Course: Molecular Oncology

Year (1ˢᵗ-2ⁿᵈ-3ʳᵈ-4ᵗʰ-5ᵗʰ-6ᵗʰ): 5ᵗʰ

Period (1ˢᵗ-2ⁿᵈ semester – annual): 1ˢᵗ semester

Credits: 8 (Medical Oncology: 2; Blood Diseases 2; Human Pathology: 3; Clinical Pathology: 1)

Objectives

Medical Oncology

- To understand the basic principles of epidemiology, genetics, risk factors of the most common cancer types
- To illustrate the general aspects of cancer diagnosis, staging, and conventional and innovative systemic therapeutic strategies including chemotherapy, hormonotherapy, targeted therapy, immunotherapy
- To describe the most common cancer complications and treatment toxicities
- To describe the main goals of clinical and translational research with the different phases of clinical trials
- To illustrate the multidisciplinary approach to patients diagnosed with main solid tumors, including gastrointestinal, breast, lung, prostate cancers and melanoma

Blood Diseases

Myeloid malignancies:

- To understand the role of next generation sequencing technologies in hematology
- To describe molecular pathophysiology of bone marrow failures, leukemias, myelodysplastic syndromes, myeloproliferative neoplasms, therapy-related myeloid neoplasms
- To illustrate inherited predisposition to hematological malignancies
- To describe mutational screening to improve the classifications of myeloid malignancies
- To illustrate integration of molecular parameters in patient prognostication
- To know personalized treatment according to molecular features

Lymphoid malignancies:

- To understand the role of circulating tumor DNA and liquid biopsy in hematology
- To understand the role of circulating tumor DNA as a novel prognostic indicator
- To illustrate how to integrate circulating tumor DNA analysis into clinical practice
- To describe risk-adapted therapy and disease monitoring: the case of Multiple Myeloma
- To illustrate disease outcome prediction and monitoring: imaging technologies and circulating tumor DNA genotyping: the case of lymphoma
- Immunotherapy: the quest for biomarkers

Human Pathology
- To interpret the terminology used in the report (histotype, grade, diagnosis, prognosis and prediction)
- To explain the basic principles and clinical significance of immunohistochemistry and molecular pathology
- To illustrate and exemplify the role of histology and immunocytochemistry in the management of an oncological patient.
- To discuss the advantages and limits of cytology in the diagnostic workflow and in the screening
- To explain why, when and how they should use cytology, histology or both
- To Know the indications and impact of molecular pathology in the management of oncological diseases
- To discuss the significance of intraoperative examination in guiding surgeon's hand
- To explain the role of biopsy sampling and surgical resection as regard the pathological staging and grading of tumors
- To understand the role of imaging and of clinical information in the diagnostic pathological process
- To interpret and discuss a pathology report of a patient with an oncological disease, including molecular analyses

Clinical Pathology
- To describe biomarkers of cancer and methods to detect them

The course includes four modules:

Module 1: Medical Oncology

The module of Medical Oncology is designed to guide medical students across the essential features of clinical oncology and to achieve an understanding of the current knowledge of the clinical, therapeutic, and pharmacological aspects of the most common solid tumor types. This course will be mainly structured focusing on practical aspects and clinical cases, in particular with regard to diagnostic and therapeutic aspects, with the goal of facilitating the learning process and the retention of fundamental information in the field of clinical oncology. Notions of the epidemiology and genetics of cancer will be discussed. Theory will be applied for the evaluation, classification, diagnosis, and monitoring of solid tumors.

The module will start introducing the general principles of tumor diagnosis and staging, and of clinical and therapeutic approach to cancer patients. Also, aspects of clinical and translational research with the different phases of clinical trials will be discussed. Subsequent lectures will cover in detail the most relevant solid tumors. In the field of Medical Oncology, molecular knowledge of conventional and innovative therapeutic targets, and related pharmacological therapies used in current practice and clinical trials will be addressed. Side effects, diagnosis and management of the most common complications, late effects in cancer survivors will also be addressed.

Module 2 Blood Diseases

This module of Blood Disease is designed to guide medical students across the essential features of molecular hematology and to achieve an understanding on the current knowledge of the blood disease processes in terms pathophysiology and the underlying genetic and molecular abnormalities. Theory will be applied for the evaluation, classification, diagnosis and monitoring of blood diseases.

Module 3 Human Pathology
The module of Human Pathology is designed so that at the end of the course, medical students should have knowledge and understanding skills to be able to describe what is Pathology; what are the main areas of application of Pathology in personalized medicine, with particular regard to molecular pathology; how does Pathology integrate in the management of a patient. The final goal will be to understand all the information listed in the pathological report and to be aware of their clinical impact.

Module 4 Clinical Pathology
The module of Clinical Pathology is designed to guide medical students across the use of phenotypic or genetic markers for the screening and diagnosis of cancer, risk stratification, prognosis, and monitoring treatment response. Serum markers, circulating tumor cells (CTC) and nucleic acids (ctDNA) will be discussed. The clinical use of liquid biopsy will be presented: from preanalytical issues to use in advanced-stage disease to select the treatment and detect resistance, as well as in early-stage disease.

Prerequisites
- Knowledge of normal anatomy and histology; physiology; biochemistry; biology; genetics; general pathology
- General bases of carcinogenesis
- Pharmacologic bases of the different classes of anticancer drugs
- General bases of malignant blood diseases

Lectures
Module: Medical Oncology
Topic 1 General aspects of cancer
Lecture: Epidemiology, genetics, and cancer prevention
Learning goals:
- Illustrate the basic principles of epidemiology and risk factors of most common cancer types
- List the general principles of hereditary and familial cancer
- Explain the general aspects of cancer prevention: primary prevention, secondary prevention (screening)

Topic 2 Clinical and therapeutic approach to the patient with cancer
Lecture: Clinical approach to the patient with cancer
Learning goals:
- Illustrate the general principles of cancer diagnosis, staging, and tumor assessment

- Describe how to take a thorough clinical history, perform a physical examination, define the performance status (different scales) and the prognosis of a cancer patient

Lecture: Treatment strategies 1
Learning goals:
- Illustrate the main systemic therapeutic options, as chemotherapy, hormonotherapy, targeted therapy, immunotherapy
- Describe the general principles of the therapeutic management of cancer patients, the importance of the multidisciplinary approach, and of personalized medicine
- Indicate the role of adjuvant/neoadjuvant treatment and of treatment for advanced/metastatic disease

Lecture: Treatment strategies 2 and clinical trials
Learning goals:
- Describe treatment endpoints, and criteria for assessment of objective response
- Describe the general aspects of clinical and translational cancer research, and different phases of clinical trials

Lecture: Complications, emergencies, and simultaneous and palliative care
Learning goals:
- Describe most common complications and emergencies associated with cancer, their diagnosis and treatment
- Illustrate the general principles of simultaneous and palliative care

Lecture: Treatment toxicities, quality of life, follow up, cancer survivors
Learning goals:
- Describe the most common side effects of anti-cancer therapies, their diagnosis and treatment, and their late effects in cancer survivors
- Illustrate other aspects of cancer patient management: nutrition, quality of life, psycho-oncology
- Illustrate the importance of follow-up care

Topic 3 Approach to main solid tumors
Learning goals:
- Develop a systematic and multidisciplinary approach to the main solid tumors, including modern laboratory, radiological and therapeutic tools currently used in oncology
- Explain the general principles of diagnosis, staging, and treatment of the main solid tumors

Lecture and clinical case discussion: Breast cancer
Lecture and clinical case discussion: Lung cancer
Lecture and clinical case discussion: Gastro-intestinal cancers
Lecture and clinical case discussion: Prostate cancer and melanoma

Module: Blood Diseases
Topic 1 Myeloid malignancies
Learning goals:
- To define the impact of genomic lesions in the biology, phenotype and prognosis of myeloid neoplasms
- To discuss the relevance of genomic information in the clinical decision making process in patients with myeloid neoplasms

Lecture: Next generation sequencing technologies in hematology
Lecture: Molecular pathophysiology of Bone Marrow Failures, Leukemias, Myelodysplastic syndromes, Myeloproliferative neoplasms, Therapy-related myeloid neoplasms
Lecture: Inherited predisposition to hematological malignancies
Lecture: Mutational screening to improve the classifications of myeloid malignancies
Lecture: Integration of molecular parameters in patient prognostication
Lecture: Personalized treatment according to molecular features

Topic 2 Lymphoid malignancies
Learning goals:
- To understand the importance of genomics to the diagnosis, risk stratification, prognosis, monitoring, and therapeutic decision-making in lymphoid malignancies

Lecture: Circulating tumor DNA and liquid biopsy in hematology
Lecture: Circulating tumor DNA as a novel prognostic indicator in hematology
Lecture: Integrating circulating tumor DNA analysis into clinical practice
Lecture: Risk-adapted therapy and disease monitoring: the case of Multiple Myeloma
Lecture: Disease outcome prediction and monitoring: imaging technologies and circulating tumor DNA genotyping: the case of lymphoma
Lecture: Immunotherapy: the quest for biomarkers

Module: Human Pathology
Topic 1 Introduction to the module
Lecture: What is pathology? What is the role of pathology in the management and understanding of neoplastic diseases?

Topic 2 Cancer Pathology
Lecture Breast pathology: from cytology to molecular pathology
Learning goals:
- Epidemiology of a breast nodule.
- Define the pathological features and the clinical significance of preneoplastic epithelial lesions of the breast:
  - a. ductal hyperplasia
  - b. lobular hyperplasia
- Compare and contrast the major clinical and pathological features of the following breast diseases:
  - a. fibroadenoma

        b. phyllodes tumor

        c. intraductal papilloma.

- Describe the epidemiological features of invasive and not invasive carcinoma of the female breast.
- Compare and contrast the pathological (cytology, histology and gross findings) and clinical features (relative incidence and prognosis) of the following types of breast carcinoma:

        a. high-grade in situ ductal carcinoma

        b. low-grade in situ ductal carcinoma

        c. in situ lobular carcinoma

        d. infiltrating carcinoma of no special type

        e. infiltrating lobular carcinoma.

        f. infiltrating carcinomas of other special types

- Discuss the role of fine needle aspiration (FNA) in the diagnosis of a patient with a breast nodule.
- Discuss the role of core-biopsy in the diagnosis of a patient with a breast nodule.
- Describe the role of intraoperative examination in a patient with a breast nodule.
- Describe how stage and grade impact on the clinical course of breast cancer.
- List the main morphological and molecular biomarkers that impact on prognosis and prediction of response to therapy in breast cancer.
- Know the correlation between the morphological and the molecular classification of breast cancer.
- Know the main pathological, genetic, and clinical features of invasive male breast cancer.

Lecture: Female genital system 1. Cervical carcinoma: pathological features, with focus on prevention (from pap test to HPV genotyping)
Learning goals:
- Illustrate the epidemiology of cervical carcinoma.
- Define the cervical transformation zone.
- List risk factors for the development of cervical carcinoma.
- Illustrate the correlation between HPV genotype and the risk of cervical carcinoma.
- Illustrate the morphologic and biologic spectrum of squamous intraepithelial lesion (SIL) in PAP smear.
- Illustrate the morphologic and biologic spectrum of preneoplastic lesions in the uterine cervix.
- Describe the impact of PAP test in the screening and prevention of cervical carcinoma.
- Illustrate the main morphological features of cervical carcinoma with regard to histotype, invasive properties, staging and grading and way of metastatization

Lecture: Female genital system 2: tumors of the uterine corpus and ovary
Learning goals:
- Describe the incidence, common locations, pathogenesis and clinical features of endometriosis.

- Illustrate risk factors, pathogenesis, clinical features, and spread of endometrial carcinoma.
- Explain the molecular pathogenesis of endometrial carcinoma and its relationships with risk factors and with different histotypes.
- Describe and compare the typical clinical presentation and microscopic features of uterine leiomyoma, leiomyosarcoma, and endometrial stromal tumor.
- Illustrate the basis of the classification of ovarian tumors and incidence of main histological types.
- Describe and compare the pathological, genetic and clinical features of ovarian surface tumors.
- Illustrate the issue of peritoneal involvement in the staging of ovarian surface tumors.
- Describe the usual clinical presentation and pathologic features of germ cell tumors of the ovary.
- Describe the most common types of sex cord-stromal tumors.
- Illustrate metastatic tumors to the ovaries.
- Explain the role of inherited predisposition in endometrial and ovarian neoplasms.

Lecture: Central and peripheral nervous system: gliomas and more
Learning goals:
- Distinguish the histologic from the biologic malignancy in primary brain neoplasms.
- Compare and contrast the clinical manifestations of a localized mass effect and the generalized increased intracranial pressure.
- Compare the incidence and distribution of meningiomas and gliomas and illustrate the main histological subgroups of glial tumors and the principles of glial tumors classification, including genetic information.
- List the histologic features to be evaluated when grading a glial neoplasm.
- Illustrate the role of intraoperative examination in the diagnosis of primary and metastatic brain tumors
- Illustrate the main prognostic features of glial tumors with emphasis on immunocytochemical and molecular markers
- Indicate the putative cell of origin of medulloblastoma, the age group most likely to develop this neoplasm, and typical routes of dissemination.
- Indicate the main neoplasms that can metastasize to the brain and discuss the main clinico-pathological features of help in the differential diagnosis with primary tumors
- Explain the similarities and the differences between schwannomas and neurofibromas.
- Describe the major clinical features of neurofibromatosis 1 and 2.

Lecture: Male genital system: Tumor of the prostate and testis
Learning goals:
- Describe the different anatomical regions of the prostate.
- Illustrate the main morphological features of adenocarcinoma of the prostate.
- Illustrate the epidemiology of prostatic neoplasm.
- Describe the diagnostic strategy of prostate cancer.

- Illustrate the definition of not-clinical significant tumor and active surveillance in prostate cancer patients.
- List the prognostic histological parameters of prostate cancer.
- Illustrate the value of germline and somatic mutations of DNA repair genes in developing prostate carcinoma.
- Define the role of mutations in BRCA genes in prostate carcinoma.
- Describe the cell types present in the testis
- Illustrate the principles of the last WHO classification of tumors of the testis
- List and describe seminomatous and non seminomatous germ cell tumors
- List and describe sex chord tumors of the testis

Lecture: Urinary system: Tumor of the kidney and of the urinary bladder and related structures
Learning goals:
- Describe the epidemiology of renal tumors
- Illustrate the main types of renal cell tumors
- Discuss the importance of genetic alterations in renal cell tumors
- Illustrate the main types of urinary bladder tumors
- Define the cancerogenetic pathways of urothelial tumors
- Discuss the importance of grading and subtyping of urothelial tumors

Lecture: Melanocytic and not melanocytic lesions of the skin
Learning goals:
- Define a melanocytic nevus.
- List the variant forms of melanocytic nevi.
- Know the importance of the family history of patients with multiple nevi.
- Define a dysplastic nevus in terms of architectural and cytologic features and clinical significance.
- Discuss the concept that some dysplastic nevi are precursors of malignant melanomas.
- Define a malignant melanoma in terms of architectural difference from a melanocytic nevus.
- Describe the risk factors for the development of a malignant melanoma.
- List the main histological variants of melanoma.
- Discuss the concept of horizontal and vertical growth in melanoma.
- Illustrate the main phenotypic features of melanoma cells.
- Discuss the significance of tumor regression as prognostic parameter related to the staging of melanoma
- Illustrate the Breslow and Clark criteria and their significance in the staging of melanoma.
- List all the information that need to be reported in a diagnosis of melanoma.
- Illustrate the role of sentinel node dissection in the evaluation of melanoma staging
- Discuss the predictive significance of b-raf mutation in melanoma cells
- Illustrate the potential sites of a metastasis for a melanoma

- Define actinic keratosis in terms of clinical presentation, etiology and preneoplastic meaning.
- Define squamous cell carcinoma of the skin in terms of etiology, pathogenesis, morphology, and prognosis.
- Illustrate criteria useful to define the grading of squamous cell carcinoma.
- Discuss whether keratoacantoma is a nosologic entity
- Define a basal cell carcinoma in terms of frequency, pathogenesis, morphology, and clinical outcome.
- Illustrate the differential diagnosis of basal cell carcinoma

Lecture: Hard & Soft tissue neoplasms: a molecularly heterogenous field
Learning goals:
- Illustrate the role of epidemiological and clinical features in the preliminary evaluation of a soft tissue neoplasm
- Discuss the frequency and the prognosis of benign fibrous histiocytoma and dermatofibrosarcoma protuberans of the skin
- Illustrate the main histotypes of soft tissue tumors which emphasis on the distinction between benign and malignant tumors.
- Discuss the more frequent tumor histotypes and related sites of origin
- Illustrate the role of morphology in the characterization of soft tissue tumours and the main criteria to define the grading of a malignant tumor
- Justify the role of immunohistochemistry in the diagnosis of soft tissue tumors
- Justify the role of molecular biology techniques in the diagnosis of soft tissue neoplasms.
- Discuss the significance of the evaluation of surgical margins in the diagnosis of soft tissue tumors
- Understand the difference between primary and secondary cancer of bone
- List factors that predispose to secondary bone cancer
- Discuss the role of a correct epidemiological, clinical and radiological evaluation in the diagnosis of bone tumors.
- Describe the following aspects of osteoma, osteoid osteoma, osteosarcoma, osteochondroma, chondroma, chondrosarcoma: morphology, bones affected, age of patient, prognosis.
- Describe the following aspects of Ewing sarcoma and giant cell tumor of bone: morphology, pathogenesis, bones   affected, age of patient, prognosis.
- Describe the following aspects of metastatic tumors to bone: incidence, route of metastasis, tissue of origin, diagnostic immunocytochemical markers

Lecture: Morphological and Molecular approach to Lung cancer
Learning goals:
- Illustrate precursor lesions of lung cancer
- Histological classification of lung cancer
- Illustrate gross findings, histology and immunohistochemical features of lung cancer

- Diagnostic, prognostic and predictive molecular features of different subtypes of lung cancer
- Describe the clinical course and prognosis of lung cancer
- Cytological and bioptic approach to lung nodule

Lecture: Morphological and Molecular approach to oesophageal and gastric cancer
Learning goals:

- Illustrate precursor lesions and conditions of oesophageal cancer
- The role of reflux esophagitis and Barrett's oesophagus in oesophageal carcinogenesis
- Illustrate gross findings, histology and immunohistochemical features of oesophageal cancer
- Describe the clinical course and prognosis of oesophageal cancer
- Illustrate precursor lesions and conditions of gastric cancer
- The role of Helicobacter pylori in gastric carcinogenesis
- Illustrate gross findings, histology and immunohistochemical features of gastric cancer
- Describe the clinical course and prognosis of gastric cancer
- Illustrate the molecular classification of gastric cancer

Lecture: Morphological and Molecular approach to Colorectal cancer
Learning goals:
- Illustrate precursor lesions of colorectal cancer
- Adenoma-carcinoma sequence
- Histological classification of colorectal cancer
- Illustrate gross findings, histology and immunohistochemical features of colorectal cancer
- Diagnostic, prognostic and predictive molecular features of colorectal cancer

Lecture: Morphological and Molecular approach to pancreatic and hepatic cancer
Learning goals:
- List the main types of liver cancers
- Illustrate risk factors and precursor lesions for hepatocellular carcinoma
- Describe the morphological and molecular features of hepatocellular carcinoma and its subtypes
- Describe the morphological and molecular features of carcinoma of extra- and intra-hepatic bile ducts
- List the main types of pancreatic cancer
- Discuss risk factors and precursor lesions for pancreatic ductal adenocarcinoma
- Illustrate the morphological features of ductal adenocarcinoma, acinar cell carcinoma, and mucinous neoplasms of the pancreas, with reference to their clinical and prognostic relevance
- Discuss the principles of pancreatic neuroendocrine neoplasms classification

Lecture: Morphological and Molecular approach to head and neck cancer cancer

Learning goals:

- Illustrate risk factors and precursor lesions for squamous cell carcinoma of the head and neck
- Describe the role of HPV in head and neck cancer
- Discuss the different types of squamous cell carcinoma of the head neck in terms of pathogenesis, morphology, and prognosis
- List and the describe the main types of nasal tumors
- List and describe the main types of salivary glands tumors

Lecture: Hematopathology: a matter of multidisciplinary integration

Learning goals:

- Illustrate the normal morphology and the physiology of lymph nodes, spleen, and bone marrow
- Illustrate the role of multidisciplinary integration of clinical, epidemiological, radiological, histopathological, and genetic data in the preliminary evaluation and diagnosis of blood cancers.
- Illustrate the indication of nodal excision and bone marrow biopsy
- Describe the histopathological changes and the main genetic alterations that occur in the bone marrow of patients with myelodysplastic syndromes, myeloproliferative neoplasms, acute myeloid leukemia, and systemic mastocytosis
- Describe the general principles of the current (2022) classification of acute myeloid leukemia
- Discuss the importance of immunohistochemical markers in the differential diagnosis of lymphomas
- Illustrate the main architectural patterns in the pathological (neoplastic or reactive) lymph node
- Illustrate the most important immunohistochemical and molecular markers in "small B-cell lymphomas"
- Illustrate the most important immunohistochemical and molecular markers in aggressive large B cell lymphoma and their prognostic relevance
- Illustrate the most important immunohistochemical and molecular markers in T cell lymphoma
- Discuss the clinical and histopathological peculiarity of Hodgkin lymphoma, its subtypes, and prognosis
- Illustrate the clinico-pathological and molecular features of Langerhans cell histiocytosis, Juvenile Xanthogranuloma, and Erdheim-Chester disease.

Topic 3 Clinical implications

Lecture: Intraoperatory exam: guiding surgeon's hand

Learning goals:

- Illustrate advantages and limits of frozen sections (including those performed for biobanking)
- Discuss the diagnostic role of cytological smears in combination with frozen section

- Illustrate advantages and limits of Intraoperative gross examination
- Illustrate the main indications of frozen sections with regards to breast and female genital system tumors, skin tumors, soft tissue tumors, thyroid nodules, CNS tumors
- Discuss which are the main diseases that are unsuitable to be investigated with intraoperative exam

Lecture: The clinical significance of a molecular pathology lab
Learning goals:
- Illustrate which are the main tumor categories where a molecular analysis can significantly contribute to the patient management and why.
- Illustrate and exemplify the diagnostic role of a molecular analysis
- Illustrate and exemplify the prognostic role of a molecular analysis
- Illustrate and exemplify the predictive role of a molecular analysis
- Illustrate tissue characteristics which make a specimen suitable to be examined in a pathology lab (pre-analitical features)
- Discuss the critical role of morphology as a guide for the execution and for the correct interpretation of a molecular test
- Illustrate the role of pathologist in a molecular pathology lab
- Illustrate which are currently the main technologies of a molecular pathology lab
- Discuss general principles of quality control in a molecular pathology lab

Module: Clinical Pathology
Topic 1 Circulating tumor markers
Lecture: Classification and clinical applications
Learning goals:
- Illustrate the basic principles of tumor markers
- Classification: genetic, biochemical, and cellular tumor markers
- Markers of cancer-related inflammation
- Clinical applications: screening, diagnosis, prognosis, response to treatment
- Individual tumor markers
- Circulating tumor cells
- Circulating nucleic acids
- Markers in other body fluids

Topic 2 Diagnostic methodologies
Lecture: The liquid biopsy
Learning goals:
- Illustrate the basic principles of liquid biopsy
- Detecting circulating tumor cells (CTC) and nucleic acids (ctDNA)
- Preanalytical issues, use in advanced-stage disease and early-stage disease
- Use of liquid biopsy in specific solid tumors
- From Papanicolaou test to early detection of endometrial and ovarian cancers

Topic 3 Diagnostic methodologies

Lecture: The Immunoscore
Learning goals:
- Illustrate the basic principles of the immunoscore
- The cellular players
- Introduction of the immunoscore in the clinical practice.
- The immunoscore: prognosis and response to immunotherapy

Teaching Methods
Lectures, clinical case discussion, journal paper presentation, tutorial activities with digital slides.
Lectures: The aim of lectures is to transfer knowledge to students by guiding them through the most relevant aspects and principles of Medical Oncology. Students are expected to participate in lectures in a proactive manner, asking questions, and taking notes as part of the learning process. Participation is mandatory.
Clinical case discussion: The aim of clinical case discussion is to activate and solidify knowledge acquired during lessons, and to increase student engagement in a collaborative learning setting. Participation is mandatory.
Small group activity (journal paper presentation): The aim is to involve students in reading (on their own, in small groups) and the publicly discussing some examples from the literature related to the topics presented in frontal lessons, and to increase student engagement in a collaborative learning setting. Participation is mandatory.
Tutorial activities with digital slides: Participation is mandatory.

Assessment
Written exam; multiple choice

End of Semester Exam content and evaluation
Content of End of Semester Exam (ESE) (63 questions): Questions will include the whole program of the course.

ESE evaluation: 63 questions, each question 0.5 points
To pass the test you need to answer to at least 36 questions correctly
60 correct answers = 30
61-63 correct answers = 30 cum laude

Texts and Suggested Websites
Medical Oncology and Clinical Pathology
- Niederhuber J, Armitage J, Doroshow J, Kastan M, Tepper J: Abeloff's Clinical Oncology – Saunders – 2019 – 6th edition
- DeVita VT Jr., Lawrence TS, Rosenberg SA: DeVita, Hellman, and Rosenberg's Cancer: Principles & Practice of Oncology – Wolters Kluwer Health – 2023 – 12th edition
- Reviews and journal papers to be provided

Blood Diseases

http://www.hematology.org/
http://www.leukemia-net.org/content/diagnostics/diagnostics/morphology/
http://www.esh.org/
http://imagebank.hematology.org/ http://teachingcases.hematology.org/
http://www.hematologylibrary.org/site/webfocus/content/index-toc.xhtml

Human Pathology

- Kumar, Abbas, Ester: Robbins and Cotran, Pathologic Basis of Disease, 10th Edition, Elsevier