

It is essential that we train medical educators capable of conducting successful biomedical research in addition to educating medical and allied health professionals.

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PhD Course Document

Teaching Degree Program In Basic Sciences

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# Programme Details

As per Section 1: Level 8 STANDARDIZED SCHEME OF STUDIES FOR DEGREE PROGRAMS OFFERED IN HEIs

|  |  |
| --- | --- |
| **COURSE TITLE** | **PhD** |
| **SPECIALITY** | **(Anatomy, Biochemistry, Haematology, Histopathology, Microbiology, Molecular Biology and Genetics, Pharmacology, Physiology)** |
| **COURSE DURATION** | **Minimum 3 years (including course work duration and Research Dissertation)** ,**Maximum 3-8 years (including course work duration) with approval of Director Research/Registrar/Controller of Examinations** |
| **TYPE OF STUDY** | **Full time** |
| **STUDY SYSTEM** | **Semesters system (Minimum of 16 weeks of teaching excluding examinations)**   * + **2 Regular semesters for coursework (1 year)**   + **4 semesters for research work** |
| **TOTAL CREDIT HOURS** | **18 (Credit Hours of Course Work + a PhD dissertation which must be evaluated by at least two PhD experts from technologically /academically advanced foreign countries in addition to local Committee members)** |
| **DISTRIBUTION OF COURSES AND CREDIT HOURS** | * **1st semester (09 Credit hours)**   + **5 Compulsory courses (8 Credit hours)**   + **Research rotations (minimum 2) (1 credit)** * **2nd semester (09 Credit hours)**   + **Specialty Courses (8 Credit Hours)**   + **Teaching rotation (1 Credit)** * **3rd,4th,5th, 6th Semesters (6 credits)Research, Dissertation** |
| **Course Load per Semester for Regular Full-Time Students** | **09 Credit Hours of Advanced Courses in the specific field and Research Methods** |
| **TEACHING INSTITUTION**  **DEGREE AWARDING INSTITUTION** | **Institute of Basic Medical Sciences (IBMS)**  **Khyber Medical University Peshawar** |
| **ADMISSION CRITERIA** | **Anatomy, Microbiology, Haematology, Histopathology, Physiology, Biochemistry:** M.Phil/M.S/FCPS and equivalent degree in relevant field with CGPA 3.0 (out of 4.0 in the Semester System) or First Division (in the Annual System)  **In addition for Pharmacology:** **M.phil in pharmacology/ pharmacy or MS foreign or Pakistani,** **Molecular biology and genetics:** MPhil/Ms in biological sciences |

# Mission

The goal of PhD Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology program is to develop doctoral-level subject educators capable of teaching basic medical discipline to medical and allied health professional students and who are capable of performing high quality biomedical research for the benefit of the nation.

# Overview

This is a three year course that shall include both *taught courses* as well as *research rotations*.

In the **first semester** students shall complete the core courses required by the Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology program as well as completing research rotations whereby selecting a research supervisor and mentor. They shall complete a qualifying exam at the end.

In the **second semester** courses in Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology as well as assistance in teaching basic sciences to medical and allied health students.

In the **third to sixth semester** they shall complete doctoral research project, dissertation writing and defending their thesis.

The students shall have a rotation in at least two research labs together with being involved in teaching students as teaching assistants to gain research and teaching experience.

# Outcomes

The Graduate of PhD in Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology will have the attributes of a Subject specialist, Scientific researcher, Educator, Effective communicator and Collaborator achieved by developing trained personnel,

• In research skills and methodology

• To conduct quality and credible research

• Educators capable of teaching medical anatomical discipline

# Objectives

The Graduate of PhD (Anatomy, Biochemistry, Haematology, Histopathology, Microbiology, Molecular Biology and Genetics, Pharmacology, Physiology) shall achieve,

## Cognitive Domain

* knowledge at the frontier of the field of Human Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology including knowledge that constitute an original contribution
* Substantial knowledge of research principles and methods applicable to the field
* An understanding of theoretical knowledge and to reflect critically on the theory and practice of Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology
* Use of intellectual independence to think critically, evaluate existing ideas, undertake systematic investigation and reflect on theory and practice of Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology to generate original knowledge

## Psychomotor Domain

* Expert technical and creative skills applicable to the field of Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology
* Expert skills to search, design, analyze and communicate research that makes a significant and original contribution to knowledge and/or professional practice of Anatomy/ Biochemistry/Haematology/ Histopathology/ Microbiology/ Molecular Biology and Genetics/ Pharmacology/ Physiology
* Communication skills to explain and critique theoretical propositions, methodologies and conclusions to communicate results to peer and the community
* Communication skills to present a complex investigation of original research for external examination against international standards

## Affective Domain

* Intellectual independence
* Initiative and creativity in new situations and/or for further Learning
* Full responsibility and accountability for personal outputs
* Plan and execute original research (Project management)
* Life-long learner to generate new knowledge, in the context of professional practice

# Program structure

**Selection**

M.Phil/M.S/equivalent degree with

CGPA 3.0 (out of 4.0 in the Semester System) or First Division (in the Annual System) Subject based GRE test with minimum passing score of 70%.

**Merit** based on entrance test (40%), Academic record (40%) & Interview (20%)

**Semester 1**

Course work +Teaching rotation

**Eligibility**

**Course work Year 1**

**Semester 2**

Course work+ Research rotation

**Qualifying Exam**

**Qualifying Exam**

**Comprehensive exam**

**Comprehensive exam**

**Semester 6: 7th -12th month**

Evaluation of thesis by 2 foreign experts Dissertation writing Minimum one paper published in HEC (W category) approved journals

Open defence, Award of PhD degree

**Research work**

**Year 2**

**Thesis & examination**

**Open Defence**

Submission of Dissertation copy to HEC for PhD Country Directory

**Semester 3:1st -3rd month**

Literature review, Research proposal (GSC, AS&RB)

**Semester 3-4: 3rd -12thmonth**

PhD Project, Dissertation writing

**Research work**

**Year 3**

**Semester 5: 1st -6th month**

PhD Project, Dissertation writing

**Annual review**

**Review**

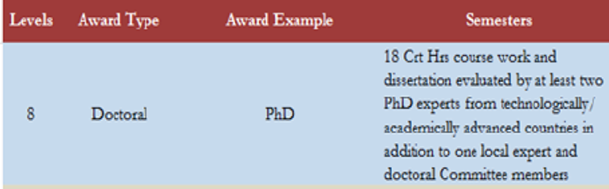


Figure 1 PhD Anatomy Programme Structure & Evaluation

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# PhD timeline

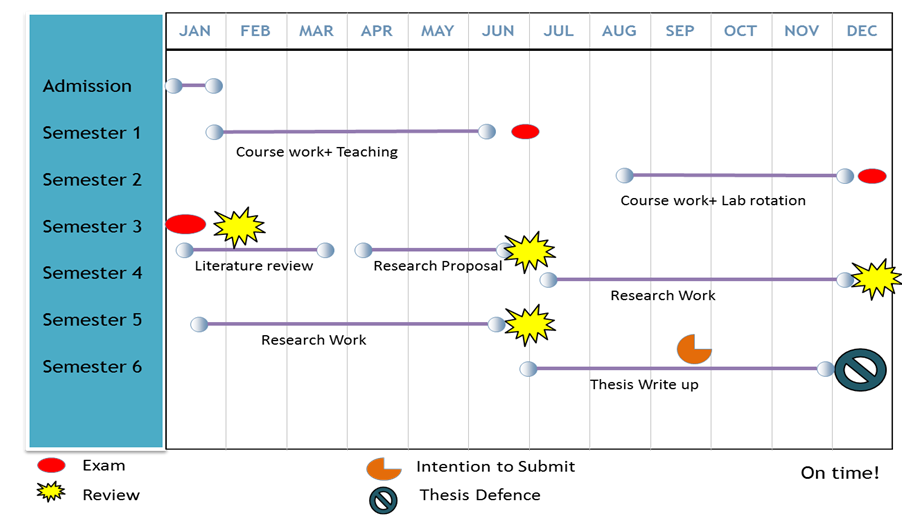


Figure 2 Timeline

# Registration in the University

1. A scholar for PhD degree program shall be registered in teaching department / institution of the University.
2. Registrar of the university shall maintain a register of PhD research scholars and assign a registration number to each scholar at the time of provisional admission.
3. A "notification of registration" for each candidate approved /allowed for admission to PhD program shall be issued by the University.
4. Registration may be renewed on payment of the prescribed fee if a scholar is re-admitted within a year after having been struck off the rolls for any valid reason.
5. A person registered for the PhD degree program shall be called **PhD research scholar**.
6. Each student so selected shall be required to register and pay the dues within 30 days from the date of issuance of the notification of registration, failing which the admission of the selected candidate shall be deemed as cancelled. The tuition fee and other dues shall be determined by the university from time to time.

# Advisors

Students shall be assigned advisors on admission by the specific department. The PhD coordinator shall serve as advisor before selection of subject specific advisors. The advisor and the student together will develop a flexible comprehensive plan of study that will be implemented in each semester. The advising file will be updated each semester and will include copies of transcripts and GPA earned.

# Attendance

The policy for minimum attendance (>75 %) in a course is mandatory to complete the requirements of a course. The instructor shall report a student’s absences and the student shall be placed on attendance probation by his/her dean/HOD and it will be notified by the department. A student shall be dropped from the University for violating the terms of such probation.

## CANCELLATION OF ENROLMENT

If a student fails to attend any lecture during the first four weeks after the commencement of the semester as per announced schedule, his/her admission shall stand cancelled automatically without any notification.

# Review Process

## Year 1

The scholar shall clear End of semester qualifying exams to progress to next semester.

The final Comprehensive exam (maximum 2 attempts) will be conducted by the examination department of KMU at the end of semester 2.

After successfully clearing comprehensive exam, the student shall proceed to Year 2 of PhD.

## Year 2

### 0-3 Months

The student should submit a review of the literature for the potential project (1500 Words minimum, 2000 Words maximum) in the form of a scientific report.

The student should submit a PhD Proposal to his/her supervisor for initial review. The supervisor will then assess the project and identify training needs if required.

The student should now accommodate supervisor comments, re-check from supervisor and submit research proposal to Graduate Study Committee with one subject specialist from within or outside KMU. This should be followed by submission of “PhD Student Review Form” (Annexure 1), literature review and defense of research proposal in the annual review meeting of the Advanced Studies Review Board (ASRB), especially arranged for the PhD students.

### 3-12 Months

The student should be working on collecting data, optimize experiments, establish collaborations and develop experimental/research plan for successful completion of PhD project.

Note: At the start of year 2, the student could potentially start collecting data, optimize experiments, establish collaborations and develop experimental/research plan.

## Year 3

The review process of Year 2 and 3 include,

* Presentation to the institutional Graduate Study Committee on six monthly basis organized by the concerned PhD Coordinator followed by submission of “PhD Student review form”,
* Scientific report\* and presentation in the PhD annual review committee#.

The annual review process should be completed by students and supervisors by 31st January. Any student starting late will normally be permitted to delay submission of their annual report until 31st March.

Two reviewers (assigned by supervisor) will assess the progress of student at the end of year 2 and 3. The performance of PhD student will then be communicated by the reviewers to supervisor and director of the institute.

### \*Scientific report

A scientific report preferably in the style of a journal article (6 to 10 pages maximum is recommended) summarizing progress made in the last year. It may therefore contain an abstract, introduction, materials and methods, results and discussion. In addition, there should be a 1500-2000 word section at the end of the report detailing the following year’s work (Future plans). To be sent to supervisor for assessment and comment (half a page maximum) and subsequently submitted to the reviewers.

#Presentation in the PhD review committee

All PhD students are required to deliver oral presentation by the end of year in the PhD review committee. This is followed by discussion with the committee members, including minimum of two subject experts. The committee will then take decision regarding the registration of student for the next session.

### Thesis pending period

Final year interview - Students within a year of the absolute thesis submission deadline will be interviewed specifically on their progress in the ASRB annual review meeting.

# Qualifying Examinations and Defence

## End of Semester Exam

Upon completion of the core curriculum, the student must prepare for and successfully pass the doctoral qualifying examination at the end of each semester (1 &2) to test their knowledge of subject, grasp of relevant literature, and the ability to form research hypotheses and experimental design. It shall be a written and oral exam.

## Comprehensive Examination

The qualifying exam is a written examination that will be designed to test the student’s fundamental knowledge of human structure and function, critical analysis and thinking, and design of an independent research proposal.

An ad hoc exam committee will be constituted by the Director of the Institute/PhD Co-ordinator and include three members of the graduate faculty, two of which shall be subject specialists. The Program Director shall chair the committee.

The committee shall request the faculty to submit questions on:

1) Material covered in any of the course work completed by the student to date,

2) Research papers or reviews that will be provided to the student, and/or

3) Philosophical matters related to the history of basic sciences and medicine or national or world events that impact medical education and biomedical research.

The committee will review the submitted questions and questions will be selected or created by the committee to ensure the questions are fair and appropriate, that they test the student’s knowledge base for areas in the subject and that they help evaluate the problem solving skills of the student.

A student can avail a maximum of two attempts in the qualifying exam; failing which will result in the student being recommended to being dropped from the PhD program. In this case the Director of the Institute can elect to offer the failed student the option of completing a terminal Master’s degree.

Once the student has passed the doctoral qualifying examination the student must register for Dissertation Research. A minimum of 06 credit hours is required for degree completion and typically occurs over 2 – 3 academic years. Initially, the student must identify a research project under the guidance of a faculty member and present to GSC and ASRB.

# Advancement to Candidacy

## Intention to submit form

It shall be the responsibility of the student to initiate their candidacy by submitting “An Intention to Submit form” (Annexure) to the PhD coordinator prior to the thesis submission date. This form initiates the identification and appointment of a committee of examiners for each thesis.

Once the completed candidacy form has been processed, the thesis committee chair will receive ballots for the oral defence of the thesis. The ballots are distributed to the other committee members by the thesis committee chair when they vote on the oral defence. Once the ballots are completed, signed and sealed it is the committee chairperson's responsibility to deliver the ballots to the Graduate Education Office immediately following the defence.

## Submission of thesis

A copy of Ph.D. Dissertation (both hard and soft) must be submitted to HEC for record in Ph.D. Country Directory and for attestation of the PhD degree by the HEC in future.

## Doctoral Oral Qualifying Examination (Thesis defence)

### Prerequisites

Prior to the doctoral student’s request for consideration for advancement to candidacy, the student must have;

* Completed most of their required core or elective course work
* Successfully passed their Preliminary/Written Qualifying Exam
* Submission of their research proposal and the formation of their research committee
* Initiation of the major components of their proposed doctoral research project
* Finally registration for any research hours
* The oral qualifying exam will be scheduled after the student has submitted a detailed dissertation research proposal and conducted preliminary experiments to substantiate the proposal.
* The Plagiarism test must be conducted on the Dissertation before its submission to the two foreign experts.
* Evaluation of the doctoral thesis by 2 eminent foreign examiners from scientifically advanced countries, approved by HEC.

### Research Publication

Publication of at least one research paper in HEC approved/recognized journal (preferably in W category) is essential before the submission of dissertation.

### The Defence

• The oral exam will be public and designed to test the student’s fundamental knowledge of their proposed studies, background for the studies, and critical analysis and thinking.

• Viva voce examination by 2 national experts, approved by HEC.

The defence of the dissertation provides an opportunity for the student to formally present their findings to their committee, the faculty and students in IBMS, and to any family member or anyone from the general public wishing to attend.

Two weeks before the dissertation defence an electronic and print announcement of the date, time, location, and title of the defence will be publicized.

At least 7 working days prior to the defence, a final draft of the student’s dissertation must be placed in the Conference Room for faculty and students to review.

The dissertation defence is two parts. First the student will make an oral, PowerPoint presentation of no longer than 45 minutes duration where they present their research.

Following the presentation, questions from the collective audience will be encouraged. Once all questions have been satisfactorily answered by the student, the audience is excused and the closed, or executive, part of the defence takes places with only the student and their committee present. The dissertation committee can asked detailed questions and expect the student to demonstrate thorough knowledge of their project and related research. Questions on general topics in Anatomy, unrelated to their research, may also be asked. Following all questioning, the student is excused from the room and the committee members, without discussion, complete the defence ballot.

## Fellowships

A limited number of fellowships are available to support doctoral studies in Anatomy. Doctoral fellows will be expected to participate with faculty in the education of medical, professional, and graduate students working in both our teaching laboratories and classrooms. Acceptance into the doctoral program does not guarantee the awarding of a fellowship or any other financial assistance. Consideration for a Doctoral Fellowship will be based on the qualifications of the candidate and the selection of the fellowship award recipient will be made solely by the Anatomy Graduate Program Director.

# Application

Students are usually admitted in the beginning of the Spring semester. Application requirements include official transcripts, official scores on the Graduate Record Examination, three letters of recommendation, a resume/cv and a goals statement.

Materials should be uploaded as part of your online application

# Program Curriculum

The research work and award of degree will be supervised by a HEC recognized PhD supervisor and co-supervisor from related areas of expertise. Upon admission to PhD program a supervisor will be allotted to the enrolled student who will guide the student in the selection of his/her area of research along with the development of research proposal and protocol. The supervisor and co-supervisor will also ensure that the student develop essential skills according to his area of research.

The requirements for PhD degree shall normally be completed within four years from the date of registration. The maximum time for the completion of PhD degree shall be six years from the date of registration in the PhD program. Only under exceptional circumstances, to be described in detail by the PhD candidate and supported by the supervisor, the PhD advisory committee may allow extension of up to one year beyond the maximum time limit of six years.

# Course Distribution

Programme wise course distribution in each department

Section 2

Programme wise Course Distribution

# Overview of Courses

## CORE/COMPULSORY COURSES

**First/Fall Semester (08 CREDITS PLUS 1)**

**BMS801 Advances in Molecular Cell Biology (1+1)**

* Cell structure and organization, Cell signaling pathways
* The language of genetics and the terminology of molecular biology. Molecular genetics like DNA structure and function replication, transcription, protein synthesis and enzymology, DNA recombination, gene structure, function and regulation
* Molecular cloning and molecular tools for studying genes and gene activity

**BMS802 Ethics for Research Scientists (1+0)**

* The course is a requirement for all pre- and postdoctoral fellows. It consists of eight 2 hour sessions given in the first half of the spring semester. For all but the first sessions, a lecture to the whole class lasting 30 to 50 minutes will be followed by small group discussions which will involve case presentations.

**BMS803 Applied Biostatistics-II (1+1)**

* principles of various study designs
* how to design a study and describe the validity and reliability of a study design
* fundamental concepts and methods of statistics in the areas of medical and biological

Research.

* Have good command on use of statistical computer software for data analysis

**BMS804 Presentation and Scientific writing skills (1+1)**

* Present and communicate research articles/research data in conferences and symposia. Critically analyse data, design a project and write up research proposals. Design experiments in the field of biological sciences.
* Collect information from the available resources, Prepare a presentation on a given topic, Deliver a lecture and manage a question-answer session
* Work as a productive member of a task force

**BMS805 Biosafety and Biosecurity (1+0)**

* Know the bio-risk associated with working in research lab
* Will know the national and international standards of lab safety
* Will comprehend bio-security of the hazardous material used in research

**BMS806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

SPECIALITY COURSES

**Second/Spring Semester (08 CREDITS PLUS 1)**

**Each Programme/Department (detailed below) (08 CREDITS)**

**BMS 807 Teaching rotation (Elective choice) (1+0)**

## RESEARCH

**Third to Sixth Semester**

**BMS 899 Dissertation Research (6 CREDITS)**

Student will propose and complete a research project under the guidance of a faculty member

## CORE COURSES

## BMS801 Advances in Molecular Cell Biology (1+1)

## 

* Cell structure and organization, Cell signaling pathways
* The language of genetics and the terminology of molecular biology. Molecular genetics like DNA structure and function replication, transcription, protein synthesis and enzymology, DNA recombination, gene structure, function and regulation
* Molecular cloning and molecular tools for studying genes and gene activity

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend in details the cell structure and organization
2. demonstrate the methods of DNA replication, transcription, protein synthesis and enzymology
3. discuss the molecular genetics of like DNA recombination, gene structure, function and regulation as well as cell signaling pathways and cancer
4. Have expertise in molecular cloning and molecular tools for studying genes and gene activity

## Course Contents:

The course contents will include; Introduction to the Study of Cell Biology, The Chemical Basis of Life, Techniques in Cell and Molecular Biology, Enzymes and Metabolism, Mitochondrion and Aerobic Respiration, The Structure and Function of the Plasma Membrane, Cytoplasmic Membrane Systems, Interactions Between Cells and Their Environment, The Nature of the Gene and Genome, Expression of Genetic Information, Cytoskeleton and Cell Motility, Cellular Reproduction, Cell Signaling and Cancer. Methods in molecular biology; Transcription in Prokaryotes & Eukaryotes; RNA Polymerase & their promoters, Transcription Factors & Activators, Chromatin Structure and its effects on Transcription; Posttranscriptional events: Splicing, Capping & Polyadenylation; Translation Mechanism: Initiation, Elongation & Termination; Ribosomes & Transfer RNA; DNA Replication, Recombination and Transposition: Mechanism & Enzymology; Homologous Recombination; Site-specific Recombination & Transposition.

## Recommended Books:

1. Karp, Gerald.Cell and Molecular Biology: Concepts and Experimentswith Student Study Guide John Wiley & Sons, Latest Ed.
2. David S. Latchman. Basic Molecular and Cell Biology Wiley Blackwell, Latest Ed.
3. Stephen L. Wolfe. Introduction to Cell and Molecular Biology. Wiley Blackwell, Latest Ed.
4. Lizabeth A. Allison. Fundamental Molecular Biology. Wiley Blackwell, Latest Ed.
5. Harvey Lodish et. al., Molecular Cell Biology. W.H. Freeman & Co, Latest Ed.
6. Robert Weaver, Molecular Biology, McGraw Hill, Latest Ed.

## Journals:

1. Biology of the Cell
2. Nature Cell Biology
3. Cell & Tissue Research
4. Journal of Cellular Physiology
5. Journal of Cellular Biochemistry
6. Journal of Molecular Cell Biology
7. Molecular and Cellular Endocrinology
8. Cellular Physiology and Biochemistry
9. Nature Reviews Molecular Cell Biology
10. International Journal of Biochemistry and Cell Biology

## BMS802 Ethics for Research Scientists (1+0)

* The course is a requirement for all pre- and postdoctoral fellows. It consists of eight 2 hour sessions given in the first half of the spring semester. For all but the first sessions, a lecture to the whole class lasting 30 to 50 minutes will be followed by small group discussions which will involve case presentations.

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend basics of research in light of the modern ethics
2. Comprehend basic knowledge of the ethical issues in biomedical research
3. Select and design research project and critically analyze and communicate scientific data
4. Analyze literature critically and comprehend the foundations of Bioethics theories
5. how to deal with patients within the boundaries of biomedical ethics
6. how to improve the basic health care services on ethical grounds

## Course Contents:

The course will include introduction to medical/bioethics, Ethical Theories, Historic perspective of bioethics in the development of vaccines and medicine and clinical trials, The Four Basic Principles of bioethics and their importance in research, Ethical justification and scientific validity of biomedical research involving human subjects, Ethical review committees. Ethical review of externally sponsored research, Obtaining informed consent: Essential information for prospective research subjects, Inducement to participate in research, Benefits and risks of study participation, Ethical justification of research involving individuals who are not capable of giving informed consent, Children, mentally retarded, behavioural disorders, Choice of control in clinical trials, and Research involving vulnerable persons, children, women and pregnant women. Safeguarding confidentiality, Bioethical research involving animals and research misconduct.

## Recommended Readings:

1. Good Medical Practice (2013); General Medical Council
2. CIOM Guidelines available online
3. Beauchamp T, Childress J; Principles of Biomedical Ethics, 7th Edition. Oxford University Press.
4. Antoniou SA, Antoniou GA, Granderath FA, et al; Reflections of the Hippocratic Oath in modern medicine. World J Surg. 2010 Dec;34(12):3075-9. doi: 10.1007/s00268-010-0604-3.
5. Good Medical Practice - Explanatory Guidance; General Medical Council
6. Managing a child or young person with suspected maltreatment; NICE CKS, March 2014 (UK access only)
7. Confidentiality and information sharing; National Treatment Agency for substance misuse, 2003
8. Consent guidance; General Medical Council
9. John Arras and Bonnie Steinbock. Ethical Issues in Modern Medicine, Mayfield, Latest Ed.
10. Françoise Baylis, Jocelyn Downie, Benjamin Freedman, Barry Hoffmaster, and Susan Sherwin. Health Care Ethics in Canada. Harcourt Brace, Latest Ed.
11. Tom L. Beauchamp and James F. Childress. Principles of Biomedical Ethics. Latest Ed. Oxford University Press.
12. Jonathan Glover, Causing Death and Saving Lives. Penguin Books, Latest Ed.
13. Glenn C. Graber and David C. Thomasma. Theory and Practice in Medical Ethics. Continuum, Latest Ed.
14. Thomas A. Mappes and David Degrazia. Biomedical Ethics, 4th ed. McGraw-Hill, Latest Ed.
15. Ronald Munson and Christopher A. Hoffman. Intervention and Reflection: Basic Issues in Medical Ethics. Latest Ed. Wadsworth.
16. Gregory E. Pence. Classic Cases in Medical Ethics. 2nd ed., McGraw-Hill, 1990.
17. Michael Yeo. Concepts and Cases in Nursing Ethics. Broadview, Latest Ed.
18. Françoise E. Baylis. The Health Care Ethics Consultant. Humana Press, Latest Ed.

## Journals:

1. American journal of bioethics
2. Journal of medicine and philosophy
3. [Bioethics](http://www.blackwellpublishers.co.uk/asp/journal.asp?ref=0269-9702)
4. [Cambridge Quarterly of Healthcare Ethics](http://uk.cambridge.org/journals/cqh/)
5. [Hastings Center Report](http://www.thehastingscenter.org/Membership/memberdefault.asp)
6. [Journal of Clinical Ethics](http://www.clinicalethics.com/)
7. [Journal of Medical Ethics](http://www.bmjpg.com/template.cfm?name=specjou_me)
8. [Journal of Medicine and Philosophy](http://www.swets.nl/sps/journals/jmp.html)
9. [Kennedy Institute of Ethics Journal](http://muse.jhu.edu/journals/kennedy_institute_of_ethics_journal/)

## BMS803 Applied Biostatistics-II (1+1)

## 

* principles of various study designs
* how to design a study and describe the validity and reliability of a study design
* fundamental concepts and methods of statistics in the areas of medical and biological

Research.

* Have good command on use of statistical computer software for data analysis

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend basics of epidemiology and principles of various study designs
2. To design a study and describe the validity and reliability of a study design
3. Comprehend concepts and methods of statistics in Biomedical research
4. Have good command on use of statistical computer softwares for data analysis

## Course Contents:

The course contents will include; Descriptive epidemiology, analytic epidemiology and epidemiological inference, Classification, morbidity and mortality rates, ratios, incidence, prevalence, sampling, screening, epidemiological models, Types of study design; their importance, uses, and limitations, field trials, controlled epidemiological surveys, sources of bias and causal models.

Introduction to statistics, types of statistical applications, population and samples, data analysis and presentation, variables, elementary statistical methods, tabulation, chart and diagram preparations, measures of central tendency and dispersion, sampling techniques and sample size estimation, probability and proportions, Tests of significance; normal test, t test, Chi square test etc, correlation and its applications, linear regression and multiple regression, logistic regression, sign test, Wilcoxon signed rank test, Mann Whitney test, Kruskal Wallis test, Spearman rank correlation, Clinical trials and intervention studies, Measures for developing health statistical indicators: morbidity and mortality statistics, Use of latest statistical computer softwares for data analysis.

## Recommended Readings:

1. Biostatistics, A foundation for analysis in health sciences by Wayne W. Daniel.
2. Gordis, L. Epidemiology. Pennsylvania: W.B. Saunders Company. Latest Ed.
3. Rothman KJ. Modern Epidemiology. Boston: Little, Brown and Company, Latest Ed.
4. Kelsey JL, Thompson WD, Evans AS. Methods in Observational Epidemiology. New York: Oxford University Press, Latest Ed.
5. Kleinbaum DG, Kupper LL, Morgenstern H. Epidemiologic Research: Principles and Quantitative Methods. Belmont, CA: Lifetime Learning Publications, Latest Ed.
6. Lilienfeld DE, Stolley PD. Foundations of Epidemiology. New York: Oxford, Latest Ed.
7. Daniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences. Latest Ed. John Wiley & Sons. Inc. New York.
8. Larson R and Farber B. Elementary Statistics: Picturing the World. Latest Ed, Prentice Hall Publications. USA.
9. Oliver, M. and Combard MS. Biostatistics for Health Professions. Latest Ed. Prentice Hall Publications, New Jersey.
10. Statistical Software: SPSS; EPIINFO; STATA; SAS

## Journals:

1. Cancer Epidemiology
2. Epidemiologic Reviews
3. Annals of Epidemiology
4. American Journal of Epidemiology
5. International Journal of Epidemiology

## BMS804 Presentation and Scientific writing skills (1+1)

* Present and communicate research articles/research data in conferences and symposia. Critically analyse data, design a project and write up research proposals. Design experiments in the field of biological sciences.
* Collect information from the available resources, Prepare a presentation on a given topic, Deliver a lecture and manage a question-answer session
* Work as a productive member of a task force

## Course Content

Here is the tentative list of topics to be covered in this course. This list is subject to change based on class progress and the instructors’ discretion.

**1. Introduction**

1. Basics of research
2. Types of scientific communication
3. Examples of different types of scientific communication
   * Original research articles
   * Research proposals
   * Review articles
   * Conference abstract
   * Really good stuff
   * Short communications
   * Special communications

**2. Scientific Literature**

* 1. Searching the scientific literature
  2. Using online search engines
  3. Refereed journal?
  4. Plagiarism

**3. Computer skills**

1. Using Computer technology
   1. Microsoft Word
   2. Formatting (including margins, tabs, indents, justification, etc)
   3. Using the table feature
   4. Creating tables of content
   5. Microsoft Excel
   6. Creating tables, charts, graphs

**4. Poster Presentations**

1. Organization and formats for posters
2. Using Microsoft power point

**5. Oral Presentations**

1. Designing and preparing slides for an oral presentation
2. Importing tables, charts and graphs from Excel
3. Optimizing pictures for use in presentations
4. Using visual aids without overdoing it
5. Using Microsoft Power point

**6. Synopsis development and steps to AS&RB**

**7. Thesis Writing**

1. Beginning to Write
2. Establishing your constraints
3. Organizing your writing
4. Preparing outlines
5. Standard formats for scientific papers, research projects and theses
6. Style guides

**b. Content**

1. Creating a literature review
2. Preparing other sections of a research report (abstract, introduction, materials and methods, results and discussion, conclusions)
3. Including and summarizing research data

**c. Using Word to prepare thesis**

1. Thesis template formation
2. Step wise guide to write thesis
3. Some tricks and tips

**d. Style and grammar**

1. Scientific writing style
2. First-person vs. Third-person; Passive vs. active voice
3. Avoiding excessive wording
4. Grammar
5. Avoiding misuse of words
6. When to use footnotes

**e. Reference citations**

1. How to use references
   * Within the text
   * How to make lists of references

**f. Revising**

1. Dealing with revisions
2. Accepting criticism
3. Making sense of supervisors’/reviewers’ comments
4. Making the changes
5. What to do if you don’t agree with supervisor’s/ reviewers’ comments

## Resources

Textbooks: Two books are required for this course:

1. How to Write and Publish a Scientific Paper. 6th Edition. Authors: Robert A. Day and Barbara Gastel. ISBN: 0-313-33040-9

2. Alley, M. 2003. The Craft of Scientific Presentations: Critical steps to succeed and critical errors to avoid. Springer, NY. 241 pages. ISBN:0-387-95555-0.

**Laptops are must for the whole course**

## Assessment:

**Students will be assessed on the following assignments containing 20 marks each:**

* Assignment 01: Literature review
* Assignment 02: Drafting of research proposal
* Assignment 03: Presentation on review of a scientific paper
* Assignment 04: Power point presentation of research proposal

Assignment 05: Poster presentation

## BMS805 Biosafety and Biosecurity (1+0)

## Course Objectives:

1. To empower students with the skills, tools, and confidence on sustainable bio-risk management.
2. To enable them to apply principles of biosafety and biosecurity in facilities.
3. To reduce/eliminate the risk of infection in laboratory setting.

## Course Contents:

1. BRM introduction, scope & importance
2. Terminology
3. AMP Model – brief introduction
4. Biorisk assessment
   1. Hazards & threat identification & analysis (frequency and magnitude)
   2. Levels of biological risks
   3. Likelihood & consequences evaluation
5. Biorisk mitigation – introduction/ brief account of a-e
   1. Elimination & substitution
   2. Engineering control
   3. Administrative control
   4. Practices & procedures
   5. PPE
6. Performance – introduction
   1. Key elements of performance
   2. Control (monitoring protocols)
   3. Assurance
   4. Improvement
7. **Biosafety** – Introduction, purpose, requirement
   1. Biosafety Levels – brief description of levels 1 – 4
   2. BSL-1
   3. BSL-2
   4. BSL-3
   5. BSL-4
   6. Laboratory Design & Facilities
8. GLWPs - importance
   1. Responsibility for enforcing GLWPs
   2. Barriers to glwps
   3. Lab equipment calibration & validation
9. PPE,**Biosecurity** – introduction, principles, history, objective
   1. Key pillars of biosecurity
      * Physical security
      * Personal management
      * Information security
      * Transport security
      * Material control & accountability
   2. Incident Management:Scope
   3. Incident response system
   4. Incident reporting
10. Waste management: Collection, segregation, transportation, storage & disposal
11. Decontamination

SPECIALITY COURSES (Per Program Ref. Section15.2.1)

# ANATOMY DEPARTMENT

(PhD Anatomy)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**ANA-801 Human Development (2+0)**

**ANA-802 Advanced Microscopic Anatomy and Micro-technique (2+1) ANA-803 Advanced Neurobiology (2+1)**

**BMS-807 Teaching rotation (Elective choice) (1+0)**

**No. of credit hours for specialty courses (8+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## Competencies

The student as a; “***Subject expert”*, *“Communicato****r”* and***“Research Scholar”.*** These competencies are then further expanded upon by objectives designed to cover the development of knowledge, skills and behaviour of the students by the time they graduate for all courses.

### Affective domain

1. Demonstrate critical thinking as to how to use their embryological knowledge to help in counselling patients, and to enhance their value as physicians
2. Manage time and courses to submit assignments on time
3. Apply principles of professional conduct in paper submission (plagiarism)
4. Demonstrate professional behaviour by completing all course requirements, including course evaluations, in a timely manner.
5. Demonstrate responsibility and accountability by attending and being punctual at all required course activities such as laboratory sessions, workshops and exams.
6. Demonstrate professional behaviour by requesting any excused absence from required course activities well ahead of the scheduled date.
7. Demonstrate professional behaviour by responding to direct communication from the course faculty in a timely fashion, particularly in circumstances when a face-to face meeting is requested to discuss issues related to academic performance.
8. Demonstrate professional and ethical behaviour by honestly completing course examinations without attempting to seek an advantage by unfair means; and by reporting any unethical behaviour of peers to the course administration.

### Research

1. Critically analyse research articles
2. Actively participate in journal club meetings, seminars, workshops and conferences in the university

## ANA-801 Human Development (2+0)

## 

* Prenatal human development; emphasis on correlation of normal development with development of common congenital malformations,
* Structure and function of human body; emphasis on anatomical relationships and concepts and their functional significance

## Objectives

By the end of the course, the graduate of PhD Anatomy must have acquired a reasonable working knowledge of:

### Cognitive domain:

1. Acquire an understanding of the importance of human embryology and developmental anatomy to enhance student appreciation of normal body structure and function and correlate it to abnormal body structure and function
2. Acquire familiarity with signalling occurring at a molecular level
3. Genetic, molecular and cellular basis of the mechanisms that regulate those critical embryological events
4. Acquire an awareness of the field of perinatology (the branch of medicine focused on the foetus and new-born infant) its approaches and tools (amniocentesis, fetoscopy, ultrasonography, molecular biology, etc

## Content

|  |  |  |
| --- | --- | --- |
| **Topic** | **No. of Hours** | **SDL** |
| Human germ cells | 2 | 2 |
| Embryo intro, conception | 2 | 1 |
| Germinal stage | 4 | 2 |
| Embryonic stage | 4 | 2 |
| Foetal stage | 8 | 2 |
| Congenital Anomalies | 4 | 2 |
| Molecular mechanisms and signalling | 6 | 2 |
| Perinatology | 2 | 1 |
| Stem cells transplantation and gene therapy | 2 | 2 |
| Critically analyse research articles and develop a literature review. |  | 10 |
| Present their critique |  | 4 |
| Total | 32 Contact hrs | SDL/DSL |

## References

1. The developing human : clinically oriented embryology 8th ed. Moore, Keith L; Persaud, T V N; Torchia, Mark G Philadelphia, PA : Saunders/Elsevier, c2008.
2. Before We Are Born 7th edn.Before we are born : essentials of embryology and birth defects 7th ed. Moore, Keith L; Persaud, T V N; Torchia, Mark G Philadelphia, PA : Saunders/Elsevier, c2008.
3. Larsen's human embryology 4th ed. Larsen's human embryology 4th ed. Schoenwolf, Gary C; Larsen, William J, (William James). Philadelphia, PA : Elsevier/Churchill Livingstone, c2009.
4. Langman's Medical Embryology 11th edn. Langman's Medical Embryology 11th ed., Sadler, T W, (Thomas W.); Langman, Jan. Philadelphia : Wolters Kluwer Lippincott Williams & Wilkins, c2010.
5. Netter's atlas of human embryology. Cochard, L. R., Machado, C. G., Craig, J. A., & Netter, F. H. (2012). Netter's Atlas of Human Embryology. Philadelphia: Saunders.
6. Human embryology and developmental biology 5th ed. Carlson, B.M. (2013) Philadelphia, PA : Mosby/Elsevier.
7. Human embryology 3rd edn.jpg Citation: Human embryology 3rd ed. Larsen, William J, (William James) this edition specially edited by Lawrence S. Serman, S. Steven Potter, William J. Scott. New York : Churchill Livingstone, c2001.
8. Embryology made Easy M.W. Rana.jpg Embryology made Easy by M.W. Rana ISBN-10: 9057025450 ISBN-13: 978-9057025457
9. Embryology (electronic resource) : an interactive tutorial and reference resource / M.A. Hill (2000) National Library Australia holding

## ANA-802 Advanced Microscopic Anatomy and Micro-technique (2+1)

## 

* Microscopic anatomy of human body; emphasis on relationships between structure and function of tissues and organs.
* Fundamental techniques and instrumentation; emphasis on principles underlying preparation of material for histological, histo-chemical and ultra-structural examination and interpretation of results.

## Objectives

By the end of the course, the graduate of MPhil Anatomy must have acquired a reasonable working knowledge of:

### Cognitive domain:

1. Acquire an understanding of the importance of form to function at the basic histological level
2. Learn the theoretical background to tissue processing for use in a variety of bio-imaging
3. Work out basic principles of use of advanced microscopy, focus on introducing participants to application of various microscopy techniques and their interpretation
4. Obtain properly sampled images, and to carry out basic image analysis of the images using

Image-J

1. Basic chemistry of fluorescent probes, reporters and proteins, and should be able to choose correct

### Psychomotor

1. Handling microscopes in the department
2. Demonstration of microscopy techniques: fluorescence, confocal, widefield, scanning electron microscope etc
3. Sample preparation, collection and controls

## Content

|  |  |  |
| --- | --- | --- |
| **Topic** | **SGD/SDL** | **Practical** |
| General Histology | **8** | **4** |
| Systems histology | **12** | **8** |
| Sample preparation | **2** | **4** |
| Slide preparation | **1** | **4** |
| Microscopy techniques | **1** | **4** |
| Fluorescent Microscopy | **1** | **4** |
| SEM, TEM | **1** |  |
| Confocal | **2** |  |
| Image analysis,Image J | **2** | **4** |
| Critically analyse research articles and develop a literature review. | **1** | **4** |
| Present their slides | **1** | **1** |
| **Total** |  | **37+SDL/DSL** |

## Resources

1. Journal of Anatomy

2. Anatomy and Embryology

3. Anatomia, Histologia, Embryologia

4. Search engines Pubmed, Science direct, OVID etc

5. Webscope

Facilities required for teaching and learning: Multimedia, availability of Text and recommended books, online access to the journals, internet access, histology slides.

<https://www1.udel.edu/biology/Wags/histopage/histopage.html>

<https://www.ibiology.org/ibioeducation/taking-courses/lenses-image-formation.html>

<https://www.ibiology.org/ibioeducation/taking-courses/what-is-light.html>

## ANA-803 Advanced Neurobiology (2+1)

## 

* Structure and function of the human nervous system; emphasis on neuroanatomical relationships of functional systems and neurobiological concepts of brain mechanisms.
* Lectures and moderated discussions of assigned journal articles will consider in greater detail the topics presented in the Human Systems Neurobiology course.

## Objectives

By the end of the course, the graduate of MPhil Anatomy must have acquired a reasonable working knowledge of:

### Cognitive domain:

1. Students shall discuss the various morphological and functional components of the nervous system

As regards the regional specialization within the brain

1. Integrate their learning of morphology to the complex molecular mechanisms for neurotransmission
2. Comprehend that the stimulation, transduction, transmission, and interpretation are necessary for neurosensory and that function of nervous system can be studied via dysfunction

### Psychomotor

1. Develop skills for practical handling of animals for research
2. Develop the skills regarding investigations and tests on humans participating in research

## Content

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Topic** | **No. of Hours** | **activity** |
| 1 | Course introduction | **2** | **1** |
| 1b | Basic organization of the nervous system |
| 2 | Morphology of the neuronal cell & Cellular and Cellular and Molecular Biology of the Neuron  Ultrastructure and function of a nerve and nerve bundle | **2** | **1** |
| 3 | Structural and functional characteristics of sensory system of the body,Overview of ascending pathways | **2** | **1** |
| 4 | Overview of descending pathways concerned with motor activities  Motor functions of the spinal cord and the cord reflexes  Upper and lower motor neuron lesions and their clinical presentations | **2** | **1** |
| 5 | Anatomical and physiological features of extrapyramidal system  Anatomical and functional features of cerebellum, basal ganglia and their connections | **2** | **1** |
| 6 | Central nervous system synapses and the principles of synaptic transmission  Structure and function of neuromuscular junction | **2** | **1** |
| 7 | Behavioural and intellectual functions of the brain | **2** | **1** |
| 8 | Anatomical and functional aspects of autonomic nervous system | **2** | **1** |
|  | Basic neurophysiology and neurochemistry governing excitability of brain | **2** | **1** |
| 9 | Structural and functional details of ventricular system of the brain and CSF circulation | **2** | **1** |
|  | Degeneration and Regeneration in CNS | **2** | **1** |
| 10 | Signalling within neurons & Ion channels and membrane potentials  Neurotransmitter release, Synaptic transmission & Synaptic plasticity | **4** | **1** |
| 11 | Techniques in neuroscience  Advanced cellular imaging techniques in neuroscience | **4** | **2** |
| 12 | Pain Physiology and neuroinflammation | **4** | **1** |
| **13** | Develop skills for animal handling | **4** | **2** |
| **14** | Prepare an animal model for research | **4** | **2** |
| **15** | Develop skills for managing investigations and tests on human participants | **4** | **2** |
| **16** | Develop skills for nervous tissue processing for Immunohistochemistry | **4** | **2** |
|  |  | **48** | **24** |

## Resources

1. Highly Recommended: Afifi and Bergman, Functional Neuroanatomy, Text and Atlas, McGrawHill, 2nd Edition, 2005.
2. Highly Recommended: Haines, Neuroanatomy: An Atlas of Structures, Sections and Systems, 7th ed. Ed. Lippincott William and Wilkins, 2007.
3. Waxman, Clinical Neuroanatomy (Paperback), McGraw-Hill Medical; 26th edition (2009)
4. Blumenfeld, Neuroanatomy Through Clinical Cases (Paperback), Sinauer Associates; 2nd edition (2010)
5. Nolte, The Human Brain: An Introduction to its Functional Anatomy, 6th Edition, (2009)
6. Goldberg, Clinical Neuroanatomy Made Ridiculously Simple, 4th Edition 2010

## ANA-804 Developmental Neurobiology (Offered occasionally,2)

* Prerequisites: ANA803.
* Principles and concepts that underlie the development of the nervous system. Lectures and discussions of assigned journal articles will cover neurogenesis, neuronal differentiation, the formation of functional neural circuit and regressive phenomena during brain development.

## Objectives

By the end of the course, the graduate of MPhil Anatomy must have acquired a reasonable working knowledge of

### Cognitive domain:

1. Discuss the molecular mechanisms of ectodermal specifications, the mechanisms involved in notochord and neural tube development
2. Refer to the essential processes involved in the development of functional neuronal networks
3. Discuss the development of neural tube and neural circuits assembly by molecular regulation of brain development
4. Project these to the comparative CNS development in animals

## Content

|  |  |  |
| --- | --- | --- |
| **Topic** | **No. of Hours** | **SGD/SDL** |
| Molecular mechanisms of ectodermal specifications | **2** | **1** |
| Development of notochord and neural tube | **4** | **2** |
| Development of functional neuronal networks | **2** | **1** |
| Development and disorders of motor & sensory neruons | **4** | **2** |
| Cell shape and polarity during neurogenesis and brain morphogenesis | **2** | **1** |
| Neural crest and neurogenic placode development | **4** | **2** |
| Development of cerebral cortex and neurogenesis | **2** | **1** |
| Neural circuits assembly | **2** | **1** |
| Formation of neural folds and neural groove and Neural crest derivatives | **2** | **1** |
| Activity dependent maturation of brain circuits | **2** | **1** |
| Comparative studies of CNS development | **2** | **1** |
| Molecular regulation of brain development | 2 | 1 |
| Total | **32 Contact hrs** | **15** |

## Resources

1. Afifi and Bergman, Functional Neuroanatomy, Text and Atlas, McGrawHill, 2nd Edition, 2005.
2. Highly Recommended: Haines, Neuroanatomy: An Atlas of Structures, Sections and Systems, 7th ed. Ed. Lippincott William and Wilkins, 2007.
3. Langman’s Human embryology, 12th edition
4. Larsen's Human Embryology - 5th Edition – Elsevier

# BIOCHEMISTRY DEPARTMENT

(PhD Biochemistry)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**BIO-801 Advanced Clinical Biochemistry (2+1)**

**BIO-802 Computational Biochemistry (2+1)**

**BIO- 803 Advanced Nutritional Biochemistry (2+1)**

**No. of credit hours for specialty courses (9)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## BIO-801 Advanced Clinical Biochemistry BIO-801 (2+1)

## Course Objectives

The course will provide examples of biochemical basis for different disease states and will provide a framework in understanding cause of disease. Students will be able to

1. Observe and learn the procedures of quality control and quality assurance that are implemented within the clinical laboratory
2. Cancer: Learn and explain the molecular basis of carcinogenesis, oncogenes, benign and malignant tumors and metastasis. Explain the molecular basis of carcinogenesis, oncogenes, benign and malignant tumors and metastasis.To explain and interpret the molecular basis of certain common genetic diseases.
3. Blood: Comprehend the diagnosis and monitoring of hemoglobinopathies (anaemia, thalassemia, sickle cell anaemia).
4. Chronic diseases: To know the molecular basis and biochemical assessment of Ischaemic heart disease, angina pectoris and myocardial infarction andInterpret the role of enzymes in the diagnosis and monitoring of myocardial infarction, liver diseases, pancreatic, metabolic diseases and blood disorders. Comprehend the molecular basis and biochemical assessment of viral hepatitis, alcoholic hepatitis and liver cirrhosis. Knowledge and understanding of the function of the kidney in a range of pathological conditions and the biochemical parameters employed to investigate renal function and diagnose kidney disease.
5. Metabolism, bone: Knowledge and understanding of the process of bone remodelling in health and disease and the biochemical investigation of normal and abnormal bone metabolism and calcium homeostasis and Understand the role of clinical biochemistry in the assessment of nutritional status and diagnosis of nutritional disorders
6. Knowledge and understanding of the clinical and laboratory investigation of common endocrine disorders and describe the use of negative feedback systems and dynamic function tests to differentiate primary and secondary endocrine disorders, In addition to understand the design, operation and performance of the approaches used to measure hormones Critically analyse and interpret data obtained from the biochemical investigation of endocrine function.
7. Diabetes: Understand the causes, classification and investigation of diabetes mellitus. Describe the design, operation and performance of the laboratory and point of care methods employed in the screening, diagnosis and monitoring of diabetes mellitus. Critically analyse and interpret data relating to the diagnosis and monitoring of diabetes mellitus. Critically compare, contrast and evaluate the performance of new and established analytical technologies for the assessment of endocrine function and the investigation and diagnosis of diabetes mellitus.
8. Children:To critically analyse and objectively interpret data obtained from the biochemical investigation of neonates and children. And to critically compare, contrast and objectively evaluate screening programmes for the assessment of the health status of mother and/or foetus during pregnancy. Further to employ a combination of reflection and critical thinking to design screening strategies for the investigation of neonates and children who fail to thrive.

## Course Content

Interpretation of anemia and biochemical parameters in haemoglobinopathies: anaemia, thalassemia, sickle cell anaemia, Cardiac diseases: Ischaemic heart disease, angina pectoris, myocardial infarction. Cardiac profile tests, atherosclerotic plaques, Lipid profile and its significance. Types of jaundice, molecular basis and biochemical assessment, viral hepatitis, alcoholic hepatitis, cirrhosis. Renal function tests (Urea, creatinine, creatinine clearance, GFR, albumen, electrolytes, urine examination) and their role in diagnosis of renal disorders, Genetic disorders: Down’s, Turner’s and Klinefelter’s syndrome Bone remodeling and bone diseases; Calcium homeostasis and interpretation of biochemical parameters of bone in different endocrine and metabolic disorders, Diagnosis of interpretation of endocrine disorders using clinical biochemistry, measuring hormones. Inborn errors of metabolism, metabolic disorders, and screening, diagnosis and monitoring of diabetes. Blood groups, Rh factor compatibility and blood transfusion. Paediatric Biochemistry; screening programs for assessment of maternal and foetal health during pregnancy, screening methods for failure to thrive. Biochemical and other techniques used in clinical chemistry ELISA, RIA, IRMA. Quality control measures in clinical laboratories.

## Recommended References

1. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics 6th Editor, Authors: Nader Rifai
2. MN Chatterjea, Textbook of Medical Biochemistry, 8th Ed
3. Medical biochemistry Satyanarayana, 4th Ed
4. Journal of Clinical Endocrinology and Metabolism
5. Journal of Biomedical Science
6. European Journal of Clinical Investigation
7. Best Practice and Research in Clinical Hematology
8. Advances in Clinical Chemistry
9. Clinical Chemistry
10. Diabetes
11. JAMA
12. NEJM
13. Paediatric Endocrinology
14. Journal of Endocrinology and Metabolism
15. Circulation
16. Blood

## BIO-802 Computational Biochemistry (2+1)

## Course Objectives

By the end of the course, the graduate of PhD MBG must have acquired a reasonable working knowledge of:

1. Software and tool used in Bioinformatics/Biochemistry for various purposes
2. Use of these tools for solving various biochemical problems.
3. Knowledge contained in databases of proteins families, properties, structures and sequences
4. Databases of DNA and RNA structures and sequences
5. Other various databases i.e. chemicals, drugs, enzymes, vitamins, carbohydrates and lipids
6. Data submission and retrieval to and from databases
7. Manage time and courses to submit assignments on time
8. Apply principles of professional conduct in paper submission (plagiarism)

## Course Content

Literature search, Critically analyse research articles and develop a literature review.Discuss the research based recent advances in the relevant field.Learn to interpret the findings in the medical literature for future research.Improve critical appraisal skills and conduct it effectively .Earn skills related to oral and written presentations. Reference management.Comprehend the limitations of the application of evidence.Develop an understanding for the principles of a research proposal.

## Lists of references

**Course notes:**  Class lectures (PPT).

1. Understanding Bioinformatics by Marketa Zvelibil and Jeremy O Baum
2. R programming for bioinformatics by Robert Gentelman
3. Bioinformatics programming by Mitchell L Model
4. Introduction to bioinformatics by Anna Tramontano
5. Bioinformatics Data Skills by Vince Buffalo
6. Bioinformatics for dummies by Jean Michel and Cedric Notridem
7. Computational Biology and Bioinformatics by Ka-Chun Wong

Periodicals, Websites etc:

1. Bioinformatics
2. BMC Bioinformatics
3. Briefing in Bioinformatics
4. Current Bioinformatics
5. PLOS computational Biology
6. Journal of Computational Biology
7. Computers in Biology and Medicine
8. Nucleic Acids Research
9. Clinical Proteomics
10. Cancer Informatics
11. BMC Systems Biology
12. Journal of Proteomics

## BIO-803 Advance Nutritional Biochemistry (2+1)

## Course description

This course consist of three main modules

**Module 1: Exercise and Sports nutrition:** Exercise and sport nutrition is a core course in Nutritional biochemistry bridging the link between food and physical performance. It refers to the nutritional needs of all active people covering the areas of exercise for health and performance in sport. It focuses on nutrition providing the fuel for exercise, recovery, performance and the essential elements for growth, maintenance and repair of the body’s tissues

## Objectives

1. To understand the basic physiology and biochemistry of exercise.
2. Relate roles of nutrition in physical performance, recovery and adaptations to exercise.
3. Contextualize discipline knowledge to performance in sports competitions.
4. Investigate issues in sports nutrition.

**Module 2: Functional Foods and Nutraceuticals:** This module is aimed to develop basic understanding of the most emerging area of nutrition that is functional foods and Nutraceuticals (where food is used as medicine). The course will describe functional foods and Nutraceuticals including their health benefits and development.

## Objectives

1. Define functional foods and Nutraceuticals
2. Describe the research on the health benefits of functional foods and nutraceuticals, identifying strengths, limitations, and future directions.
3. To equip students with knowledge and understanding of modern aspects of nutritional science and novel food usage.

**Module 3: Clinical Nutrition:** Clinical nutrition is study of nutrition in context of treatment and prevention of diseases. The course deals with the nutritional aspects of diseases and clinical disorders by integrating students' existing knowledge of physiology, biochemistry and food science.

## Objectives:

1. To demonstrate knowledge of nutrition principles and their application to disease prevention and treatment
2. Demonstrate knowledge of medical terminology and medical abbreviations associated with nutrition related diseases and conditions.
3. Collect, organize and assess data relating to the health and nutritional status of individuals.

## Course Contents:

**(Module 1)** Exercise physiology, Exercise biochemistry, Supplements and ergogenic aids, Nutrition for weight and resistance training, Nutrition for endurance training, Loosing, making and gaining weight for athletes **(Module 2)** Basics of functional foods and Nutraceuticals, Classification, Health benefits, Pre-biotics, Pro-biotiocs, Nutritional labelling and health claims **(Module 3)** Nutritional Assessment, Nutrition in Obesity, Nutrition in Malnutrition, Cardiovascular disease, Diabetes, Oncology, Nutrition support methods

**Books Recommended:**

1. Nancy Clark,s Sports Nutrition Guide book 5th Edition
2. Clinical Nutrition 2nd Edition
3. Marinos Elia, Olle Ljungqvist, Rebecca J Stratton, Susan a Lanham-New, Dame Sally C. Davies
4. Appetite regulation, use of stimulants and cultural and biological influences, Julie Bienertova-Vasku.
5. Sports and exercise nutrition (Nutrition Society text book series) by Susan A Lanham-New, Samantha J steras, Susan M Shirrefs & Adam L Collins

**Journals:**

1. Appetite Journal
2. International Journal of clinical nutrition and dietetics
3. Clinical Nutrition Journal
4. Journal of sports nutrition
5. Journal of International Society of Sports Nutrition

# HISTOPATHOLOGYY DEPARTMENT

(PhD Histopathology)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**HIS- 801 Community oriented Histopathology (1+3)**

**HIS-802 Biomarkers and molecular pathology (1+1)**

**HIS-803 Cancer Genetics (2+1)**

**BMS-807 Teaching rotation (Elective choice)**

**No. of credit hours for specialty courses (9)**

**OPTIONAL COURSES**

**HIS-804 Research Techniques in Histopathology (1+1)**

**HIS- 805 Seminar (2+0)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## General and transferable skills

After completion of this course the students of PhD program will be able to:

* 1. Impart the above mentioned skills and knowledge to their students.
  2. Interpret various pathologies and discuss the etiology, pathogenesis and morphology of diseases.
  3. Display a professional attitude.
  4. Demonstrate a commitment to patient care.
  5. Follow the biosafety procedure of the lab.
  6. Show respect to laboratory colleagues.
  7. Value the diagnostic and research culture of institute.

## HIS-801 Community oriented Histopathology (1+3)

## Objectives:

### Knowledge and understanding:

After completion of this course the students of PhD program will be able to:

1. Enlist various community oriented diseases in the field of histopathology.
2. Explain the etiology of various community oriented diseases in the field of histopathology.
3. Understand the pathogenesis of various community oriented diseases in the field of histopathology.
4. Explain the gross examination of various community oriented diseases in the field of histopathology.
5. Understand the process of tissue processing.
6. Describe the morphology of various community oriented diseases in the field of histopathology.
7. Interpret the histo-morphology of various community oriented diseases in the field of histopathology.
8. Discuss the genetic basis of various community oriented diseases in the field of histopathology.
9. Explain advanced and predictive histopathology (e.g. IHC and FISH) of various community oriented diseases in the field of histopathology.
10. Relate the pathology of diseases to clinical outcomes.

### Intellectual skills

After completion of this course the students of PhD program will be able to:

1. Explain the relation of abnormal pathology to organ and organ system.
2. Describe the systemic manifestation of a pathological condition.

### Professional and Practical Skills

After completion of this course the students of PhD program will be able to:

1. Perform gross examination of tissue samples.
2. Perform tissue processing from gross specimen to H & E staining
3. Manipulate tissue processor and microtome.
4. Interpretation of H&E staining of samples.
5. Formulate a differential diagnosis based on histo-morphology of various community oriented diseases in the field of histopathology.
6. Recommend a final diagnosis based on histo-morphology of various community oriented diseases in the field of histopathology.
7. Formulate the differential diagnosis of various pathologies from H&E and other special stains (IHC, FISH).

## Course Contents:

|  |  |  |  |
| --- | --- | --- | --- |
| **Topic** | **No. of Hours** | **Lectures** | **Lab/Tutorial** |
| Gastrointestinal tract | **12** | **2** | **10** |
| Hepato-pancreatico-biliary tract and spleen | **9** | **1** | **8** |
| Respiratory tract and Cardiovascular system | **9** | **1** | **8** |
| Male genital tract and prostate | **12** | **2** | **10** |
| Female genital tract and breast | **12** | **2** | **10** |
| Skin, soft tissue, bones and joints | **9** | **1** | **8** |
| Head and neck (with thyroid and parathyroid) | **12** | **2** | **10** |
| Pituitary, Eye and ENT | **7** | **1** | **6** |
| Urinary tract | **12** | **2** | **10** |
| Cervix cytology | **9** | **1** | **8** |
| Thyroid and lymph node cytology | **9** | **1** | **8** |
| Total | **112** | **16** | **96** |

## Recommended Readings:

1. Pathologic Basis of disease by Robbins
2. Rosai and Ackerman's Surgical Pathology, Rosai.

*Journals:*

Please follow the link for some exciting pathology journals

<http://www.mdlinx.com/pathology/journals.cfm>

## HIS-802 Biomarkers and molecular pathology (1+1)

## Course Objectives:

### Knowledge and understanding:

After completion of this course the students of PhD program will be able to:

1. Enlist various biomarkers.
2. Explain the origin of biomarkers.
3. Understand the role of biomarkers in disease pathology.
4. Explain the significance of biomarkers in the field of histopathology.
5. Understand the process of biomarker discovery and validation.
6. Describe the pathway of biomarker from discovery to clinical application.
7. Discuss the role of research biomarkers.
8. Interpret the histo-morphology of various biomarkers in histopathology.
9. Discuss the genetic basis of biomarkers.
10. Explain the advanced and predictive histopathology (e.g. IHC, FISH, RT-PCR) based on bioamrkers.
11. Relate biomarkers to clinical outcomes.

### Intellectual skills

After completion of this course the students of PhD program will be able to:

1. Explain the relation of biomarkers to organ and organ systems.
2. Describe the systemic manifestation of a pathological condition in relation to diagnostic and research biomarkers.

### Professional and Practical Skills

After completion of this course the students of PhD program will be able to:

1. Manipulate tissue processor and microtome.
2. Interpretation of IHC, FISH and PCR based biomarkers.
3. Formulate a differential diagnosis based on biomarkers.
4. Recommend a final diagnosis based on biomarkers.
5. Interpret various statistical models related to biomarkers research.

## Contents:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Topic** | **No. of Hours** | **Lectures** | | **Lab/Tutorial** | |
| What is a biomarker? | **1** | | **1** | | **0** |
| Biomarkers discovery, validation and clinical application | **3** | | **2** | | **1** |
| Diagnostic biomarkers | **2** | | **1** | | **1** |
| Prognostic biomarkers | **2** | | **1** | | **1** |
| Predictive biomarkers | **2** | | **1** | | **1** |
| Interpretation and application of biomarkers | **6** | | **4** | | **2** |
| **Total** | **16** | | **10** | | **6** |

## Recommended Readings:

1. Pathologic Basis of disease by Robbins
2. Rosai and Ackerman's Surgical Pathology, Rosai.
3. Review of biomarkers

*Journals:*

Please follow the link for some exciting pathology journals

<http://www.mdlinx.com/pathology/journals.cfm>

## HIS-803 Cancer Genetics (2+1)

## Course Objectives:

Upon completion, of course the students will be able to:

1. Molecular and cellular events involved in tumor formation, progression and metastasis
2. Identify the common indications for referring a patient to cancer genetic services
3. Become familiar with the systematic approach to evaluating a patient’s risk of developing cancer Mendelian inheritance patterns/Non-Mendelian inheritance patterns
4. Understand how genetics contributes to predisposition and progression of cancer
5. Identify the different cancer predisposition syndromes and their features, inheritance patterns, and cancer risks
6. Elicit and construct a complete three generation pedigree using questions important for cancer genetic counseling
7. Understand the differences and overlap of cancers by tissue type
8. Understand modern aspects of RNA biology

## Course Contents:

The course contents will include: Introduction to cancer regarding cellular and molecular events involved in tumor formation, progression and metastasis, introduction to genetics and basic concepts in genetic inheritance of diseases, hereditary cancer related genetic syndromes and pedigree analysis, genetic counseling, specific examples of hereditary cancer in different tissues, advances in cancer diagnosis and therapeutics with special emphasis on gene expression and gene therapy.

## Recommended Readings:

1. Douglas Hanahan and Robert A, Weinberg (2011) Hallmarks of cancer, The Next Generation. Cell 144(5):646-674
2. Thompson and Thompson. Genetics in Medicine. 7th Ed. Philadelphia, PA
3. Helen M Kingston. ABC of clinical genetics 3rd Ed. BMJ Books, London
4. Laura M. Gunder Scott A. Martin. Essentials of Medical Genetics for Health Professionals. Jones & Bartlett Learning Canada
5. <http://www.cancer.net/>.
6. Peer reviewed scientific article related to the topics

**Journals:**

1. Cancer Genetics
2. Genetics in Medicine
3. Nature Genetics
4. Nature Reviews Cancer
5. Genes, Chromosomes and Cancer
6. Nature Reviews Genetics
7. British journal of cancer

## His: 804 Research Techniques in Histopathology (1+1)

## Course Objectives:

Upon completion, of course the students should be able:

1. To have skills regarding gross and special techniques in histopathology
2. To have basic knowledge of quality control in surgical pathology
3. To have basic knowledge of the molecular pathology techniques

## Course Contents:

The course contents of this subject include; specimen fixation, embedding, sectioning/microtomy, staining, mounting, immunohistochemistry, molecular pathology (PCR, in situ hybridization FISH and CISH).

## Recommended Readings:

1. Rosai and Ackerman’s Surgical Pathology, 10th Edition
2. Modern Surgical Pathology by Weidner et al., Latest Ed.
3. Anderson Pathology by Damjanor & Linder Latest Ed.
4. Sternberg’s Surgical Pathology, Latest Edition

## Journals:

1. Tumor Biology
2. Pathology
3. Histopathology
4. [Human Pathology](http://www.sciencedirect.com/science/journal/00468177)
5. Pathology and Pathobiology
6. Journal of Clinical Pathology
7. Analytical Cellular Pathology
8. [Annals of Diagnostic Pathology](http://www.sciencedirect.com/science/journal/10929134)
9. American Journal of Hematology
10. [Experimental and Molecular Pathology](http://www.sciencedirect.com/science/journal/00144800)
11. Experimental and Toxicologic Pathology

## His: 811 Seminar (2+0)

## Course Objectives:

Upon completion of this course the students should be able:

1. To search updated literature for any topic given for seminar
2. To comprehend and prepare scientific presentation on the topic of seminar
3. To present the topic of seminar in front of colleagues and faculty members
4. To improve their language and interact with the people

## Course Contents:

The course contents of this subject will be decided with the mutual understanding of the scholar and the concerned faculty member.

## Recommended Readings:

1. <http://www2.cs.uregina.ca/~hilder/cs499-900/Presentation%20Guidelines.pdf>
2. <http://www.oid.ucla.edu/sites/default/files/oid/docs/CUTF%20guidelines.pdf>
3. <http://www.academia.edu/4347529/Preparing_And_Presenting_a_Seminar_-_A_Guide>
4. <http://www.tulane.edu/~wiser/seminar/guide.html>
5. Any other related web material

# HAEMATOLOGY DEPARTMENT

(PhD Haematology)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

### HEM-801 Molecular Haematology (2+0)

**HEM-802 Haematology practice in Pakistan (2+1)**

**HEM-803 Recent advances in Haematology Therapeutic (2+1)**

**BMS-807 Teaching rotation (Elective choice) (1+0)**

**No. of credit hours for specialty courses (8+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

### Transferrable skills:

1. Prepare a Microsoft PowerPoint presentation

2. Use Microsoft Word for writing assignments

3. Use Endnote/Reference Manager to cite published literature

4. Be able to explain disease system to undergraduate medical students, and scientific and non-scientific audience

## HEM-801 Molecular Haematology (2+0)

## Overall aim

The overall aim of the course is to furnish the students with the principles and practices of molecular haematology. By the end of this course, students should be able to discuss the molecular basis of haematological diseases, laboratory aspects of molecular genetic testing, and their impact on disease outcome.

## Intended learning outcomes (ILOS)

### A. Cognitive domain:

After completion of this course the students will be able to:

1. Describe the molecular basis of haemoglobinopathies. Discuss genotype-phenotype relationship in haemoglobinopathies. Compare genetic diagnosis of haemoglobinopathies with that of conventional diagnostic methods.
2. Relate the genetics of leukaemia and lymphoma to disease etiology, diagnosis, monitoring and outcome.
3. Describe cancer stem cells and discuss their impact on treatment response, relapse risk and disease outcome. Discuss the recent advances in CML stem cell research.
4. Describe minimal residual disease monitoring. Discuss the significance of minimal residual disease as a prognostic marker. Compare and contrast various methods of monitoring minimal residual disease. List current challenges in adapting MRD as routine laboratory test in Pakistan.
5. Discuss molecular basis of iron metabolism. Discuss strategies to prevent and treat iron deficiency at individual and population levels.
6. Describe the currently accepted physiological process of coagulation.
7. Trace the mechanisms of factor deficiencies in congenital bleeding disorders. Discuss the current challenges in gene therapy in coagulation disorders.
8. Discuss molecular basis of platelet disorders. Discuss in detail Von Willibrand disease.
9. Discuss the molecular basis of blood cell allo-antigens.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Learning outcome** | **Contents** | **Essential teaching material** | **Teaching hours** | **Assessment** |
| **Molecular basis of haemoglobinopathies:**  Describe the molecular basis of haemoglobinopathies. Discuss genotype-phenotype relationship in haemoglobinopathies. Compare genetic diagnosis of haemoglobinopathies with that of conventional diagnostic methods. | 1. Structure, genetic control and synthesis of normal haemoglobin.  2. The molecular pathology of haemoglobin  3. Genotype – phenotype relationships in thalassaemia  4. Structural haemoglobin variants  5. Genetic diagnosis of haemoglobin disorders | 1. Molecular haematology, 3rd edition (Chapter 1)  2. Post Graduate haematology, 7th edition, (chapter 3) | 4 hours    1. Lecture – 2 hour  2. Case discussions in SGD format. – 2 hours | MCQs |
| **Molecular genetics of leukaemia**  Relate the genetics of Leukaemia and lymphoma to disease etiology, diagnosis, monitoring and outcome. | 1. The cancer genome  2. Classes of DNA mutations  3. Genotype-phenotype relationship in leukaemia  4. Pre-natal acquisition of cancer  5. Laboratory diagnosis of genetic mutations in leukaemia | 1. Molecular haematology, 3rd edition (Chapter 3 and 5)  2. Post-graduate haematology, 7th edition (chapter 18) | 4 hours  1. Lecture – 2 hour  2. SGD Recent article – 2 hour | MCQs |
| **Cancer stem cells**  Describe cancer stem cells and discuss their impact on treatment response, relapse risk and disease outcome. Discuss the recent advances in CML stem cell research. | 1. Cancer stem cells  2. Clonal evolution of cancer  3. Recent articles on CML stem cells | 1. Molecular haematology, 3rd edition (Chapter 29)  2. Hughes and Ross, *Blood,* 2016  3. Shah et al, *Blood,* 2016 | 3 hours  1. Lecture – 2 hour  2. Journal club in SGD format – 1 hour. Review research article on CML stem cells. | MCQs |
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| **Minimal residual disease**  Describe minimal residual disease monitoring. Discuss the significance of minimal residual disease as a prognostic marker. Compare and contrast various methods of monitoring minimal residual disease. List current challenges in adapting MRD as routine laboratory test in Pakistan. | 1. Minimal residual disease  2. Flow monitoring of MRD  3. PCR monitoring of MRD  4. Sanger sequencing and Next Generation Sequencing MRD  4. MRD in Pakistan | 1. Molecular Haematology, 3rd edition (Chapter 6)  2. Van Dongen, Lancet, 1998 | 3 hours  1. Lecture – 2 hour  2. Journal club in SGD format – 1 hour. Review the MRD article by Van Dongen. | MCQs |
| **Molecular basis of iron metabolism**  Discuss molecular basis of iron metabolism. Discuss strategies to prevent and treat iron deficiency at individual and population levels. | 1. Iron absorption, storage and metabolism  2. Hereditary haemochromatosis and Iron overload  3. Anemia of chronic disease | 1. Molecular haematology, 3rd edition (Chapter 12, 13,14)  2. Post Graduate haematology, 7th edition, (chapter 3)  3. Articles on population-based interventional strategies. | 4 hours  1. Lecture – 3 hour  2. Case discussions in SGD format – 1 hour | MCQs |
| **Coagulation**  1. Describe the currently accepted physiological process of coagulation.  2. Trace the mechanisms of factor deficiencies in congenital bleeding disorders. Discuss the current challenges in gene therapy in coagulation disorders. | 1. Normal Haemostasis  2. Genetic basis of haemophilia and Von Willebrand disease  3. Congenital platelet disorders | 1. Post Graduate Haematology, 7th edition (Chapters 36, 38)  2. Molecular Haematoloy, 3rd edition (Chapter 17-20) | 6 hours  1. Lecture – 4 hour  2. Case discussions in SGD format – 2 hour | MCQs |
| **Blood cell antigens**  1. Discuss current blood banking models. Describe the status of blood banking in Pakistan. Critically analyse research articles on prevalence of transfusion-transmitted infections (TTIs) in multi-transfused patients. | 1. Blood group systems  2. Blood group antigens and antibodies  2. HLA antigens  3. Functions of blood group antigens | 1. Post Graduate Haematology, 7th edition (Chapters 12)  2. Molecular Haematoloy, 3rd edition (Chapter 21, 22) | 6 hours  1. Lectures – 4 hours  2. Review articles on multi-transfused cohorts. | MCQs |
| **Non-malignant disorders**  Describe the mechanisms of neutrophil function. Discuss molecular basis of diseases arising from neutrophil dysfunction. | 1. Mechanism of neutrophil function  2. Disorders of neutrophil dysfunction | 1. Post Graduate Haematology, 7th edition  2. Molecular Haematoloy, 3rd edition (Chapter 21, 22) | 2 hours  1. Lecture – 2 hours | MCQs |

1. Discuss current blood banking models. Describe the status of blood banking in Pakistan. Critically analyse research articles on prevalence of transfusion-transmitted infections (TTIs) in multi-transfused patients.
2. Describe the mechanisms of neutrophil function. Discuss molecular basis of diseases arising from neutrophil dysfunction.

### Psychomotor domain:

After completion of this course the students of PhD program will be able to:

1. Develop critical reasoning skills
2. Develop the art of critical analysis of research articles.
3. Synthesize and develop testable hypotheses
4. Design a research study investigating molecular basis of disease.

### Lists of references

* 1. **Course notes:** Class lectures (PPT)
  2. **Recommended books and articles:** 
     1. Post-graduate haematology, Wiley Blackwell, 7th edition (2016)
     2. Moelcular Hematology, Wiley Blackwell, 3rd edition (2010)
  3. **Periodicals, Websites etc**:

Blood, Haematologica, Leukaemia, British Journal of Haematology

## HEM-802 Haematology Practice in Pakistan (2+1)

## Overall aim

The overall aim of the course is to furnish the students with the core scientific knowledge that encompasses pathophysiological, clinical and therapeutic aspects of haematological diseases which impact most heavily on developing world

## Intended learning outcomes (ILOS)

### A. Cognitive domain:

After completion of this course the students will be able to:

1. Discuss the disease processes and its outcomes of iron and vitamins deficiency as a part of malnutrition and replacement therapy. Discuss the potential strategies for reducing prevalence/ incidence of iron deficiency at individual and population levels.
2. Discuss the management of malaria. Also, how to recognize the early signs of complications of malaria and their management.
3. Perform risk-benefit analysis of the available treatment modalities in coagulopathies in Pakistan.
4. Discuss early warning signs of developing cancers/screening and risk prediction models for early diagnosis keeping in view limited resources of developing countries.
5. Discuss clinical, biological and epidemiological characteristics of malignancies more common in developing countries. Discuss the management of malignancies and management of oncological emergencies
6. Discuss the importance of nutritional assessment and intervention. Also discuss key points in care and prevention of infections in haematological malignancies.
7. Nursing care, palliative and supportive therapy for patients with malignancies. Role of psycho-social support and counselling of these patients in context of developing countries.
8. Discuss policy making strategies such as optimization of resources and collaboration with international organizations. Also highlighting the importance of maintaining cancer registries and descriptive epidemiology for haematological malignancies. And highlight the initiatives like twining programs and telemedicine specially in paediatric haematological oncology.

### Practicals :

During this course students will require to do OPD with consultants in Fatimid /HMC and LRH

1. To learn management of patients with most common occurring anaemias in developing countries.
2. To learn management of haematological malignancy patients.
3. To learn management of haemoglobinopathies in context of limited resources in developing countries.

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| **ILO** | MIT | Assessment |
| **Nutritional anaemias:**  Discuss the disease processes and its outcomes of iron and vitamins deficiency as a part of malnutrition and replacement therapy. Discuss the potential strategies for reducing prevalence/ incidence of iron deficiency at individual and population levels. | 4 hours (2+2)    1. Lecture – 2 hour  2. Case discussions in SGD format – 2 hour | MCQs |
| **Infectious diseases**  Discuss the management of malaria. Also, how to recognize the early signs of complications of malaria and their management. | 4 hours (2 + 2)  1. Lectures – 2 hours  2. Case discussion in SGD format – 2 hours | MCQs |
| **Coagulopathies**  Perform risk-benefit analysis of the available treatment modalities in coagulopathies in Pakistan. | 4 hours (2 + 2)  1. Lecture – 2 hour  2. Hospital visit – 2 hours | MCQs |
| **Cancer**  1.Discuss early warning signs of developing cancers/screening and risk prediction models for early diagnosis keeping in view limited resources of developing countries. | 4 hours (2+2)  1. Lecture – 2 hour  2. Clinic – 2 hour | Presentations/ assignments |
| **Cancer Treatment**  Discuss clinical, biological and epidemiological characteristics of malignancies more common in developing countries. Discuss the management of malignancies and management of oncological emergencies. | 4 hours (2+2)  1. Lecture – 2 hour  2. Clinic – 2 hour | MCQs |
| **Nutrition status in cancer in Pakistan**  1.Discuss clinical, biological and epidemiological characteristics of malignancies more common in developing countries. Discuss the management of malignancies and management of oncological emergencies. | 4 hours (2+2)  1. Lecture – 2 hour  2. Clinic – 2 hour  3. Practical – teacher would ask students to write a case history on a patient needing anti-thrombotic agents in the local settings – 2 hours | MCQs |
| **Supportive care in cancer in Pakistan**  Nursing care, palliative and supportive therapy for patients with malignancies. Role of psycho-social support and counselling of these patients in context of developing countries. | 4 hours (2+2)  1. Lecture – 1 hour  2. Case discussions in SGD format – 1 hour  3. Clinic – 2 hours | MCQs |
| **Improving patient care by collaborations**  Discuss policy making strategies such as optimization of resources and collaboration with international organizations. Also highlighting the importance of maintaining cancer registries and descriptive epidemiology for haematological malignancies. And highlight the initiatives like twining programs and telemedicine especially in paediatric haematological oncology. | 4 hours (2+2)  1. Lectures –2 hours  2. Assignment on collaborative research – 2 hours | MCQs |

### **Psychomotor domain:**

After completion of this course students will be able to:

1. Plan a treatment strategy for most common anaemias.
2. Plan a treatment strategy for malaria patients.
3. Predict adverse events in patients on treatment for haematological disorders including malignancies.
4. Interpret laboratory tests that help assess success or failure of treatment.

## HEM-803 Recent advances in Haematology Therapeutic (2+1)

## Overall aims

The overall aim of the course is to furnish the students with the core scientific knowledge of drugs their effects and side effects on blood and controversies in pharmacological agents and therapies used in Haematology.

## Intended learning outcomes (ILOS)

### Cognitive domain:

After completion of this course the students of MPhil leading to PhD program will be able to:

* 1. Discuss the basic principles of iron and vitamins replacement therapy. Discuss the potential strategies for reducing prevalence/ incidence of iron deficiency at individual and population levels.
  2. Discuss the management of iron overload with regards to transfusion dependent thalassaemia. List causes of ineffective iron chelation and discuss strategies to prevent iron overload in patient with beta thalassaemia major.
  3. Classify coagulopathies. Discuss the management in detail. Discuss treatment of coagulopathies in context of developing countries.
  4. Enlist different classes of anti-thrombotics and discuss its pharmacodynamics and pharmacokinetics in detail.
  5. Classify antiplatelet agents and its management and complications
  6. Discuss the types of anti-fibrinolytic agents, its indications for therapy.
  7. Discuss the management of hemorrhagic complications of anti coagulation agents.
  8. Explain in detail the agents used to treat haematological malignancies.
  9. Explain the principles of pharmacotherapy in haematological malignancies
  10. List most common adverse effects of drugs used in treating haematology

### Psychomotor domain:

After completion of this course the students of MPhil leading to PhD program will be able to:

1. Plan a treatment strategy for most common anaemias,
2. Predict adverse events in patients on treatment for haematological disorders including malignancies.
3. Interpret laboratory tests that help assess success or failure of treatment.

## Recommended books and articles:

i. Post-graduate haematology, Wiley Blackwell, 7th edition (2016)

ii. Basic and Clinical Pharmacology, A and L Lange, 13th edition (2015)

iii. Commonly used drugs in haematologic disorders, Elise Anders and Sucha Nand, Elsevier (2014)

Periodicals, **Websites**,..etc:

1. Blood

2. Haematologica

3. Leukaemia

4. British Journal of Haematology

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| --- | --- | --- | --- |
| **ILO** | Content | MIT | Assessment |
| **Nutritional anaemias:**  Discuss the basic principles of iron and vitamins replacement therapy. Discuss the potential strategies for reducing prevalence/ incidence of iron deficiency at individual and population levels. | 1. Nutritional Anaemias overview  2. Principles of therapy  2a. Iron  2b. Vit B12  2c. Folate  3.Route of administration.  4.Dose .  5.Drug/drug interaction.  6.Drug/ food interaction.  7.Hypervitaminosis.  8.Failure of therapy.  9.Combination therapy. | 6 hours (4+2)    1. Lecture – 2 hour  2. Case discussions in SGD format – 2 hour  3. Practical – teacher would ask students to check various iron, Folate and B12 formulations available locally. Read the leaflets and discuss pharmacokinetics, pharmacodynamics, doses and adverse effects. – 2 hours | MCQs |
| **Iron overload**  Discuss the management of iron overload with regards to transfusion dependent thalassaemia. List causes of ineffective iron chelation and discuss strategies to prevent iron overload in patient with beta thalassaemia major. | 1. Definitions of iron overload  2. Complications of iron overload  3. Chelation agents  4. Monitoring of chelation efficacy | 4 hours (2 + 2)  1. Lecures – 2 hours  2. Iron chelation formulations available locally. – 2 hours | MCQs |
| **Coagulopathies**  Classify coagulopathies. Discuss the management in detail. Discuss treatment of coagulopathies in context of developing countries. | 1. Types of coagulation disorders.  2. Presenting symptoms.  3. Coagulation profile and factor assay  4. Management.  5. Fresh Frozen Plasma:dosage.  6. Cryoprecipitate.  7. Immunoglobulin.  8. Recombinant factors.  9.Transfusion reactions and risks.  10. Follow up investigations. | 4 hours (2 + 2)  1. Lecture – 1 hour  2. Case discussions in SGD format – 1 hour  3. Practical – teacher would ask students to check various coagulation factors available locally. Read the leaflets and discuss pharmacokinetics, pharmacodynamics, doses and adverse effects. | MCQs |
| **Antithrombotic**  **Agents**  Enlist different classes of anti-thrombotics and discuss its pharmacodynamics and pharmacokinetics in detail | 1. Heparin  2. Warfarin  3. FXa  4. Direct thrombin inhibitors  5. Formulations  6. Mechanisms of action  7. Indications/ contraindications  8. Adverse effects  9. Management of complications | 6 hours (4+2)  1. Lecture – 2 hour  2. Case discussions in SGD format – 2 hour  3. Practical – teacher would ask students to write a case history on a patient needing anti-thrombotic agents in the local settings | Presentations/ assignments |
| **Anti-platelet**  **agents**  Classify antiplatelet agents and its management and complications. | 1. Aspirin  2. Clopidogrel  3. Abciximab  4. Dipyradamol  5. Formulations  6. Mechanisms of action  7. Indications/ contraindications  8. Adverse effects  9. Management of complications | 6 hours (4+2)  1. Lecture – 2 hour  2. Case discussions in SGD format – 2 hour  3. Practical – teacher would ask students to write a case history on a patient needing anti-thrombotic agents in the local settings – 2 hours | MCQs |
| **Anti-fibrinolytic agents**  Discuss the types of anti-fibrinolytic agents, its indications for therapy. | 1. Amino caproic acid  2. Fibrinogen  3. Transemic acid  4. Formulations  5. Mechanisms of action  6. Indications/ contraindications  7. Adverse effects  8. Management of complications | 6 hours (4+2)  1. Lecture – 2 hour  2. Case discussions in SGD format – 2 hour  3. Practical – teacher would ask students to write a case history on a patient needing anti-thrombotic agents in the local settings – 2 hours | MCQs |
| **Complications of anti-coagulation agents**  Discuss the management of hemorrhagic complications of anti- coagulation agents | 1. Warfarin  2. Heparin  3. Antiplatelet drugs  4. Direct thrombin inhibitors  5. Management of complications  6. Pharmacokinetics  7. Pharmacodynamics | 4 hours (2+2)  1. Lecture – 1 hour  2. Case discussions in SGD format – 1 hour  3. Practical – Perform coagulation assays. Write a report on assays of bleeding and coagulation. | MCQs |
| **Therapeutics in haematological malignancies**  1. Explain in detail the agents used to treat haematological malignancies.  2. Explain the principles of pharmacotherapy in haematological malignancies  3. List most common adverse effects of drugs used in treating haematology | 1. Principles of anti-cancer chemotherapy  2. Classification of anti-cancer chemotherapeutic drugs  - Chemotherapy  - Targeted therapy  - Immunomodulatory therapy  3. Principles of dosing and regimen  4. Treatment in Acute Lymphoblastic Leukaemia  5. Treatment in Acute Myeloid Leukaemia  6. Treatment in Chronic Myeloproliferative neoplasms  7. Treatment in Lymphoproliferative disorders | 12 hours (6+6)  1. Lectures – 6 hours  2. Presentations – 10 minutes each x 6 (2 hours)  3. Morphology sessions – 4 hours | MCQs |

# PHARMACOLOGY DEPARTMENT

(PhD Pharmacology)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

### PHM- 801: TECHNIQUES IN DRUG DESIGNING (2+1)

### PHM- 802: ADVANCES IN PHARMACOKINETICS (1+0)

### PHM- 803: CLINICAL PHARMACOLOGY II (2+0)

### PHM- 804: MOLECULAR PHARMACOLOGY (2+0)

**BMS-807 Teaching rotation (Elective choice) (1+0)**

**No. of credit hours for specialty courses (8+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## PHM- 801: TECHNIQUES IN DRUG DESIGN (2 +1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Understand different challenges in drug discovery
2. Comprehend knowledge and analytical techniques applied to drug development.
3. Analyze the bioactive compounds
4. Know various analytical methods assessing the purity

## Course Contents

1. **Extraction**: Various methods of extractions.
2. **Fractionation:** Give conceptof polarity of organic solvents and fractionation of natural products on the basis of polarity for pharmacological screening.
3. **Separation Techniques:** Need for learning separation techniques, separation techniques in natural product research and drug discovery, extraction techniques.
4. **Chromatography:** General principles, classification of chromatographic techniques, normal and reversed phase, bonded phase chromatography, stationary phases, activity of stationary phases, elutropic series, and separation mechanisms.
5. **Column chromatography**: column packing, sample loading, column development, detection.
6. **Flash chromatography and Vacuum liquid chromatography**: objectives, optimization studies, selecting column and stationary phases, selecting suitable mobile phases, automated flash chromatography, and reverse phase flash chromatography.
7. **High Pressure Liquid Chromatography (HPLC):** Principles, instrumentation, peak shapes, capacity factor, selectivity, plate number, plate height, resolution, band broadening, pumps, injector, detectors, columns, column problems, gradient HPLC, HPLC solvents, trouble shooting, sample preparation, method development.
8. **Gas chromatography:** principles, instrumentation, split-less injector, head space sampling, columns for GC, detectors, quantification.
9. **Biochromatography**: Size exclusion chromatography, ion exchange chromatography, ion pair chromatography, affinity chromatography general principles, stationary phases and mobile phases.
10. **Gas chromatography:** Introduction to GC-MS and LC-MS techniques and their application in natural products.

## Recommended Readings:

1. Applied Thin Layer Chromatography, 2nd edition Elke Hahn Deinstrop
2. Wiley-VCH
3. HPLC Made to Measure: A Practical Handbook for Optimization Stavros Kromidas
4. Wiley-VCH
5. Thin Layer Chromatography: A Modern Practical Approach Practical HPLC method development
6. Lloyd R. Snyder, Joseph J. Kirkland and Joseph L. Glajch John Wiley and Sons
7. Braun RE, (1987) “Introduction to instrumental analysis” McGraw Hill Book Co. NY.
8. Bryant R, (1989) “The pharmaceutical quality control hand book” Aster Pub. Corp. Eugene. USA
9. Pakistan Pharmacopeia, (1973)
10. British Pharmacopeia (1993).
11. USP (1996).
12. Chapman JR, (1986) “Practical organic Mass Spectroscopy” John-Wiley & Sons. NY

## PHM-802- ADVANCES IN PHARMACOKINETICS 1+0 Credit Hrs

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend basic knowledge of pharmacology
2. Comprehend knowledge of pharmacokinetics
3. Discuss the types of adverse drug reactions and outline the process of drug development and approval
4. Comprehend the mechanism of drugs action, bioavailability and excretion
5. Apply knowledge to impact changes that can positively impact basic and clinical research

## Course Contents:

The course contents of this subject include, absorption distribution metabolism and elimination, Mechanism of drug absorption, physiochemical, biological and pharmaceutical factors affecting drug absorption through GIT, Drug disposition**,** Protein and tissue binding, Bioavailability and bioequivalence, Pharmacokinetic characterization of drugs, nonlinear pharmacokinetics, Physiologic pharmacokinetics models

## Recommended Readings:

1. Basic & Clinical Pharmacology by Katzung et al. Latest Ed.
2. Basis of Pharmacology by Goodman & Gillman Latest Ed.
3. Rang & Dale’s Pharmacology by H.P. Rang, M.M. Dale, R.J. Flower. Latest Ed.
4. Lippincott's Illustrated Reviews: Pharmacology by Richard A Harvey, Pamela C. Champe, Richard Finkel, and Luigi X. Cubeddu. Latest Ed.
5. Physicochemical Principles of Pharmacy, Fourth Edition Alexander T. Florence and David Attwood Pharmaceutical press
6. Pharmaceutical Dissolution Testing Jennifer Dressman and Johannes Kramer Taylor and Francis

## Journals:

1. Acta Pharmacologica Sinica
2. Journal of Clinical Pharmacology
3. Biomedicine and Pharmacotherapy
4. European Journal of Pharmacology
5. Teaching and Learning in Medicine
6. British Journals of Clinical Pharmacology
7. Pharmacology, Biochemistry and Behaviour
8. European Journal of Clinical Pharmacology
9. Canadian Journal of Physiology & Pharmacology
10. Clinical and Experimental Pharmacology and Physiology

## PHM: 803 Clinical Pharmacology II 2+0 Credit Hrs

## Course Objectives:

Upon completion of course the students will be able to:

1. Define a clinical trial
2. Define social process and Social change
3. Understand personality and interpersonal skills that may be helpful for understanding patients’ profile, research colleagues’ profile and dynamics of team members of clinical trials
4. Comprehend basic knowledge for carrying out of clinical trials.
5. Know current legislation of PAKISTAN regarding clinical trials and clinical studies
6. Know about the FDA rules and regulations for regulation of a clinical trial.
7. Understand the concept of a clinical trials
8. Design a clinical trial in clinical set up of local environment
9. Apply techniques of extrapolation based on findings of a trial

## Course Contents:

The course contents of this subject include; social processes, social change, interpersonal skills, personal and group dynamics, definition of Clinical trial, types of clinical trial, registration of a clinical trial, regulation of a clinical trials, biasness and how to minimize the biasness, Current legislation of Pakistan related to drug research, FDA rules to regulate clinical research, interpretation of results of a clinical trial and its extrapolation.

## Recommended Readings:

1. Basic & Clinical Pharmacology by Katzung 12th Edn.
2. Basis of Pharmacology by Goodman & Gillman Latest Ed.
3. [Lippincott's Illustrated Reviews: Pharmacology](http://www.amazon.com/Lippincotts-Illustrated-Reviews-Pharmacology-4th/dp/0781771552/ref=sr_1_11?ie=UTF8&s=books&qid=1272267132&sr=1-11) by Richard A Harvey, [Pamela C. Champe](http://www.amazon.com/Pamela-C.-Champe/e/B000APHLSY/ref=sr_ntt_srch_lnk_11?_encoding=UTF8&qid=1272267132&sr=1-11), Richard Finkel, and [Luigi X. Cubeddu](http://www.amazon.com/Luigi-X.-Cubeddu/e/B001IGSJLC/ref=sr_ntt_srch_lnk_11?_encoding=UTF8&qid=1272267132&sr=1-11). Latest Ed.
4. The manuals of Drug Laws
5. SROs on the websites of Drug Regulatory Authority of Pakistan/PM&DC/ Pharmacy Council of Pakistan.
6. The psychology of prejudices and discriminations Living churchil latest edition

## Journals: Acta Pharmacologica Sinica

1. Journal of Clinical Pharmacology
2. [The American Journal of Medicine](http://www.sciencedirect.com/science/journal/00029343)
3. European Journal of Pharmacology
4. Biomedicine and Pharmacotherapy
5. Pharmacology, Biochemistry and Behaviour
6. European Journal of Clinical Pharmacology
7. Canadian Journal of Physiology & Pharmacology
8. Clinical and Experimental Pharmacology and Physiology

## PHM 804 : Molecular Pharmacology 2+0 Credit Hrs

## Course Objectives:

Upon completion of course the students will be able to:

1. Outline various receptor-ligand (drug) interaction models
2. Review the principles of drug metabolism on molecular level
3. Interpret the genetic variations leading to changes in drug metabolism among the group of metabolizers.
4. List different epigenetic mechanisms governing expression of different genes.
5. Identify drugs that act through epigenetic mechanism by lab analyses
6. Review different types of enzymatic reactions exploitable by drug intervention.
7. Evaluate the changes in enzymes activity under various conditions through a defined lab protocol.
8. Compare DNA damages in a lab due to different toxins &/or drugs.
9. Evaluate and characterize anticancer mechanism of drugs.

## Course Content

1. Genomic Regulation of Drug Actions
   1. Introduction to Pharmacogenetics and Personalized medicine
   2. Genetic basis of drug response and roles of single nucleotide polymorphisms, copy number variation, tandem repeat polymorphisms; gene insertion and deletion; gene duplications; alternative splicing & their effects on drug
   3. Drug Metabolism affected by polymorphisms in Cytochrome P450 isoforms.
2. Drugs Acting Through Epigenetic Mechanisms
   1. Fundamentals of Epigenetics
   2. Examples of Drugs Acting Through Epigenetic Mechanisms
3. Signal Transduction and Modulation
   1. Types of Secondary Messengers
   2. Types of Receptors including
   3. Regulation of inter and intra cellular signalling
4. Molecular Pharmacology of Enzymes
   1. Types of Enzymes on the basis of their mechanism of action
   2. Effects of different drugs on enzyme function
5. Pharmacology of Transcription and Translation
   1. Different types of post-transcriptional and translational modifications.
   2. Induction and inhibition of gene expression
   3. Intervention at post-translational levels by modulating protein kinases and phosphatases
6. Regenerative medicine and gene therapy
   1. Stems cells, their classification and features
   2. Stem cell-based drugs
   3. Cell therapy and regenerative medicine
   4. Gene therapy protocols and role in treatment of monogenic disorders
7. Mitochondrial medicine
   1. Principles of mitochondrial homeostasis
   2. Drugs targeting mitochondrial channels and metabolism
8. Techniques in Molecular Pharmacology
   1. Single Nucleotide Polymorphisms (SNPs) Genotyping
   2. Protocols for Evaluation of Enzyme Activity
   3. Protein Separation and Purification
   4. DNA Damage Assays
   5. Anticancer Drug Testing & its Molecular Basis

## Recommended Readings:

1. Clementi, Francesco, and Guido Fumagalli, eds. General and Molecular Pharmacology: Principles of Drug Action. John Wiley & Sons, 2015.
2. Molecular Pharmacology: From DNA to Drug Discovery by John Dickenson, Fiona Freeman, Chris Lloyd Mills and Christian Thode
3. Novel Anticancer Drug Protocols (Methods in Molecular Medicine) by John K. Buolamwini and Alex A. Adjei
4. Molecular Analysis and Genome Discovery by Ralph Rapley and Stuart Harbron
5. High Throughput Screening: Methods and Protocols (Methods in Molecular Biology) (Methods in Molecular Biology). by William P. Janzen
6. Molecular Similarity in Drug Design by P.M. Dean.
7. Basis of Pharmacology by Goodman & Gillman Latest Ed.
8. [Lippincott's Illustrated Reviews: Pharmacology](http://www.amazon.com/Lippincotts-Illustrated-Reviews-Pharmacology-4th/dp/0781771552/ref=sr_1_11?ie=UTF8&s=books&qid=1272267132&sr=1-11) by Richard A Harvey, [Pamela C. Champe](http://www.amazon.com/Pamela-C.-Champe/e/B000APHLSY/ref=sr_ntt_srch_lnk_11?_encoding=UTF8&qid=1272267132&sr=1-11), Richard Finkel, and [Luigi X. Cubeddu](http://www.amazon.com/Luigi-X.-Cubeddu/e/B001IGSJLC/ref=sr_ntt_srch_lnk_11?_encoding=UTF8&qid=1272267132&sr=1-11). Latest Ed.

## Journals:

1. The Annals of Pharmacotherapy
2. Basic Clinical Pharmacology
3. Biochemical Pharmacology
4. Biomedical Pharmacotherapy
5. British Journal of Pharmacology
6. Clinical and Experimental Pharmacology and Physiology
7. Clinical Pharmacology & Therapeutics
8. Current Opinion in Pharmacology
9. European Journal of Pharmacology
10. International Journal of Immunopharmacology
11. International Journal of Pharmaceutics
12. International Journal of Pharmacology
13. Expert Opinion in Pharmacology
14. Journal of Clinical Pharmacology
15. Journal of Pharmacy and Pharmacology
16. Journal of Pharmaceutical and Biomedical Analysis
17. Molecular Pharmaceutics
18. Pharmacogenomics
19. Pharmacogenetics and Genomics
20. Pharmacogenomics Journal
21. Pharmacogenomics Magazine
22. Pharmacological Reports
23. Pharmacological Research
24. Pharmacology Reviews
25. Pharmacology & Therapeutics
26. Trends in Pharmacological Sciences

# PHYSIOLOGY DEPARTMENT

(PhD Physiology)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

### PHY- 801: Endocrinology II (1+1)

### PHY- 802: Respiration, Sports and Cardiovascular Physiology (2+1)

### PHY- 803: Advanced Neurobiology (in accordance with ANA 803) (2+1)

**BMS-807 Teaching rotation (Elective choice) (1+0)**

**No. of credit hours for specialty courses (8+1)**

**OPTIONAL COURSE**

**PHY -804: Diabetology (1+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

PHYSIOLOGY

## PHY 801: Endocrinology II Credit Hrs (1+ 1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the classification of endocrine glands, their functions and feedback control

Mechanisms

2. Use the equipment in a physiology research laboratory e.g ELISA, western blot, PCR

## Course Contents:

General principles (classification, mechanism of action and feedback control), transport,

metabolism, actions and control of secretion of the Endocrine system;

Detail discussion about physiology of Pituitary, thyroid, adrenal, Pancreas, Parathyroid glands and associated hormones.

Pathophysiology and associated disease of hormones related to Pituitary, thyroid, adrenal, Pancreas and Parathyroid glands

## Recommended Readings:

1. Benjamin Cummings: Interactive Physiology 10-System Suite. Benjamin-Cummings Publishing

Company, Subs of Addison Wesley Longman, Inc. Latest Ed.

2. Best and Taylor: Text Books of Physiology Latest Ed.

3. Cindy L. Stanfield: Principles of Human Physiology. Benjamin Cummings, Latest Ed.

4. Dee Undglaub Silverthorn: Human Physiology: An Integrated Approach. Benjamin Cummings, Latest

Ed.

5. Ganong WF: Review of Physiology Latest Ed.

6. Guyton AC: Textbook of Physiology Latest Ed.

7. Samson Wright’s Applied Physiology

8. Board Review Series Latest Ed

## Journals:

1. APS Journals: Endocrinology and Metabolism

2. APS Journals: Physiological Reviews

3. Canadian Journal of Applied Physiology Reviews

4. European Journal of Applied Physiology

5. Journal of Applied Physiology

6. Pakistan Journal of Physiology

7. Physiology

8. The Journal of Physiology

## PHY 802: Respiration, Sports and Cardiovascular Physiology (2+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the basic structure and function of heart, ECG recording and interpretation
2. Understand haemodynamics and respiratory adjustments under resting and exercising conditions
3. Understand physiological principles to manage a person in shock due to various reasons
4. Comprehend organization of respiratory tract and lungs.
5. Comprehend the mechanism of breathing and respiration
6. Discuss disorders of the blood, CVS and respiratory system
7. Comprehend Physiological re-adjustments of body systems during exercise
8. Comprehend the bodily effects of exercise
9. Discuss physiological principles of muscle wasting and disuse atrophy
10. Human investigation and hands on training of exercise tolerance test (ETT), ECG, Exercise Physiology, calculation of body composition, Ultrasonography

Interpret the results and draw inference

## Course Contents:

Physiology of cardiac muscle, Conductive system of the heart, Cardiac cycle, Regulation of cardiac function, ECG Recording and interpretation, Recognition of changes in ECG during different pathological conditions, Cardiac output and its regulation, Heart sounds and murmurs, Blood pressure and its regulation, Cardiovascular regulation during exercise, Coronary circulation; Organization of respiratory tract, Mechanics of breathing, Lung volumes and capacities, Dead space and lung compliance, Respiratory membrane and diffusion of gases, Transport of gases, Regulation of respiration, Respiratory adjustment during exercise, Non-respiratory function of respiration, Hypoxia and Cyanosis.

Physiology of Exercise and changes in various body systems during exercise, Cardiovascular and respiratory re-adjustments during exercise; body-building and disuse atrophy

Exhibit attitude towards research on human volunteers and ethical aspects

Study of various equipment in a physiology research laboratory, using the modern equipment like PowerLab®, Physiographs, Spirometry, blood gas analysis, treadmill exercise experiments, ECG recording in resting and exercise, Exercise Physiology, calculation of body composition, Ultrasonography,

Interpret the results and draw inference

## Recommended Readings:

1. Benjamin Cummings: Interactive Physiology 10-System Suite. Benjamin-Cummings Publishing

Company, Subs of Addison Wesley Longman, Inc. Latest Ed.

2. Best and Taylor: Text Books of Physiology Latest Ed.

3. Cindy L. Stanfield: Principles of Human Physiology. Benjamin Cummings, Latest Ed.

4. Dee Undglaub Silverthorn: Human Physiology: An Integrated Approach. Benjamin Cummings, Latest

Ed.

5. Ganong WF: Review of Physiology Latest Ed.

6. Guyton AC: Textbook of Physiology Latest Ed.

7. Samson Wright’s Applied Physiology

8. West JB: Respiratory Physiology–The essentials

9. Board Review Series Latest Ed

## Journals:

1. APS Journals: Heart and Circulatory Physiology

2. APS Journals: Lung Cellular and Molecular Physiology

3. Canadian Journal of Applied Physiology Reviews

4. European Journal of Applied Physiology

5. Journal of Applied Physiology

6. Pakistan Journal of Physiology

7. The Journal of Physiology

## PHY 803: Advanced Neurobiology (in accordance with ANA 803) (2+1)

## Course Objectives:

Upon completion of course the students will be able to comprehend:

1. Functions of cells, cell membranes and its organelles
2. Membrane potential, mechanism of action of nerves and muscles
3. Parts of central and peripheral nervous system and their physiology
4. knowledge of autonomic nervous system
5. Comprehend ethical considerations in using animals or Humans for research experiments
6. Practical handling of animals for research
7. Doing investigations and tests on humans participating in research
8. Animal handling training
9. Prepare an animal model for research
10. Exhibit attitude towards research on human volunteers and ethical aspects

## Course Contents:

The course will include: Physiology of cell, cell organelles and cell membranes, membrane potential, action potential.

Structure and functions of nerve and muscle, neuromuscular transmission, contraction of muscles, neuromuscular blockers, tetanization, fatigue, pathophysiology of skeletal system

Structure and functions of nerve, nervous system, synapse and synaptic transmission, types and functions of sensory receptors, organization and functions of spinal cord and reflexes, ascending and descending tracts, muscle spindle and normal muscle tone, functions of thalamus, structure and functions of Cerebral Cortex, Cerebellum, Classification and functions of Basal Ganglia, Hypothalamus and Limbic system, Intellectual functions of Brain, Autonomic nervous system; physiology of sleep, memory and epilepsy; Physiology of smell, taste, hearing and vision, optics of vision, errors of refraction and their correction, colour vision, hearing tests; pathophysiology of the nervous system and special senses.

Animal handling training

Prepare an animal model for research

Exhibit attitude towards research on human volunteers and ethical aspects

Animal preparation and experiments on laboratory animals, maintenance of animal house; Routine physiology experiments on animals and humans.

Study of various equipment in a physiology research laboratory, using the modern equipment like PowerLab®, Physiographs, use of transducers, hearing tests on audiograph, tuning fork tests, Nerve conduction, muscle strength

Interpret the results and draw inference

## Recommended Readings:

1. Benjamin Cummings: Interactive Physiology 10-System Suite. Benjamin-Cummings Publishing

Company, Subs of Addison Wesley Longman, Inc. Latest Ed.

2. Best and Taylor: Text Books of Physiology Latest Ed.

3. Cindy L. Stanfield: Principles of Human Physiology. Benjamin Cummings, Latest Ed.

4. Dee Undglaub Silverthorn: Human Physiology: An Integrated Approach. Benjamin Cummings, Latest

Ed.

5. Ganong WF: Review of Physiology Latest Ed.

6. Guyton AC: Textbook of Physiology Latest Ed.

7. Samson Wright’s Applied Physiology

8. Board Review Series Latest Ed

## Journals:

1. APS Journals: Cell Physiology

2. APS Journals: Journal of Neurophysiology

3. Canadian Journal of Applied Physiology Reviews

4. Cellular Physiology and Biochemistry

5. European Journal of Applied Physiology

6. Journal of Applied Physiology

7. Pakistan Journal of Physiology

8. The Journal of Physiology

## PHY 804: Diabetology (1+1)

## Course Objective

Upon completion of the course student will be able to comprehend

Metabolic abnormalities in relation to glucose, lipids and protein metabolism. Diabetes mellitus and its types. Glucose and insulin regulation. Clinical assessment of disease and monitoring of progress

## Course Content

Diabetes mellitus and its types. Metabolic abnormalities of glucose, carbohydrate and protein metabolism. Regulation of glucose and insulin. Glucose and insulin response curves. First phase insulin response.

Management of diabetes in relation to treatment and cure. Progression of diabetes and its complications and its monitoring and management. Interpretation of tests related to diabetes.

# MOLECULAR BIOLOGY AND GENETICS DEPARTMENT

(PhD Molecular biology and genetics)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

### MBG-801 Advances in Medical Genetics (2+1)

### MBG-802 Computational biology –II (2+1)

### MBG-803 Molecular Genetics of Microbes (2+1)

**No. of credit hours for specialty courses (9)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## MBG-801 Advances in Medical Genetics (2+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the language of genetics and the terminology of molecular biology
2. Have an understanding of the role of genetics in diseases and disorders
3. Know how to operate various screening and diagnostic technologies in genetic diseases
4. Have knowledge of gene therapy and genetic counselling

## Course Contents:

1. Fundamentals of Genetics
2. The Cellular and Molecular Basis of Inheritance
3. Developmental Genetics
4. Transmission Genetics
5. Polygenic and Multifactorial Inheritance
6. Genetics of Behavior
7. Gene Mutations
8. Genetics in Medicine:
9. Hemoglobin & the Hemoglobinopathies
10. Biochemical Genetics; Immunogenetics
11. Cancer Genetics
12. Genetic Factors in Common Diseases
13. Clinical Genetics:
14. Congenital Abnormalities and Dysmorphic Syndromes
15. Genetic Counseling
16. Chromosomal Disorders
17. Single-Gene Disorders
18. Genetic Technologies
19. Screening for Genetic Diseases
20. Prenatal Testing and Reproductive Genetics
21. The Human Genome Project
22. Gene Therapy
23. Ethical and Social Issues.
24. Contemporary topics in molecular medicine
25. Applications of r-DNA technology in Fetal and Neonatal Medicine
26. Medical Microbiology
27. Medical Oncology
28. Therapeutics and Forensic Medicine
29. Molecular and genetic etiology of human disease like asthma, heart failure; hyperlipidemia, thrombopoiesis; diabetes.

## Recommended Books:

1. Human Genetics: Concepts and Applications. Ricki Lewis, McGraw Hill, Latest Ed.
2. Medical Genetics: Jorde, LB, Carey JC, Bamshad MJ, White RL. Mosby, Latest Ed.
3. EMERY’s s Elements of Medical Genetics PD Turnpenny and S Ellard Elsevier Churchill Livingstone, Latest Ed.
4. Molecular Medicine: An Introductory Text. RJ Trent; Churchill Livingstone, Latest Ed.
5. Science and Medicine Latest Ed.

## MBG-802 Computational Biology-II (2+1)

## Course Contents:

1. Introduction to bioinformatics
2. Introduction to Data generation
3. Tools, databases and software used in Bioinformatics
4. Applications of Bioinformatics
5. Biological Database and its Types
   1. Literature (Pubmed, Googlescholar etc)
   2. Nucleic acid databases (NCBI, DDBJ, and EMBL)
   3. Protein databases (Primary, Composite, and Secondary)
   4. Specialized Genome databases: (SGD, TIGR, and ACeDB)
   5. Structure databases (CATH, SCOP, and PDBsum)
   6. Metabolic pathway database (KEGG pathway database)
6. Data storage and retrieval
7. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt)
8. Introduction to Sequences and alignments
   1. SEQUENCE ANALYSIS
   2. Sequence Alignments and Visualization
   3. FASTA and BLAST
   4. Local alignment, Global alignment, Pairwise alignment, Multiple sequence alignment
   5. Translating DNA into proteins
   6. Tools used for Alignments
9. Genomics: Proteomics and Metabolomics
10. Microarray
11. MICROARRAY DATA NORMALIZATION
12. MICROARRAY DATA ANALYSIS
13. MICROARRAY APPLICATIONS
14. EXPRESSION ANALYSIS
15. EVOLUTIONARY TRESS AND PHYLOGENY
16. Evolutionary Trees, Types and tools used to calculate.
17. Concepts of trees- Distance matrix methods, Character based methods.
18. UPGMA, NJ and small parsimony trees
19. Protein Databases
    1. Protein secondary and tertiary structure databases: PDB, HSSP, FSSP, CATH, SCOP
    2. Motif and Domain: Motif databases and analysis tools
    3. Domain databases (CDD, SMART, ProDom) and Analysis tools.
20. Proteins Structure prediction and analysis
    1. Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED,
    2. J-Pred
    3. Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition, Ab-intio Method
21. RNA Structure prediction and analysis
    1. Structural features of RNA: Primary, Secondary, Tertiary.
    2. Introduction to RNA Secondary structure prediction
    3. Methods for RNA Secondary structure prediction
    4. Limitation of RNA Secondary structure prediction
22. Computer aided drug design
    1. Chemoinformatics: Cheminformatics tools for drug discovery.
    2. Chemical Structure Representation (SMILE & SMART).
    3. Chemical databases: CSD, ACD, WDI, ChemBank, hazardous chemical database,
    4. PUBCHEM. Zinc, drugbank, chemspider
    5. Quantitative Structure Activity Relationship (2D & 3D).
    6. Combinatorial libraries & their design.
    7. High throughput screening, virtual screening, Lipinski's rule of five.
    8. Drug Discovery and design : Target identification , Target Validation , Lead Identification ,lead optimization , preclinical Pharmacology & Taxology.
    9. Docking Methods:Introduction, Docking and scoring, Application in the drug design
    10. absorption, distribution, metabolism, and excretion (ADME) property prediction,
    11. computer based tools for drug design.

## MBG-803 Molecular Genetics of Microbes (2+1)

## Course Objectives:

* Students will gain a sense of the role of genetics in defining biological phenomena through the study of systems where genetics uncovered new processes and/or mechanisms.
* Students will come to understand how the level of understanding of a biological process increases by using a historical approach to study classical systems of gene regulation in bacteria.
* Students will observe and learn the essentiality of the development of methods, e.g., those of bacterial genetics, recombinant DNA, and molecular genetics, in the ever-increasing depth of understanding of biological processes, using mechanisms of gene regulation as the model.

## Course Contents:

* Introduction to the genetics of microbes’ genomes
* Mechanisms behind stability and change in microbial genomes.
* Mutations; genetic analysis in bacteria;
* Mechanisms behind the information flow from DNA to proteins and the multiple levels at which gene expression can be regulated.
* Genetic aspects of extrachromosomal elements such as bacteriophages and plasmids.
* . mobile genetic elements
* Genetics and evolution of viruses of eukaryotes.
* Methods and techniques used in molecular and microbial genetics.

# MICROBIOLOGY DEPARTMENT

(PhD Microbiology)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**MIC 801: Advances in Bacteriology (2+1)**

**MIC 802: Advances in Virology (1+1)**

**MIC 803: Advances in Immunology (1+1)**

**MIC 804: Advances in Parasitology and Mycology (1+1)**

**No. of credit hours for specialty courses (8+1)**

**OPTIONAL COURSES**

**MIC 805: Advanced molecular techniques (1+1)**

**MIC 806: Advances in cytology and cell signaling (1+1)**

**MIC 807: Advanced Microscopy (1+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

## MIC 801: Advances in Bacteriology (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the basic knowledge of bacterial cell structure, function, classification, morphology and genetic makeup of bacteria
2. Describe how the molecular mechanisms involved in bacterial infections and development of resistance to antibiotics in certain bacterial species
3. Describe the diversity and organization of systematic bacterial pathogens and their interactions with host at molecular level.
4. Comprehend various systemic bacterial infections of the host including skin, enteric, respiratory, nervous system, cardiovascular system and Genito-urinary system.
5. Discuss the molecular mechanisms involved in infection and spread of bacteria, rickettsia and chlamydia and comprehend the animal- human interface of diseases.
6. Have command on various techniques used in molecular bacteriology lab.

## Course Contents:

The course contents of this subject include: Principles of medical bacteriology including molecular mechanism involved in bacterial cell physiology, growth, spread and disease causation. The molecular mechanism involved in maintenance of normal flora of body organs and bacterial pathogenesis, molecular mechanism of developing resistance. The course will also include the molecular methods in lab diagnosis of bacterial diseases, development of antimicrobial agents and vaccines against different diseases. The bacterial and human interactions will be studied at molecular level including their genetic makeup and their genetic association with the development of resistance to the available antibiotics. The course will also include molecular mechanism involved in different systematic pathogens and their association with the community i.e. tuberculosis, pneumonia enteric diseases, skin infections and other high virulence bacteria which may produce toxins and outbreaks.

## Recommended readings:

1. Medical Microbiology by Greenwood D, R Slack, J Peutherer Latest Ed Churchil Livingstone.
2. Medical Microbiology by Mims, Dockrell, Goering, Roitt, Wakelin, Zuckerman Latest Ed. Elsevier.
3. Color Atlas and Text book of Diagnostic Microbiology by Koneman, Allen, Janda, Schreckenberger, Winn Jr. Latest Ed. Lippincott Williams & Wilkins.
4. Manual of Clinical Microbiology, Latest Ed. by Murray, Baron, Pfaller, Tenover, Yolken, ASM Press USA.
5. Foundations in Microbiology by Talaro and Talaro, WCB. Latest Ed
6. Microbiology and Immunology by Jawetz, Lewinson Latest Ed
7. Cheesbrough, M. Latest Ed Medical Laboratory Manual for Tropical Countries. Microbiology, tropical health technology, Butterworth and Co (pubs) Ltd, Borough Green, Sevenonaks, Kent TN15 8PH.
8. Kingsbury, D. T., and G. E. Wagner. Microbiology. Latest Ed, Williams and Wilkins, Baltimore
9. Mendel, G. L., R. G. Douglas, J. E. Bennett, Latest Ed. Principles and Practice of Infectious Disease. Churchill Living stone Inc,
10. Park, J. E. Latest Ed Park’s textbook of Preventive and Social Medicine. M/S Banarsides Bhanot (pub), 1167, Prem Nagar, Jabalpur, 4820021, India.

**Journals:**

1. Nature Reviews Microbiology
2. Archives and Microbiology
3. Cellular Immunology
4. Cellular Microbiology
5. Critical Reviews in Microbiology
6. Journal of Molecular Microbiology and Biotechnology
7. Journal of Microbiological Methods
8. BMC infectious diseases
9. Microbial pathogenesis
10. Journal of bacteriology
11. Journal of bacteriology and Mycology
12. International journal of bacteriology
13. Trends in bacteriology

## MIC 802: Advances in virology (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend basic knowledge of structure and function of virus and its classification.
2. Know the molecular mechanisms involved in viral infections and development of genetic resistance by creating different strains of viruses.
3. Know the diversity and organization of systematic viral pathogens and their interactions with host at molecular level.
4. Comprehend various systemic viral infections of the host including those spread through blood, enteric, respiratory, nervous system, cardiovascular system and Genito-urinary system.
5. Know the molecular mechanisms involved in infection and spread of different medically important viruses and comprehend the animal- human interface of viral diseases.
6. Have full command on various techniques used in diagnostic molecular virology lab.

## Course Contents:

The course contents of this subject include: Principles of medical virology including molecular mechanism involved in viral life cycle and replication, spread and disease causation. The molecular mechanisms involved in viral pathogenesis and the development resistance. The course will also include the molecular methods in lab diagnosis of different viral diseases, development of antiviral agents and vaccines. The viral diseases spreading from animals to humans will also be studied at molecular level including viral genetic makeup and their genetic association with the development of resistance to the available antibiotics. The course will also include molecular mechanism involved in different systematic viral pathogens and their association with the community i.e. Hepatitis, HIV Aids and other sexually transmitted virus, Cancer causing viruses and other medically important viruses which may cause outbreaks. The course will also include antiviral therapy and antiviral drug development.

## Recommended readings:

1. Medical Microbiology by Greenwood D, R Slack, J Peutherer Latest Ed Churchil Livingstone.
2. Medical Microbiology by Mims, Dockrell, Goering, Roitt, Wakelin, Zuckerman Latest Ed. Elsevier.
3. Color Atlas and Text book of Diagnostic Microbiology by Koneman, Allen, Janda, Schreckenberger,
4. Winn Jr. Latest Ed. Lippincott Williams & Wilkins.
5. Manual of Clinical Microbiology, Latest Ed. by Murray, Baron, Pfaller, Tenover, Yolken, ASM Press
6. Foundations in Microbiology by Talaro and Talaro, WCB. Latest Ed
7. Microbiology and Immunology by Jawetz, Lewinson Latest Ed
8. Cheesbrough, M. Latest Ed Medical Laboratory Manual for Tropical Countries. Microbiology, tropical health technology, Butterworth and Co (pubs) Ltd, Borough Green, Sevenonaks, Kent TN15 8PH.
9. Kingsbury, D. T., and G. E. Wagner. Microbiology. Latest Ed, Williams and Wilkins, Baltimore
10. Mendel, G. L., R. G. Douglas, J. E. Bennett, Latest Ed. Principles and Practice of Infectious Disease. Churchill Living stone Inc,
11. Park, J. E. Latest Ed Park’s textbook of Preventive and Social Medicine. M/S Banarsides Bhanot (pub), 1167, Prem Nagar, Jabalpur, 4820021, India.

**Journals:**

1. Advances in Virus Research
2. Journal of virology
3. Nature Reviews Microbiology
4. Archives and Microbiology
5. Cellular Microbiology
6. Critical Reviews in Microbiology
7. Journal of Molecular Microbiology and Biotechnology
8. Journal of Microbiological Methods

## MIC 803: Advances in Immunology (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the basic knowledge and organization of immune system and its components at molecular level.
2. Know the molecular mechanism involved in microbial immunology and host responses against different pathogens.
3. Know the molecular mechanism involved in development and function PAMPs and DAMPs, antigen and antibody, TLRs and NLRs, interleukin and interferon.
4. Know the molecular mechanisms involved in various immunes system disorders, their causes and impact on the host.
5. Know the molecular mechanisms involved in the development of inflammation, allergy, auto immunity and immunodeficiency in response to different microbial pathogens.

## Course Contents:

The course contents of this subject include:

The structure, organization, functions and molecular mechanisms involved in maintenance of the immune system. The molecular mechanisms involved in cell signalling i.e. structure, types and molecular interactions of antigens and antibodies, pathogen associated molecular patterns (PAMPs) and danger associated molecular patterns (DAMPs), Toll-like receptors (TLRs) and Nod-like receptors (NLRs), interleukin and interferon. Molecular mechanisms involved in inflammation, humoral and cell- mediated immunityand the associated activity of complement system during microbial infection**.** Molecular mechanism involved in the development of immune system disorders,Allergy and hypersensitivity, autoimmunity and Immunodeficiency.

## Recommended readings:

1. Medical Microbiology by Greenwood D, R Slack, J Peutherer Latest Ed Churchil Livingstone.
2. Medical Microbiology by Mims, Dockrell, Goering, Roitt, Wakelin, Zuckerman Latest Ed. Elsevier.
3. Color Atlas and Text book of Diagnostic Microbiology by Koneman, Allen, Janda, Schreckenberger, Winn Jr. Latest Ed. Lippincott Williams & Wilkins.
4. Manual of Clinical Microbiology, Latest Ed. by Murray, Baron, Pfaller, Tenover, Yolken, ASM Press USA.
5. Foundations in Microbiology by Talaro and Talaro, WCB. Latest Ed
6. Microbiology and Immunology by Jawetz, Lewinson Latest Ed
7. Cheesbrough, M. Latest Ed Medical Laboratory Manual for Tropical Countries. Microbiology, tropical health technology, Butterworth and Co (pubs) Ltd, Borough Green, Sevenonaks, Kent TN15 8PH.
8. Kingsbury, D. T., and G. E. Wagner. Microbiology. Latest Ed, Williams and Wilkins, Baltimore
9. Mendel, G. L., R. G. Douglas, J. E. Bennett, Latest Ed. Principles and Practice of Infectious Disease. Churchill Living stone Inc,
10. Park, J. E. Latest Ed Park’s textbook of Preventive and Social Medicine. M/S Banarsides Bhanot (pub), 1167, Prem Nagar, Jabalpur, 4820021, India.

**Journals:**

1. Nature Reviews Immunology

2. Cellular Immunology

3. Clinical and Experimental Immunology

4. Nature Reviews Microbiology

5. Archives and Microbiology

6. Cellular Microbiology

7. Critical Reviews in Microbiology

8. Journal of Molecular Microbiology and Biotechnology

9. Journal of Microbiological Methods

## MIC 804: Advances in Parasitology and Mycology (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the basic knowledge, structural organization and genetic makeup of medically important parasites and fungi.
2. Know the molecular mechanisms involved in parasitic and fungal infections and development of resistance to conventional therapies.
3. Know the diversity and organization of general and systematic parasitic and fungal pathogens and their interactions with host at molecular level.
4. Comprehend various systemic parasitic and fungal infections of the host including skin, enteric, respiratory, nervous system, and genito-urinary system.
5. Comprehend the molecular mechanism involved in different opportunistic infections of parasites and fungi.
6. Know the molecular mechanisms involved in infection and spread of different parasites and fungi at animal- human interface.
7. Have full command on various techniques used in molecular parasitology and mycology.

## Course Contents:

The course contents of this subject include:

Principles of medical parasitology and mycology including molecular mechanism involved in cellular physiology, growth, spread and disease causation. The molecular mechanism involved in maintenance of normal flora of body organs and parasitic and fungal pathogenesis and molecular mechanism of developing resistance. The course will also include the molecular methods in diagnosis of parasitic and fungal diseases, their pathogenesis in normal and immunocompromised host. The course will also include the development of anti-helminthic and antifungal drugs and vaccines against different diseases. Parasitic and fungal interaction with their human host will be studied at molecular level including their genetic makeup and their genetic association with the development of resistance to the available therapies. The course will also include molecular mechanism involved in different systematic manifestations of parasitic and fungal infections and their association with the community and any outbreaks.

## Recommended readings:

1. Medical Microbiology by Greenwood D, R Slack, J Peutherer Latest Ed Churchil Livingstone.
2. Medical Microbiology by Mims, Dockrell, Goering, Roitt, Wakelin, Zuckerman Latest Ed. Elsevier.
3. Color Atlas and Text book of Diagnostic Microbiology by Koneman, Allen, Janda, Schreckenberger, Winn Jr. Latest Ed. Lippincott Williams & Wilkins.
4. Manual of Clinical Microbiology, Latest Ed. by Murray, Baron, Pfaller, Tenover, Yolken, ASM Press USA.
5. Foundations in Microbiology by Talaro and Talaro, WCB. Latest Ed
6. Microbiology and Immunology by Jawetz, Lewinson Latest Ed
7. Cheesbrough, M. Latest Ed Medical Laboratory Manual for Tropical Countries. Microbiology, tropical health technology, Butterworth and Co (pubs) Ltd, Borough Green, Sevenonaks, Kent TN15 8PH.
8. Kingsbury, D. T., and G. E. Wagner. Microbiology. Latest Ed, Williams and Wilkins, Baltimore
9. Mendel, G. L., R. G. Douglas, J. E. Bennett, Latest Ed. Principles and Practice of Infectious Disease. Churchill Living stone Inc,
10. Park, J. E. Latest Ed Park’s textbook of Preventive and Social Medicine. M/S Banarsides Bhanot (pub), 1167, Prem Nagar, Jabalpur, 4820021, India.

## Journals:

1. Nature Reviews Microbiology
2. Archives and Microbiology
3. Cellular Microbiology
4. Critical Reviews in Microbiology
5. Journal of Molecular Microbiology and Biotechnology
6. Medical Mycology
7. Nature Reviews Microbiology
8. Archives and Microbiology
9. Cellular Microbiology
10. Critical Reviews in Microbiology
11. Journal of Molecular Microbiology and Biotechnology
12. Journal of Microbiological Methods

## MIC 805: Advanced research techniques (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend the basic knowledge and lab techniques involved in cell signaling, genomics and proteomics.
2. Comprehend the principles of research techniques used in Microbiology and microbial immunology
3. Have an understanding of the application of various techniques used in research
4. Know how to conduct experiment using research techniques
5. Have knowledge of qualitative and quantitative research techniques in microbiology

## Course Contents:

The course contents will include: Introduction to qualitative and quantitative research techniques, Principle, steps and reagents used in primary cell culture and cell lines, advanced staining procedures including immune-staining, basic and advanced microscopy including confocal microscopy, principles and application of Flow cytometry, Principles, steps and reagents used in PCR, detection and interpretation of results in Real Time PCR, ELISA, Western Blotting, Southern blotting, Cloning, Northern Blotting,, Spectrophotometry, Chromatography, HPLC, Oligo-designing, Phylogenetic tools and techniques.

## Recommended Books:

1. Series: Methods in Microbiology- Elsevier
2. Molecular Medicine: An Introductory Text. RJ Trent; Churchill Livingstone, Latest Ed.
3. Science and Medicine Latest Ed.
4. Any other book recommended by instructor(s)

## Journals:

1. Journal of Microbial methods-Elsevier
2. [Bioscience Methods | A Bioscience Publishing Platform](https://www.google.com.pk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjFiJDu6q_JAhWEo5QKHQ8vBycQFggkMAE&url=http%3A%2F%2Fbm.biopublisher.ca%2F&usg=AFQjCNHlPRnVSdW_8WcYdA9LPheztQ0QiA&bvm=bv.108194040,d.dGo)
3. [Bioscience Protocols and Methods](https://www.google.com.pk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwjFiJDu6q_JAhWEo5QKHQ8vBycQFggqMAI&url=http%3A%2F%2Flibguides.mit.edu%2Fprotocols&usg=AFQjCNFrUkmFwefbLZqthiCcqr7tqEjGlg&bvm=bv.108194040,d.dGo)
4. [International Journal of Research in BioSciences (IJRBS)](https://www.google.com.pk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiszKeo66_JAhWIipQKHZ8TDwcQFggaMAA&url=http%3A%2F%2Fwww.ijrbs.in%2F&usg=AFQjCNGpMeP3m9H14UjauzsfHzIABT9vsQ&bvm=bv.108194040,d.dGo)
5. [International Journal of Current Research in Biosciences](https://www.google.com.pk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwiszKeo66_JAhWIipQKHZ8TDwcQFgg9MAU&url=http%3A%2F%2Fwww.ijcrbp.com%2F&usg=AFQjCNFRQR_dO7nlEh86TeoUPjVnd1u93g&bvm=bv.108194040,d.dGo)
6. Any other journal recommended by instructor(s)

## MIC 806: Cell culture and cell signaling (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend in details the cell signaling and cell culture (Primary and cell line)

2. Know the methods of cell transfection, cell electroporation and molecular mechanisms involved in cell signaling and proteomics

3. Know the standard mechanisms involved in primary cell generation and cell lines

4. Have expertise in using primary cells and cell lines in basic medical research including microbiology, virology, immunology, and cancer research

## Course Contents:

The course contents will include;

Introduction to cell and eukaryotic cell culture, the molecular basis of cell life in vitro, freeze thawing of the eukaryotic cell lines and their cell culture. Generation of primary human and murine cells including Macrophages, Dendritic cells and epithelial cells. Extraction of different hematological cells and their use for experimentation. Studying different sticky and non-sticky cells and their growing condition. The course will also include: Cell signaling (which is a communication process that governs basic activities of cells and coordinates all cell action). Including their microenvironment, issue repair, and immunity as well as normal tissue homeostasis, errors of signaling including cancer, autoimmunity, and diabetes.

All different types of cell signaling based on mechanical and biochemical methods i.e.

**Intracrine** (signals produced by the target cell and stay within the target cell).

**Autocrine (**signals produced by the target cell, are secreted, and affect the target cell itself via receptors).

**Juxtacrine** (signals target adjacent cells).

**Paracrine (**signals target cells in the vicinity of the emitting cell)

**Endocrine** (signals target distant cells).

**Recommended Reading**

**Books**

1. Structure and Function in Cell Signaling by John Nelson latest Edition
2. Handbook of Cell Signaling by Ralph A. Bradshaw and Edward A. Dennis latest Edition
3. Cell Signaling by John T. Hancock Latest Edition
4. Basics of Cell Signaling – Wiley online
5. Textbook of Cell Signaling in Cancer by Robert and Jacques latest Edition

**Journals**

1. Journal of Innate immunity
2. Journal of cell signaling OMICS International
3. Cellular signaling Elsevier
4. Journal of cell signaling and trafficking
5. Journal of receptors and signal transduction
6. Journal of cell communication and signaling

## MIC 807: Advanced Microscopy (1+1)

## Course Objectives:

Upon completion of course the students will be able to:

1. Comprehend in details recent advances in microscopy including fluorescent microscopy, confocal microscopy, flowcytometery and electron microscopy

2. Know the methods the microscopy methods and interpretation of the associated softwares

3. Know the standard mechanisms involved in microscopic diagnostics

4. Have expertise in using basic and advanced microscopy in research and diagnostics

## Course Contents:

The course contents will include;

Introduction to advanced microscopy, mechanisms involved in different microscopy techniques and the basic principles of advanced microscopy. Use of advanced microscopes including, microscope care,slide preparation and operating procedures of fluorescent microscopy, confocal microscopy, flowcytometry and electron microscopy. Will also study the role of microscopy in basic medical research and diagnostics. The students will also learn standard operating procedures and data interpretation using specific softwares for these microscopes

## Recommended Reading

Books

1. Bradbury, S. (1968) The Microscope, past and present. Pergamon Press.
2. Turner, G. L’E. (1980) Essays on the history of the microscope. Senecio Publishing
3. Rost, F. W. D. (1991). Quantitative fluorescence microscopy. C. U. P.
4. Sanderson, J. B. (1994) Biological microtechnique. RMS Handbook No. 28. Bios press.
5. Ross, K. F. A. (1967). Phase contrast and interference microscopy for cell biologists. Edward Arnold.
6. Introduction to Confocal Fluorescence Microscopy by Michiel Müller
7. Handbook of biological confocal microscopy
8. Introduction to flow cytometry by James V. Watson
9. Advanced Flow Cytometry: Applications in Biological Research by A. Krishan

Journals

1. Journal of microscopy
2. Oxford journal of microscopy
3. Journal of microscopy and microanalysis
4. Journal of advanced microscopy research
5. Fluorescent microscopy journal
6. Journal of electron microscopy
7. Flowcytometry in clinical pathology

# PhD Dental Material

PhD Dental Materials)

## Overview

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

**No of credit hours for Compulsory courses**  (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**DMS-801 Advanced Material Characterization Techniques (1+1)**

**DMS-802 Biomaterials for Oral and Dental tissues (1+1)**

**DMS-803 Tissue Engineering Strategies (1+0)**

**DMS-804 Oral and Dental Soft Tissue Engineering (1+1)**

**DMS-805 Oral and Dental Hard Tissue Engineering (1+0)**

**BMS-807 Teaching rotations (two) (1+0) Elective**

**No. of credit hours for Specialty courses. (8+1)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (06 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

**12.26** **DMS-801 Advanced Material Characterization Techniques (1+1)**

## Course Objectives:

* + 1. To empower students with the skills, tools, and confidence in doing material characterizations.
    2. To enable them to apply principles of safety, and lab management into biomaterial research.
    3. To empower students to choose the right material for specific application is investigating the chemical, physical, and biological characteristics of it.

## Course Contents:

1. Introduction
2. Chemical characterization techniques
3. Physical characterizations techniques
4. Biological characterization techniques

## Recommended Readings:

1. Park, J., Lakes, R.S., 2007. Biomaterials: An Introduction. Springer Science & Business Media, New York.
2. Park, J.B., Bronzino, J.D., 2002. Biomaterials: Principles and Applications. CRC Press, Boca.
3. Di Silvio, L., 2008. Cellular Response to Biomaterials. Elsevier Science, Amsterdam, The Netherlands.
4. Ve´key, K., Telekes, A., Vertes, A., 2011. Medical Applications of Mass Spectrometry. Newnes, Oxford.
5. Ahuja, S., Scypinski, S., 2010. Handbook of Modern Pharmaceutical Analysis. Academic Press, USA.
6. Artyushkova, K., Atanassov, P., 2013. X-ray photoelectron spectroscopy for characterization of bionanocomposite functional materials for energy-harvesting technologies. ChemPhysChem. 14, 2071À2080.
7. Tayebi L., Moharamzadeh K.,2017. Biomaterials for Oral and Dental Tissue Engineering, UK.

**12.30** **DMS-802 Biomaterials for Oral and Dental tissues (1+1)**

## Course Objectives:

1. To empower students with different types of biomaterials with potential applications in the reconstruction of oral and dental tissues.
2. To equip students with research update on biomaterials manufacturing, mechanical, biological properties, and characterization methods as well as their relative advantages, limitations, and potential future developments on their optimization for applications in tissue repair and regeneration.
3. To empower students on tissue engineering strategies for different types of oral and dental soft and hard tissues and the potential in vitro and in vivo applications of the 3D tissue models.

## Course Contents:

1. Introduction to oral and dental tissue engineering
2. Bioactive glasses and calcium phosphates

2.1 Introduction

2.2 Bioactive glasses

2.3 Calcium phosphates

3. Polymers for oral and dental tissue engineering

3.1 Introduction

3.2 Different types of polymeric scaffolds

3.3 Methods for scaffold fabrication

4. Hydrogels in craniofacial tissue engineering

4.1 Introduction

4.2 Hydrogel biomaterials

5. Dental biocomposites

5.2 Classification of biocomposites

5.3 Natural biocomposites

5.4 Synthetic biocomposites

5.5 Unique properties and adaptability of biocomposites

5.6 Applications of biocomposites materials in dentistry

5.7 Restorative applications

5.8 Bone cements

5.9 Allogeneic bone grafts

5.10 Xenografts

5.11 Alloplastic grafts

5.12 Shortcomings of existing biocomposites and recent developments

6. Surface modification of dental implants

6.1 Introduction

6.2 Surface treatment methods

6.3 Prospective surface modification methods

7. Biocompatibility of dental biomaterials

7.1 Introduction

7.2 Concepts of biocompatibility testing

7.3 In vitro tests

7.4 Animal tests

7.5 Usage tests

7.6 Combining in vitro, animal, and usage tests together

7.7 Biomaterials for tissue engineering

8. Processing and preservation of biomaterials and regulatory issues

8.1 Introduction

8.2 Processing of biomaterials

8.3 Sterilization of biomaterials

8.4 Preservation and storage

8.5 Regulatory issues

## Recommended Readings:

1. Drury, J.L., Mooney, D.J., 2003. Hydrogels for tissue engineering: Scaffold design variables and applications. Biomaterials. 24, 4337À4351.
2. ISO 2009. International Standards Organization, biological evaluation of medical devices, ISO 10993.
3. Ji, W., Sun, Y., Yang, F., Van Den Beucken, J.J., Fan, M., Chen, Z., et al., 2011. Bioactive electrospun scaffolds delivering growth factors and genes for tissue engineering applica-tions. Pharm. Res. 28, 1259À1272.
4. Park, J., Lakes, R.S., 2007. Biomaterials: An Introduction. Springer Science & Business Media, New York.
5. Park, J.B., Bronzino, J.D., 2002. Biomaterials: Principles and Applications. CRC Press, Boca.
6. Di Silvio, L., 2008. Cellular Response to Biomaterials. Elsevier Science, Amsterdam, The Netherlands.
7. Ve´key, K., Telekes, A., Vertes, A., 2011. Medical Applications of Mass Spectrometry. Newnes, Oxford.
8. Ahuja, S., Scypinski, S., 2010. Handbook of Modern Pharmaceutical Analysis. Academic Press, USA.
9. Artyushkova, K., Atanassov, P., 2013. X-ray photoelectron spectroscopy for characterization of bionanocomposite functional materials for energy-harvesting technologies. ChemPhysChem. 14, 2071À2080.
10. Tayebi L., Moharamzadeh K.,2017. Biomaterials for Oral and Dental Tissue Engineering, UK.

**12.34** **DMS-803 Tissue Engineering Strategies (1+0)**

## Course Objectives:

1. To empower students with the knowledge of tissue engineering.
2. To enable students about regenerative medicine in dentistry.

## Course Contents:

1. Specific considerations in scaffold design for oral tissue engineering

Introduction

Scaffold fabrication techniques

Multi-tissue scaffolds for oral and dental regeneration

Applications of scaffolds in oral tissue engineering

1. Stem cells from oral and maxillofacial tissues

Introduction

Types of stem cells extracted from oral and maxillofacial tissues dental pulp stem cells

Application of clinically relevant stem cells in oral and maxillofacial surgery

1. Bioreactor design for oral and dental tissue engineering

Introduction

Fundamentals of bioreactors and bioreactor design

Different types of bioreactors

Application of bioreactors for tissue engineering of oral tissue

1. Growth factors for oral and maxillofacial regeneration applications

Introduction

Platelet-derived growth factor

Insulin-like growth factors

Transforming growth factor beta

Bone morphogenic proteins

Platelet rich plasma

Vascular endothelial growth factor

## Recommended Readings:

1. Park, J., Lakes, R.S., 2007. Biomaterials: An Introduction. Springer Science & Business Media, New York.
2. Park, J.B., Bronzino, J.D., 2002. Biomaterials: Principles and Applications. CRC Press, Boca.
3. Di Silvio, L., 2008. Cellular Response to Biomaterials. Elsevier Science, Amsterdam, The Netherlands.
4. Ve´key, K., Telekes, A., Vertes, A., 2011. Medical Applications of Mass Spectrometry. Newnes, Oxford.
5. Ahuja, S., Scypinski, S., 2010. Handbook of Modern Pharmaceutical Analysis. Academic Press, USA.
6. Artyushkova, K., Atanassov, P., 2013. X-ray photoelectron spectroscopy for characterization of bionanocomposite functional materials for energy-harvesting technologies. ChemPhysChem. 14, 2071À2080.
7. Tayebi L., Moharamzadeh K.,2017. Biomaterials for Oral and Dental Tissue Engineering, UK.
8. Anusavice, K.J., Shen, C., Rawls, H.R., 2013. Phillips’ Science of Dental Materials. Elsevier Health Sciences, St Louis, MO.
9. Gupte, M., Ma, P., 2012. Nanofibrous scaffolds for dental and craniofacial applications. J.Dental Res. 91, 227À234.
10. Jaklenec, A., Wan, E., Murray, M.E., Mathiowitz, E., 2008. Novel scaffolds fabricated from protein-loaded microspheres for tissue engineering. Biomaterials. 29, 185À192.

**12.38** **DMS-804 Oral and Dental Soft Tissue Engineering (1+1)**

## Course Objectives:

1. To empower students with the knowledge of tissue engineered human oral mucosal models.
2. To enable them to understand strategies used for production of 3D human mucosal oral models.

## Course Contents:

1. Oral mucosa tissue engineering

Introduction

Normal human oral mucosa

Split-thickness oral mucosa engineering

Full-thickness oral mucosa engineering

Applications of tissue-engineered oral mucosa

2. Tissue-engineered models of oral soft tissue diseases

Introduction

In vitro models of dysplasia and oral cancer

Tissue-engineered models of radiotherapy-induced oral mucositis

In vitro three-dimensional models of bisphosphonate and medication-related osteonecrosis

Imaging and spectroscopic diagnostic techniques

Oral candidiasis disease modeling

Oral mucosal models of bacterial infection

Immune response studies

Drug delivery systems

3. Periodontal soft tissue reconstruction

Introduction

Autologous grafts

General considerations for biomaterials in periodontal soft tissue reconstruction

Allogenic materials

Xenogeneic materials

Autogenous materials

Tissue engineering

Alloplastic materials

4. Layered scaffolds for periodontal regeneration

Introduction

Structure of periodontium

Requirements of a layered scaffold for periodontal regeneration

Current solutions available

5. Dental pulp tissue engineering and regenerative endodontic therapy

Introduction

Pulp therapy

Regenerative endodontic procedures

6. Oral nerve tissue repair and regeneration

Introduction

Peripheral neuroanatomy applicable to dentistry

Nerve tissue engineering principles

Applicable stem cells in oral and maxillofacial nerve repair

Growth factors in oral and maxillofacial nerve repair

Clinical applications and future trends

7. Tissue engineering of salivary glands

Introduction

Salivary gland function, anatomy, and histology

Salivary gland diseases and pathology

Prevention and preservation of salivary glands

Tissue-engineering approaches

Regeneration challenges

8. Facial muscle tissue engineering

Introduction

Anatomy and structure of facial muscles

Tissue engineering approaches

Cells

Scaffolds

Laboratory and clinical challenges

9. Vascularization

Introduction

Craniofacial and dental tissue-engineering approaches

Clinical transplantation of engineered blood vessels

Current strategies to increment vascularization

Key challenges and future trend References

## Recommended Readings:

1. Park, J., Lakes, R.S., 2007. Biomaterials: An Introduction. Springer Science & Business Media, New York.
2. Park, J.B., Bronzino, J.D., 2002. Biomaterials: Principles and Applications. CRC Press, Boca.
3. Di Silvio, L., 2008. Cellular Response to Biomaterials. Elsevier Science, Amsterdam, The Netherlands.
4. Ve´key, K., Telekes, A., Vertes, A., 2011. Medical Applications of Mass Spectrometry. Newnes, Oxford.
5. Ahuja, S., Scypinski, S., 2010. Handbook of Modern Pharmaceutical Analysis. Academic Press, USA.
6. Artyushkova, K., Atanassov, P., 2013. X-ray photoelectron spectroscopy for characterization of bionanocomposite functional materials for energy-harvesting technologies. ChemPhysChem. 14, 2071À2080.
7. Tayebi L., Moharamzadeh K.,2017. Biomaterials for Oral and Dental Tissue Engineering, UK.
8. Atkinson, M.E., Jowett, A., White, F.H., 2000. Principles of Anatomy and Oral Anatomy for Dental Students. Cava Cadavers, Taddington.
9. Chai, W., Brook, I., Emanuelsson, L., Palmquist, A., van Noort, R., Moharamzadeh, K., 2012. Ultrastructural analysis of implant-soft tissue interface on a three-dimensional tis-sue-engineered oral mucosal model. J. Biomed. Mater. Res. A 100, 269À77.
10. Krejci, N.C., Cuono, C.B., Langdon, R.C., Mcguire, J., 1991. In vitro reconstitution of skin: fibroblasts facilitate keratinocyte growth and differentiation on acellular reticular der-mis. J. Invest. Dermatol. 97, 843À848.

**12.42** **DMS-805 Oral and Dental Hard Tissue Engineering (1+0)**

## Course Objectives:

1. To empower students with the strategies used to date for tissue engineering of the alveolar bone as well as the laboratory and clinical challenges associated with bone tissue engineering.
2. To know about translation of research from animal to human construct.
3. To know how to minimize the need for lengthy, costly, and contro- versial animal studies which can be misleading due to interspecies molecular and physiological differences.

## Course Contents:

1. Bone tissue engineering in maxillofacial region

Introduction

Natural alveolar bone structure

Strategies for bone tissue engineering

Tissue-engineered bone

Challenges in bone tissue engineering

2. Periodontal and peri-implant hard tissue regeneration

Introduction

Conventional approaches

Tissue engineering

3. Regeneration concerns in craniofacial cartilage and bone defects

Introduction

Tissue engineering bone grafts

Craniofacial tissue engineering approaches

4. Craniofacial surgery, orthodontics, and tissue engineering

Introduction

Scaffolds

Stem cells

Alveolar bone defects, current, and future repairing techniques

Periodontal ligament tissue engineering

Low-intensity pulsed ultrasound

5. Tooth tissue engineering

Introduction

Biological structure of teeth

Developmental process of tooth formation

Triad of tooth tissue engineering

Whole teeth regeneration: Recent strategies and techniques

6. Pharmacological agents for bone remodeling: An experimental approach

Introduction

Calcium

Vitamin D

Prostaglandins

Thyroid hormone

Gonadal hormones

Fibroblast growth factor

Nonsteroidal antiinflammatory drugs (ibuprofen, aspirin) and acetaminophen

Bisphosphonates (pamidronic acid, zoledronic acid)

## Recommended Readings:

1. Park, J., Lakes, R.S., 2007. Biomaterials: An Introduction. Springer Science & Business Media, New York.
2. Park, J.B., Bronzino, J.D., 2002. Biomaterials: Principles and Applications. CRC Press, Boca.
3. Di Silvio, L., 2008. Cellular Response to Biomaterials. Elsevier Science, Amsterdam, The Netherlands.
4. Ve´key, K., Telekes, A., Vertes, A., 2011. Medical Applications of Mass Spectrometry. Newnes, Oxford.
5. Ahuja, S., Scypinski, S., 2010. Handbook of Modern Pharmaceutical Analysis. Academic Press, USA.
6. Artyushkova, K., Atanassov, P., 2013. X-ray photoelectron spectroscopy for characterization of bionanocomposite functional materials for energy-harvesting technologies. ChemPhysChem. 14, 2071À2080.
7. Tayebi L., Moharamzadeh K.,2017. Biomaterials for Oral and Dental Tissue Engineering, UK.
8. Shah, N.J., Hyder, M.N., Quadir, M.A., Dorval Courchesne, N.-M., Seeherman, H.J., Nevins, M., et al., 2014. Adaptive growth factor delivery from a polyelectrolyte coating promotes synergistic bone tissue repair and reconstruction. Proc. Natl. Acad. Sci. U.S.A. 111, 12847.
9. Woodard, J.R., Hilldore, A.J., Lan, S.K., Park, C.J., Morgan, A.W., Eurell, J.A.C., et al., 2007. The mechanical properties and osteoconductivity of hydroxyapatite bone scaffolds with multi-scale porosity. Biomaterials. 28, 45À54.
10. Zhong, J.-J., 2010. Recent advances in bioreactor engineering. Korean J. Chem. Eng. 27, 1035À1041.

# PhD Oral Pathology:

* + **Overview**

**CORE/COMPULSORY COURSES First/Fall Semester (08 CREDITS PLUS 1)**

**BMS-801 Advances in Molecular Cell Biology (1+1)**

**BMS-802 Ethics for Research Scientists (1+0)**

**BMS-803 Applied Biostatistics-II (1+1)**

**BMS-804 Presentation and Scientific writing skills (1+1)**

**BMS-805 Biosafety and Biosecurity (1+0)**

**BMS-806 Research rotations (two) (1+0) Elective**

Other elective courses as appropriate for interest of student

No of credit hours for compulsory courses (**8+1)**

**SPECIALITY COURSES Second/Spring Semester (08 CREDITS PLUS 1)**

**OPT-801 Advanced Microscopic, histological and molecular techniques (2+1)**

**OPT-802 Oral Cyto-pathology (1+0)**

**OPT-803 Oral and Maxillofacial Pathology (1+1)**

**OPT-804 Oro-dental Microbiology (1+0)**

**OPT-805 Oral Medicine and Radiology (1+1)**

**No. of credit hours for specialty courses (9)**

**RESEARCH Third to Sixth Semester (06 CREDITS)**

**BMS-899 Dissertation Research (6 CREDITS)**

Student shall propose and complete a research project under the guidance of a faculty member

SPECIALITY COURSES

* + **OPT-801 ADVANCED MICROSCOPIC, HISTOLOGICAL & MOLECULAR TECHNIQUES (2+1)**
  + **Course Objectives:**
* The advanced laboratory techniques for tissue handling including basic histological slide preparation and staining techniques (basic and special stains), Use and handling of light microscope / Dissecting microscope
* Preparation of blood and oral cytological smears
* Preparation of Frozen section and how to interpret the biopsy findings shall be the main focus of practice.
* Tissue preparation and immunohistochemistry shall be done along with molecular imaging and diagnostic studies shall be carried out.
* Oral and Maxillofacial diagnostic reporting as per the ethical norms and standard operational protocols shall be practically demonstrated and studied.
  + **Course Contents:**

1. Provision of the highest level of microscopy diagnostic skills utilizing, new technologies in immunohistochemistry and molecular studies
2. Handling of specimen’s and tissue samples with salivary gland and mucosal diseases, diseases of the jaw bones, and other head and neck pathology.
3. perform and/or collaborate in scientific or clinical research projects
4. excel as an medical educator and leader in the specialty.
5. Recording of gross findings and report writing after carrying out the biopsy.
6. Provision of relevant special tests and antibodies, where required.
7. A good hand in microscopy
   * **Recommended Readings**
8. Bancroft's Theory and Practice of Histological Techniques, Kim S Suvarna, ‎Christopher Layton, PhD, ‎John D. Bancroft, 2012.
9. Oral and Maxillofacial Pathology by Brad Neville, Douglas D. Damm , Carl M. Allen, and Jerry Bouquot, Jan 15, 1999
10. Oral pathology, clinical pathological correlations by Joseph A. Regezi, James J. Sciubba 1993.
    * **Journals**
11. Journal of oral pathology and medicine
12. British Dental Journal
13. Journal of Dental Research
    * **OPT-802 ORAL CYTOPATHOLOGY (1+0)**
    * **Course Objectives:**

* Learning and practicing competency in cytological smear preparations with special reference to cystic and salivary gland pathology.
* Identification of cytological smears and diagnosis along with histopathological reporting.
* Special stains and techniques to be applied where required.
  + **Course Contents:**

1. Recognise normal cell populations and the typical patterns of the common benign and malignant neoplasms seen in cytological preparations from the head and neck pathology.
2. The role of needle aspirate samples from thyroid, salivary gland, lymph node and other sites for diagnosis.
3. The structuring of reports and have an appreciation of the clinical uses of cytopathology and the consequence of reports – positive and negative Correlation with histology where available.
4. Differentiate, on the basis of morphology the air dried from fixed preparations
5. Identify, record and recognize the nuclear and cellular changes for labelling it as an invasive process on the cytological smear preparations.
   * **Recommended Readings**
6. Fine Needle Aspiration Cytology, Svante R. Orell, ‎Gregory F. Sterrett, ‎Darrel Whitaker – 2005.
7. Atlas of Salivary Gland Tumor Cytopathology, Oral and surgical pathology ,Dardick, Irving, ‎Pathology Images Inc – 2006.
8. Shafer'S Textbook Of Oral Pathology (6Th Edition), William G. Shafer, ‎Maynard Kiplinger Hine, ‎Barnet M. Levy.
   * **Journals**
9. Journal of oral pathology and medicine
10. British Dental Journal
11. Journal of Dental Research
    * **OPT-802 ORAL AND MAXILLOFACIAL PATHOLOGY (1+1)**

* The principles of Oral and maxillofacial pathology in relationship to diseases of the teeth, soft tissues and bone supporting the structures of the oral and maxillofacial region are the primary focus of this course.
* The importance of early recognition of abnormal conditions in view of their oral manifestations shall be emphasized.
* Inflammation and healing, developmental disturbances of the oral and peri-oral regions, blood and lymph node diseases, Tumours of the soft tissues including alveolar bones, cartilage, muscles and those having neuronal origin shall be discussed.
* Salivary gland diseases, Lymphomas and infectious diseases of the oral and maxillofacial region shall be studied with special reference to their etiology, pathophysiology, clinical manifestations and diagnostic tests including histopathological, radio graphical and immune histochemical analysis, where possible.

**12.37 Course objectives**

1. Knowledge of core pathological processes affecting the body at an organ and particularly the tissue level recognizing the etiological factors responsible for the disease process.
2. Detailed knowledge of the histopathological diagnosis of diseases affecting the teeth, the jaw bones, the oral soft tissues and the salivary glands by correlating the clinical and radio graphical features with histopathological picture.
3. In-depth clinical perspective to oral disease processes in order to determine the provisional diagnosis.
4. Necessary knowledge and skills in relation to tissue handling and processing
5. Encourage interdisciplinary management of patients
6. To produce oral and maxillofacial pathologists who can ultimately practice unsupervised in oral and maxillofacial pathology settings, contributing to comprehensive, safe and high quality dental (and medical) care, including in the general roles required for routine diagnosis for oral and dental diseases within the ethical standards of the profession and the community.

**12.38 Course contents**

The course content includes; diseases of the enamel, dentine and pulp, periodontium, alveolar bone, oral mucosa and related skin disorders, diseases of the bones and joints of the maxillofacial region, Salivary gland diseases, infections, soft tissue disorders affecting the oral and maxillofacial region, lymphoid and hematological disorders involving the oral and maxillofacial region, metabolic, genetic and acquired disorders with oral and maxillofacial manifestations, tumors, cysts and other pathological conditions of the head & neck region.

**12.39 Recommended readings (Text books)**

1. Oral and Maxillofacial Pathology by Brad Neville, Douglas D. Damm , Carl M. Allen, and Jerry Bouquot, Jan 15, 1999
2. Contemporary Oral and Maxillofacial Pathology by J. Philip Sap, Lewis R. Eversole and George P. Wysocki, Jan 15 1997
3. Essentials of Oral Pathology and Oral Medicine by R.A. Cawson and E.W. Odell, Oct2, 2002
4. Oral Pathology by J.V. Soames and J.C. Southam, 1998
5. Color Atlas of Clinical Oral Pathology by Brad W. Neville, Douglas D. Damm, and Dean K. White, 1999
6. Oral pathology, clinical pathological correlations by [Joseph A. Regezi](https://www.google.com.pk/search?tbo=p&tbm=bks&q=inauthor:%22Joseph+A.+Regezi%22), [James J. Sciubba](https://www.google.com.pk/search?tbo=p&tbm=bks&q=inauthor:%22James+J.+Sciubba%22) 1993.
7. Oral pathology by [J. V. Soames](https://www.google.com.pk/search?tbo=p&tbm=bks&q=inauthor:%22J.+V.+Soames%22), [J. C. Southam](https://www.google.com.pk/search?tbo=p&tbm=bks&q=inauthor:%22J.+C.+Southam%22) 1993.

**12.40 Journals**

1. Journal of oral pathology and medicine
2. British Dental Journal
3. Journal of Dental Research
   1. **OPT-804 ORO-DENTAL MICROBIOLOGY (1+0)**
   * **Course Objectives:**

* The discipline of Oral Microbiology is a clinical specialty, and is based on involvement of the student/ trainee in laboratory procedures as well as in clinical set up.
* It is concerned with the diagnosis and assessment of diseases of the oral and maxillofacial region and identification of particular pathogens/ organisms causing an infection.
* Provision of relevant investigatory tests and identification of microorganisms responsible for pathogenesis of infectious diseases of oral and dental structures.
  + **Course Contents:**

1. Describe the principles of general microbiology, the factors responsible for virulence in oral bacteria, the pathogenesis of infectious diseases (basic knowledge of immune responses, barriers, bacterial toxins, adhesins, mechanisms of escape against immunity, etc.)

2. Discuss the current state of dental microbiology, evolution of oral microbes, bacterial genetics (bacteria, mechanisms of horizontal gene transfer – transformation, transduction, conjugation, specific genetic elements – insertion sequences, transposons, integrons, etc.)

3. Explain the microbiological, biochemical and pathological aspects of dental plaque and biofilms.

4. Discuss and explain the bacteriological etiology and pathogenic mechanisms of the two major plaque-related diseases, caries and chronic marginal periodontal disease, and their possible sequelae.

5. Describe the principles of recombinant DNA technology and describe applications to dentistry.

6. Describe the bases of preventive measures and strategies directed against caries and periodontal disease.

7. Describe the principles of clinical asepsis.

8. Discuss the basic scientific rationale for the practice of dentistry with regard to the diagnosis, treatment and prevention of oral microbiological disease and their sequelae.

9. Identify the morphology and arrangement of bacterial cells.

10. Compare and contrast cell wall components in Gram-negative and Gram-positive bacteria. Describe how the cell structure differences cells leads to a given Gram stain result.

11. Describe how oxygen affects the growth of aerobes, obligate anaerobes, and facultative anaerobes.

12. Explain the differences between microbial colonization and infection and give examples of each process.

13. Describe the beneficial roles of normal flora in the host-microbe ecological relationship.

14. Describe and apply the newest approaches in culture independent microbiological techniques to understand the taxonomic and genomic diversity of oral bacteria.

* + **Recommended Readings**

1. Jawetz Melnick & Adelbergs Medical Microbiology, Karen C. Carroll, Janet S. Butel, Stephen A. Mors, 2015.
2. Review of Medical Microbiology and Immunology, Warren E. Levinson, ‎Warren Levinson , 2008.
3. Oral and Maxillofacial Pathology by Brad Neville, Douglas D. Damm , Carl M. Allen, and Jerry Bouquot, Jan 15, 1999
4. Contemporary Oral and Maxillofacial Pathology by J. Philip Sap, Lewis R. Eversole and George P. Wysocki, Jan 15 1997
5. Essentials of Oral Pathology and Oral Medicine by R.A. Cawson and E.W. Odell, Oct2, 2002
6. Oral Pathology by J.V. Soames and J.C. Southam, 1998
7. Color Atlas of Clinical Oral Pathology by Brad W. Neville, Douglas D. Damm, and Dean K. White, 1999
   * **Journals**

1. Journal of oral pathology and medicine

2. British Dental Journal

3. Journal of Dental Research

* + **OPT-802 ORAL MEDICINE AND RADIOLOGY (1+1)**
* Oral medicine is a branch of dental sciences that deals with the diagnosis and management of various diseases of the oral and maxillofacial region while radiology is the basic form of investigation which is carried out as the first line of diagnostic tool in all the dental and alveolar diseases, etc.
* An oral pathologist should know the basic management planning for a pathology and should be able to understand and record the radiological findings in order to correlate with the histological report for a conclusive diagnosis.
  + **Course Objectives:**

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1. Detailed knowledge of the clinical manifestations, histopathological diagnosis of diseases affecting the teeth, the jaw bones, the oral soft tissues and the salivary glands by correlating the clinical and radio graphical features with histopathological picture.
2. In-depth clinical and systemic perspective to oral disease processes in order to determine the virulence factor and provisional diagnosis.
3. Necessary knowledge and skills for proper chair side examination, investigations and devising a treatment plan.
4. Encourage interdisciplinary management of patients
5. Learning and practicing the advanced treatment modalities available, e.g. use of laser technology for curing oral lesions.
6. Practical application of radiological techniques for taking X-rays of different types and the clinical significance of the x-ray findings.
7. Knowledge of CBCT and CADCAM as advanced techniques and research based upon these advanced methods for improving investigatory and diagnosis.
   * **Course Contents:**

The course shall contain the management planning for all the diseases of the oral and maxillofacial region. Clinical correlation with systemic manifestations, appropriate investigatory tests with special reference to radiological diagnosis shall be done. Reading, understanding and recording the findings on the basis of all forms of radiographs, MRI, CT scans shall also be discussed. Utilization of advanced techniques e.g. laser technology, CBCT and CADCAM for oral and maxillofacial diseases shall also be discussed.

* + **Recommended Readings**

1. Tyldesley's Oral Medicine, Textbook by E. Anne Field, Lesley Longman, and William R. Tyldesley, 2003.
2. Oral and Maxillofacial Pathology by Brad Neville, Douglas D. Damm , Carl M. Allen, and Jerry Bouquot, Jan 15, 1999
3. Oral and Maxillofacial Radiology: A Diagnostic Approach, David Mac Donald, 2011.
4. Contemporary Oral and Maxillofacial Pathology by J. Philip Sap, Lewis R. Eversole and George P. Wysocki, Jan 15 1997
5. Essentials of Oral Pathology and Oral Medicine by R.A. Cawson and E.W. Odell, Oct2, 2002
6. Oral Pathology by J.V. Soames and J.C. Southam, 1998
7. Color Atlas of Clinical Oral Pathology by Brad W. Neville, Douglas D. Damm, and Dean K. White, 1999
   * **Journals**

1. Journal of oral pathology and medicine

2. British Dental Journal

3. Journal of Dental Research