccal mucosa
 - 3.5 saliva
4. Briefly describe factors to be considered when sampling for oral bacteria, including:
 - 4.1 sampling site
 - 4.2 host factors

- 4.3 oxygen tolerance
- 4.4 cultivation
- 5. Describe how each of the following factors can influence the composition of the oral flora:
 - 5.1 natural teeth
 - 5.2 dentures
 - 5.3 acidogenic bacteria
 - 5.4 broad spectrum antibiotics
- 6. Describe process of microbial colonization in oral cavity during the following phases of life:
 - 6.1 at birth
 - 6.2 at tooth eruption
 - 6.3 in the edentulous mouth
 - 6.4 in the presence of dentures
- 7. Describe the following concerning bacterial colonization in the oral cavity:
 - 7.1 relative degree of specificity
 - 7.2 role of adhesins, including polysaccharide-lectins and the *Streptococcus mutans* glucan system
 - 7.3 role of fimbriae (e.g., *Actinomyces viscosus*)
 - 7.4 electrostatic interactions including the effects of antiplaque agents

XIII. BACTERIAL BIOLFILMS

1. Define bacterial biofilm.
2. Describe formation and structure of biofilms
3. Describe the ecological community in a biofilm
4. Describe the behavior of bacteria in a biofilm.
5. Describe the host-microbe relationship in a biofilm.
6. Describe the survival advantages of a biofilm.
7. Describe the clinical relevance of biofilms.
8. Describe the role of bacterial biofilms in persistent and chronic infections.

XIV. MICROBIOLOGY OF PLAQUE

1. Describe that dental plaque is biofilm.
2. Describe the following concerning the acquired pellicle:
 - 2.1 the chemical composition including examples of specific compounds
 - 2.2 rate of production
3. Describe the role of the following in the development of dental plaque.
 - 3.1 gram positive cocci

- 3.2 gram positive rods
- 3.3 anaerobic bacterial species
- 3.4 oxygen
- 3.5 saliva

- 4 Describe mechanism of adhesion and co-adhesion.

- 5 List the following concerning dental plaque:
 - 5.1 approximate number of species present
 - 5.2 approximate number of bacteria per milligram
 - 5.3 average amount in oral cavity

- 6. Describe the chemical composition of dental plaque.

- 7. Describe, including examples, how changes in the microbial composition of dental plaque may result from each of the following:
 - 7.1 changes in diet
 - 7.2 oral diseases
 - 7.3 antibiotic therapy

- 8. List the factors of dental plaque which are potentially pathogenic.

- 9. Describe the chemical composition of dental calculus.

XV. CARIES

1. Describe the development, composition and metabolism of dental plaque as it pertains to caries activity.
2. Describe dental caries as a nonspecific bacterial disease.
3. Describe streptococci as specific etiologic agents of dental caries.
4. Describe the general morphologic and physiologic features of lactobacilli.
5. Describe lactobacilli as specific etiologic agents of dental caries.
6. Describe the cariogenic potential of *Actinomyces*, *Candida* and other microorganisms.
7. Describe dental caries from the standpoint of the contemporary theories of its formation and host-parasite relationships.
8. Describe the differences in the caries susceptibility of teeth and the types of carious lesions associated with different tooth sites.
9. Explain the importance of saliva as a host factor in dental caries.
10. Describe the impact of diet as an environmental factor on caries activity.
11. Describe briefly the efficacy of oral hygiene as a caries preventive/control measure.
12. Describe pit and fissure sealants as a method of caries prevention.
13. Describe the effectiveness of fluoride as a caries preventive/control agent.

14. List other chemotherapeutic anti-caries agents and their mechanisms of action.

XVI. MICROBIOLOGY OF PERIODONTAL DISEASES

1. Review the structure of periodontium with emphasis on junctional epithelium and gingival crevicular fluid (GCF).
2. Introduce the concept of periodontal diseases and their classification.
 - 2.1 gingivitis
 - 2.2 periodontitis
 - 2.3 concepts of detachment, pocket formation, bone loss and tooth loss
3. Introduce “specific plaque theory” of periodontal diseases.
 - 3.1 evidence indicating that periodontal diseases are of bacterial origin
 - 3.2 criteria for defining a diseases causing bacterium
 - 3.3 major problems obstructing the identification of the disease-causing bacteria
4. Describe supra- and sub-gingival plaques and their association with periodontal diseases.
 - 4.1 plaque and biofilm
 - 4.2 plaque and periodontium
 - 4.3 plaque formation
 - 4.4 bacterial species in plaque
 - 4.5 characteristics of supra- and sub-gingival plaque
 - 4.6 concept of bacterial succession
5. Describe roles of bacteria in periodontal diseases.
 - 5.1 roles in dental plaque formation and pathogenesis
 - 5.2 virulent factors
6. Describe special bacteria that are involved in periodontal diseases
 - 6.1 *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans* and *Bacteroides forsythus* in chronic periodotitis.
 - 6.2 *Prevotella intermedia*, *Fusobacterium nucleatum* and *Treponema denticola* in acute necrotizing ulcerative gingivitis (ANUG)
 - 6.3 characteristics and morphology of the above bacteria
7. Review host's immune defense mechanisms in periodontium.
 - 7.1 physical, chemical, biological defenses in oral cavity and saliva
 - 7.2 innate and acquired immunity
 - 7.3 GCF: IgA, IgG and leukocytes
8. Describe the role of host's immune system in periodontal diseases.
 - 8.1 immune system is a two-edge sword
 - 8.2 inflammatory mechanisms that lead to tissue damage
 - 8.3 cells and molecules that are involved in tissue damage

XVII. PULP AND PERIAPICAL INFECTIONS

1. List the microorganisms that predominate in pulp and periapical infections and their origins.
2. Describe the resistance factors which may protect the dental pulp from bacterial infections.
3. Describe four routes by which bacteria or their products can enter the pulp chamber.
4. Describe the bacterial virulence factors which may be involved in pulp and periapical infections.
5. Describe the bacteria isolated from different pulp and periapical infections and criteria that might affect the flora in these different circumstances.
6. Describe the following concerning microbial culturing of endodontic infections:
 - 6.1 advantages and disadvantages of routine endodontic culturing
 - 6.2 instances in which endodontic culturing is useful
 - 6.3 collection and transport of endodontic specimens
7. Discuss the therapy for endodontic infections from a microbiological aspect.

XVIII. ORAL MICROBES AND SYSTEMIC DISEASE

1. Describe the mechanism for establishing a link between oral infections and systemic diseases.
2. Describe the relationship between oral infections and cardiovascular disease.
3. Describe the evidence that periodontal disease is associated with cardiovascular disease.
4. Describe the evidence that periodontal disease in the mother is associated with pre-term low birth weight infants.
5. Describe the relationship between diabetes mellitus and periodontal disease.
6. Describe the mechanisms that allow bacteria to leave the oral cavity and populate distant sites.

XIX. DIAGNOSTIC MICROBIOLOGY

1. Describe flow chart for diagnosis of infectious diseases.
2. Describe sampling methods and delivery.
3. Describe diagnostic methods based on morphology and specific enzymes.
4. Describe serologic and immunological methods.
 - 4.1 Antibody and monoclonal antibody
 - 4.2 Aggregation, Western blot and ELISA
 - 4.3 TB test based on T cell response

5. Describe molecular biological methods (northern blot and PCR).
6. Describe other merging techniques.

RESOURCES

I. Media Resources

A. Printed media

All class materials will be posted in Blackboard.

II. Human Resources

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STUDY PLAN AND REQUIREMENTS

This course consists of a semester-long series of lectures. You are expected to attend all scheduled lectures.

You should review the objectives before each lecture. The objectives may be satisfied by using the information presented in lectures and handouts. You will be responsible for this material on your examinations.

If you have difficulty with the material, you should meet with the appropriate faculty member for individualized assistance.

DENF 1551 MICROBIOLOGY AND IMMUNOLOGY 2009 Fall Semester Schedule

Tuesday and Thursday, 1-2:50 pm; Room 340; with exceptions
Exams are in Room 207.

DATE	DAY	TIME	TITLE	PRESENTER
Aug 18	Tu	1-2:50 pm	Basic Immunology	J. Klein
Aug 20	Th	1-2:50 pm	Basic Immunology	J. Klein
Aug 25	Tu	1-2:50 pm	Basic Immunology	J. Klein
Aug 27	Th	1-2:50 pm	Clinical Immunology	Y. Lou
Sep 1	Tu	1-2:50 pm	Clinical Immunology	Y. Lou
Sep 3	Th	1-2:50 pm	Clinical Immunology	Y. Lou
Sep 8	Tu	1-2:50 pm	Characteristics and Growth of Bacteria	K. Morano
Sep 9	Wed	1-2:50 pm	Exam 1 Room 207 Material from Aug 18-Sep 3	Faculty
Sep 10	Th		<i>No class</i>	
Sep 15	Tu	1-2:50 pm	Antibiotics Sterilization/Disinfection	A. van Hoof
Sep 17	Th	1-2:50 pm	Host/Parasite Relationships Epidemiology of Infectious Disease	S. Norris
Sep 22	Tu	1-2:50 pm	Pathogenic Bacteria	Y. Lou
Sep 24	Th	1-2:50 pm	Pathogenic Bacteria	Y. Lou

DATE	DAY	TIME	TITLE	PRESENTER
Sep 29	Tu	1-2:50 pm	Pathogenic Bacteria	Y. Lou
Oct 1	Th	1-2:50 pm	EXAM 2 Room 207 (material from Sep 15 – Sep 29)	Faculty
Oct 6	Tu	1-2:50 pm	Pathogenic Bacteria	Y. Lou
Oct 8	Th	1-2:50 pm	Pathogenic Bacteria	Y. Lou
Oct 13	Tu	1-2:50 pm	Pathogenic Bacteria	Y. Lou
Oct 15	Th	1-2:50 pm	Basic Mycology Fungal Diseases	M. Lorenz
Oct 20	Tu	1-2:50 pm	Fungal Diseases (1 hr) Diagnostic microbiology (1hr)	M. Lorenz Y. Lou
Oct 22	Th	1-2:50 pm	EXAM 3 Room 207 (material from Oct 6 – Oct 20)	Faculty
Oct 27	Tu	1-2:50 pm	Virology	Storthz
Oct 29	Th	1-2:50 pm	Virology	Storthz
Nov 3	Tu	1-2:50 pm	Virology	Storthz
Nov 5	Th	1-2:50 pm	Virology	Storthz
Nov 10	Tu	1-2:50 pm	Virology	Storthz
Nov 12	Th	1-2:50 pm	Virology	Storthz
Nov 17	Tu	1-2:50 pm	Oral Microbiology	Tribble
Nov 19	Th	1-2:50 pm	EXAM 4 Room 207 (material from Oct 27 - Nov 12)	Faculty
Nov 24	Tu	1-2:50 pm	Oral Microbiology	Tribble
Nov 26	Th		<i>Thanksgiving Holiday</i>	
Dec 1	Tu	1-2:50 pm	Oral Microbiology	Tribble
Dec 3	Th	1-2:50 pm	Oral Microbiology Course Evaluation	Tribble
Dec 14	Mon	10-11:50 pm	FINAL EXAM Room 207 (not comprehensive, material from Nov 17- Dec 3)	Faculty

EVALUATION METHODS

There will be five examinations during the course, each comprising 20% of your grade. The last exam will be given during exam week. The examinations will consist of multiple-choice questions. There will be no remakes of any examination during the course.

Grade reporting and course failures will be handled as specified by the current *Student Guide to Academic Studies*.