

(Applicable to the batch of students admitted in the academic year 2025-26 onwards)

B.Sc. Bio Medical Science (CBCS)

FACULTY OF SCIENCE, SU

B.Sc. (BIO MEDICAL SCIENCE)

Syllabus (CBCS)

(w.e.f. 2025-2026)



FACULTY OF SCIENCE
SATAVAHANA UNIVERSITY
KARIMNAGAR – 505002

2025

B.Sc (Hons) Biomedical Sciences

Preamble, Eligibility, Job Opportunities for the Course and Vertical Mobility for the Students

- The B.Sc. (Hons) Biomedical Sciences is likely to be started from the academic year 2024-2025 across a few selected colleges in the Telangana State.
- The course is interdisciplinary in nature. The syllabus has been designed to offer a comprehensive technical skill, domain knowledge in the area of biomedical sciences and make the students employable in the National Laboratories, Private Institutes, Government and Private Hospitals and Diagnostic Centers.
- **There are 8 Core Papers, 9 Elective Papers, 4 Skill Enhancement papers, 1 Generic Elective paper, Project work, and Summer Internship.** The course has been designed to impart knowledge and technical skills to the students. Students will have hands-on training in medical lab techniques, epidemiological data analysis, biomedical, microbiological, genetical, besides Skill Enhancement courses.
- **Internship at the Pharma Industry, Diagnostic Centers/Hospitals and Biotech Companies:** At the end of the third year, students will undergo internship for a period of one year (two semesters). There will not be any theory classes during this period. However, students will submit the project report at the respective colleges at the end of 8th semester and credits will be allotted based on the quality of the project report that they prepare. Further, companies may not be able to provide any stipend during this period.
- It is mandatory for all the students to complete the project work and take up summer internship in recognized R&D institutions/Laboratories of repute / Universities/Hospitals/Pharma Industry/Biotech companies/diagnostic centres etc. **Generic Elective Course** has been designed to give exposure to the students in the discipline of Biomedical Sciences.
- **Eligibility Criteria:** Students who have passed the Intermediate Course with any Science streams such as Maths, Biology, Physics, Chemistry/ Biology, Physics, Chemistry/ Botany, Zoology, Chemistry/Biochemistry, Microbiology, Genetics, Biotechnology with Chemistry as compulsory subject are eligible/or its equivalent. The intake of students is purely based on merit basis at the Intermediate level.
- **Employment Opportunities:** The Biomedical Graduates can work as biomedical scientists, biotechnologists, clinical research associates, clinical scientists in the biochemistry, hematology, immunology, forensic scientist, microbiologist, Physician's associates, research scientist in life sciences, research scientist in medical sciences, scientific laboratory technician, toxicologist, crime scene investigator, genetic counselor, medical sales representative, medical science liaison officer, occupational hygienist, associate endocrinologist in the clinics, neuroscientist, scientific writer, teaching laboratory technician, medical lab diagnostic analyzer, health and biosafety executive in the government and private hospitals and in the intensive care units, biosafety officer

for the disposal of municipal waste and workers, and biosafety officer for the disposal of hazardous waste in the National Research Organizations. Further, they can be also employed as:

- Executive in diagnostics
 - Executive in preclinical testing
 - Executive in clinical trails
 - Executive in clinical data management (CDM)
 - Executive in quality analysis(QA)
 - Executive for Regulatory Affairs (RA)
 - Executive as statistical programming
 - Executive biologics quality analysis (QA) and testing (QA&T)
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- **Mobility of the Students:** Student graduates either can seek jobs, or else for further studies they are eligible in any post graduate course such as M.Sc in Biomedical Science ,Chemistry, Bio Chemistry, Bioinformatics, Biotechnology, Environmental Science, Food and Nutrition, Food Technology, Forensic Science, Genetics, Home Science, Medical Biochemistry, Medical Microbiology, Medical Pharmacology, Medical Toxicology, Microbiology, Bioscience, or across any discipline in Life Sciences.
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- **Students who get through B.Sc (Honours) degree are eligible to study MS abroad /Eligible for UGC/CSIR NET exam to join in PhD degree in any one of the disciplines mentioned above.**

B.Sc(Hons.)Biomedical Sciences Course (2024-2025)
Ability Enhancement Compulsory Course- AECC (Environmental Science/Basic Computers)

Courses		Papers	Total Credits	Credits for each paper/Semester					
				B.Sc.					
				I	II	III	IV	V	VI
Core Courses DSC	Optional-1- Chemistry	4	20	5 (Chem)	5 (Chem)	5 (Chem)	5 (Chem)	-	-
	Optional 2--BMS 1	4	20	5 C-101	5 C-103	5 C-105	5 C-107	-	-
	Optional-3 BMS 2	4	20	5 C-102	5 C-104	5 C-106	5 C-108	-	-
Elective Courses DSE	Optional-1- Chemistry	2	10	-	-	-	-	5 (Chem)	5 (Chem)
	Optional-2-BMS 1	2	10	-	-	-	-	5 E-109 A/B	5 E-111 A/B
	Optional-3-BMS 2	2	10	-	-	-	-	5 E-110 A/B	5 E-112 A/B
Language	English (First Language)	5	20	4	4	3	3	3	3
	Second Language	5	20	4	4	3	3	3	3
AECC	Environ/ Computer Skills	1	2	2	-	-	-	-	-
	Environ./Computers	1	2	-	2	-	-	-	-
SEC Skill Enhancement Course SEC	SEC1	1	2	-	-	2 (BMS-S301)	-	-	-
	SEC2	1	2	-	-	2 (BMS-S301)	-	-	-
	SEC3	1	2	-	-	-	2 (BMS-S301)	-	-
	SEC4	1	2	-	-	-	2 (BMS-S301)	-	-
GE	Open Stream	1	4	-	-	-	-	4	-
Internship		1	4	VII & VIII semester internship					4
Project Work/Optional		1	4	-	-	-	-	-	4
Total Credits in each semester				25	25	25	25	25	29
Total Credits till 6 th semester				154					
Credits for Internship during the 7 th and 8 th Semesters		14	14	182					

B.Sc (Hons.) Biomedical Sciences - Semester-Wise Papers

SEMESTER-I

Paper I-	Medical Biochemistry, Molecular Biology, Genetics, Microbiology (BMS-C101)
Paper II -	Medical Endocrinology, Medical Diagnostics (BMS-C102)

SEMESTER-II

Paper III -	Integrated Human Physiology, Anatomy, and Pathology (BMS-C103)
Paper IV -	Applied Biostatistics for Pharmaceutical Sciences (BMS-C104)

SEMESTER-III

Paper V -	Applied Immunology and Introduction to Biologics (BMS-C105)
Paper VI -	Drug discovery, CDM and Statistical Programming (BMS-C106)

SEMESTER-IV

Paper VII -	Pharmacology and Pharmacokinetics (BMS-C107)
Paper VIII -	<i>In vitro</i> Assay Development and Drug Screening (BMS-C108)

SEMESTER-V

Elective Paper IX-	Bioanalytical Techniques (BMS-E-109A) / Bioinformatics (BMS-E109B)
Elective Paper X-	Biosafety and Infectious Diseases (BMS-E-110A) / Regulatory Affairs in Pharmacology and Toxicology (BMS-E110B)

SEMESTER-VI

Elective Paper- XI -	Clinical Toxicology (BMS-E-111A) / Cancer Biology (BMS-E-111B)
Elective Paper- XII -	Preclinical Drug Safety and Efficacy Analysis and Physiologically Based Pharmacokinetic (PBPK) Modeling in Drug Discovery Development (BMS-E-112A) / Clinical Genetics (BMS-E-112B)
Elective Paper XIII -	Biostatistics, Intellectual Property Rights and Entrepreneurship (BMS-E-113A)

SEMESTER VII and SEMESTER VIII

Project Work : Students will undertake Internship/Project work either at the Pharma Industry / Biotech Companies/ Diagnostic Centers / Corporate and Government Hospitals during the semesters VII and VIII. Students will submit the work at the respective colleges after the completion of the Internship. Stipend may be /or may not be provided to the students during this period. Credits will be allotted semester-wise for the Internship/project work.

Skill Enhancement Courses

Skill Enhancement Course -	I - Clinical Biochemistry and Molecular Diagnostics (BMS-S301)
Skill Enhancement Course - (BMS-S302)	II - In Vitro and in Vivo Assay Development and Drug Screening
Skill Enhancement Course -	III - Techniques in Forensic Science (BMS-S303)
Skill Enhancement Course -	IV - DNA Fingerprinting (BMS-S304)
Generic Elective -	Any Student Can Opt for this Elective Paper (Other Than the Students from the Stream of Biomedical Sciences)

Title of the Paper -	Fundamentals of Medical Diagnostics (only theory, no practicals)
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B.Sc(Hons.)Biomedical Sciences Programme
Proposed Structure of B.Sc Biomedical Sciences Programme
Eligibility of Teachers

Semester-I

Paper I -Medical Biochemistry,Molecular Biology, Genetics, Microbiology (BMS-C101)
(This paper will be taught by a faculty member with M.Sc or PhD in Biochemistry/Microbiology/Botany/Zoology/Biotechnology/Environmental Sciences degree)

Paper II - Medical Endocrinology, Medical Diagnostics (BMS-C102)
(This paper will be taught by any faculty member with MB.;BS or M.Sc or PhD in Biophysics/Biotechnology/Microbiology/Biochemistry/ degree)

Semester-II

Paper III - Integrated Human Physiology, Anatomy, and Pathology (BMS-C103)
(This paper will be taught by a faculty member with MB.;BS or M.Sc or PhD in Human Physiology/Human Anatomy/Human Pathology/Biochemistry/Microbiology/Genetics/Biotechnology degree)

Paper IV - Applied Biostatistics for Pharmaceutical Sciences (BMS-C104)
(This paper will be taught by a faculty member with B.Pharmacy/M.Pharmacy or M.Sc or PhD in Microbiology/Biotechnology/Genetics/Biochemistry/Zoology degree)

Semester III

Paper V- Applied Immunology and Introduction to Biologics(BMS-C105)
(This paper will be taught by any faculty member with M.Sc or PhD in Genetics/Zoology/Biotechnology/Biochemistry/Microbiology/B.Pharmacy/M.Pharmacy degree)

Paper VI- Drug discovery, Clinical Data Management (CDM) and Statistical Programming(BMS-C106)
(This paper will be taught by any faculty member with M.Sc or PhD in Statistics/P.G. Diploma in Bioinformatics/B.Tech or M.Tech Bioinformatics/Medical Biochemistry degree)

Semester-IV

Paper VII -Pharmacology and Pharmacokinetics(BMS-C107)
(This paper will be taught by any faculty member with MB.;BS or M.Sc or PhD in Pharmacology/B.Pharmacy or M.Pharmacy degree)

Paper VIII - *In vitro* Assay Development and Drug Screening (BMS-C108)
(This paper will be taught by any faculty member with a background on Human Pathology or a clinician with MB.;BS/or B.Pharmacy/M.Pharmacy/PhD in Pharmacy degree)

Semester-V

Elective Paper – IX- Bioanalytical Techniques (BMS-E109A) /Bioinformatics (BMS-E109B)
(These papers will be taught by any faculty member with M.Sc or PhD in Biophysics/Botany/Zoology/Biochemistry/Biotechnology/Microbiology/Genetics/P.G. Diploma in Bioinformatics/B.Tech or M.Tech/PhD in Bioinformatics)

Elective Paper –X - Biosafety and Infectious Diseases (BMS-E-110A) /Regulatory Affairs in Pharmacology and Toxicology (BMS-E110B)

(These papers will be taught by any faculty member with MB.;BS/M.Sc or PhD in Genetics/ Microbiology/Biochemistry/B.Pharmacy/M.Pharmacy or PhD degree in pharmacy)

Semester-VI

Elective Paper – XI - Clinical Toxicology(BMS-E-111A) / Cancer Biology (BMS-E-111B)

(These papers will be taught by any faculty member with a background on Human Pathology/ clinician with MB;BS degree/M.Sc or PhD in Biochemistry/Microbiology/Genetics/B.Pharmacy or M.Pharmacy or PhD in Pharmacy)

Elective Paper – XII - Preclinical Drug Safety and Efficacy Analysis and Physiologically Based Pharmacokinetic (PBPK) Modeling in Drug Discovery Development (BMS-E-112A)/Clinical Genetics (BMS-E-112B)

(These papers will be taught by a faculty member with M.Sc or PhD in Genetics/P.G. Diploma in Bioinformatics or B.Tech or M.tech or PhD in Bioinformatics)

Elective Paper – XIII –Biostatistics, Intellectual Property Rights and Entrepreneurship (BMS-E-113A)
(This paper can be handled by any faculty member with M.Sc or PhD in Genetics/Microbiology/Biochemistry/Biotechnology/Botany/Zoology/Biotechnology degree or Diploma in IPR).

SEMESTER VII and SEMESTER VIII

Project Work :Students will undertake Internship/Project work either at the Pharma Industry / Biotech Companies/ Diagnostic Centers / Corporate and Government Hospitals during the semesters VII and VIII. Students will submit the work at the respective colleges after the completion of the Internship. Stipend may be /or may not be provided to the students during this period. Credits will be allotted semester-wise for the Internship/project work.

Skill Enhancement Course - I - Clinical Biochemistry and Molecular Diagnostics (BMS-S301)
Skill Enhancement Course - II - In Vitro and in Vivo Assay Development and Drug Screening (BMS-S302)
Skill Enhancement Course - III –Techniques in Forensic Science (BMS-S303)
Skill Enhancement Course - IV –DNA Fingerprinting (BMS-S304)

(The skill enhancement courses can be handled by Government and private hospitals, diagnostic centers, industries etc.)

Generic Elective - Any Student Can Opt for this Elective Paper
(Other Than the Students from the Stream of Biomedical Sciences)

Title of the Paper - Fundamentals of Medical Diagnostics
(This paper will have only theory and no practical classes)

(This paper can be handled by Biochemistry/Microbiology/Biotechnology)

Equipment Required for Conducting the B.Sc Biomedical Science Course in Telangana

- 1. Colorimeter**
- 2. pH meter**
- 3. Autoclave**
- 4. Laminar Air Flow**
- 5. Single Pan Balance**
- 6. Refrigerator**
- 7. -20 °C Freezer**
- 8. Refrigerated Centrifuge**
- 9. UV-VIS Centrifuge**
- 10. Thermocycler (Bio-Rad or any other Standard Company)**
- 11. Hot Air-Oven**
- 12. Incubator Shaker**
- 13. Gyrotory Shaker**
- 14. Air-Conditioners**
- 15. Computers with basic minimum software**
- 16. Submerged Electrophoretic Unit with Power Pack for Protein Separation**
- 17. Gel Electrophoretic Unit with Power Pack for DNA and RNA separation**
- 18. Pestles and Mortars**
- 19. Pipette Man (50 µl, 100 µl, 200 µl and 1000 µl) - All 3 quantities each**
- 20. Clean Air Room**
- 21. ELISA Reader**
- 22. Gel Documentation System**
- 23. Light Microscopes**
- 24. Fluorescent Microscope**
- 25. Brightfield Microscope**
- 26. Western Blotting Unit**
- 27. Open-source statistical tools like R and Python (Jupyter Notebooks, Pandas, SciPy for statistical analysis).**
- 28. Descriptive Statistical Analysis Using R, RStudio, Python to summarize pharmaceutical data sets with descriptive statistics and visualizations**
- 29. SAS Programming software for Clinical Trials**
- 30. OpenClinica or REDCap software for Clinical Data Management**
- 31. BOD Incubator**
- 32. Crime Scene Barricades**
- 33. Forensic Light Source**
- 34. Fume Hood**
- 35. Microfuge**
- 36. Paper Chromatographic Units**
- 37. Specific forensic analytical equipment, like cyanoacrylate fuming chambers for lifting of latent fingerprints**
- 38. Video Recording Facility**

Glassware, Plasticware, Stains and InterNet Facilities

- 1. Burettes, conical flasks, pipettes, measuring cylinders, Petri Dishes**
- 2. Needles, Syringes, Gloves, Cotton, Small Glass Bottles for Collection of Blood samples**
- 3. Pipette Tips, Eppendorf Tubes**
- 4. Test tube Stands**
- 5. White blood cell manual counter in specially designed chambers (Neubauer) or with automated counters**
- 6. Glass slides with cover slips**
- 7. Pen drives**
- 8. Password Cracking Investigation Tools**
- 9. HotSHOT DNA Extraction Kit or Dipstick DNA Extraction Kit**
- 10. 5x HOT FIREPol® Blend Master Mix Ready To Load**
- 11. PCR Grade Water**
- 12. DNA barcoding Primer Mix**
- 13. GelGreen® DNA Stain**
- 14. 100 bp DNA Ladder**
- 15. Protein Ladder**
- 16. Giemsa stain**

B.Sc(Hons.)- Biomedical Sciences - Semester I - Theory
Paper I- Basics of Medical Biology (BMS-C101)

(Faculty Members are Requested to Orient the Students towards Biomedical Sciences)

Unit I –Role of Biomolecules in Medical Biology

(a) Proteins and Peptides

Introduction to amino acids, peptide bond and protein structure.
Composition and functions of hemoglobin, Ferritin, C- Reactive Protein (CRP) and Rheumatoid factor.
Peptide: Types, benefits and safety of peptides
Role of peptides in diagnostics
Peptides as therapeutic agents – current applications
Potential role of bioactive peptides in prevention and treatment of chronic diseases

(b). Enzymes as drugs and role in clinical medicine

Enzymes in pharmaceutical industry
Therapeutic application of enzymes
Proteolytic enzymes – Sources and benefits
Proteases in therapy
Role of proteolytic enzymes in disease prevention and medical biology
Diagnostic and therapeutic potential of protease inhibition

(c). Carbohydrates and Lipids

Carbohydrates: Basics of monosaccharides, disaccharides and polysaccharides.
Composition of glycogen.
Biomedical importance of Chitin, chitosan and Glycosaminoglycans.
Lipids: Classification of lipids and fatty acids.
Biological significance (MUFA & PUFA), Fate of dietary lipids.
Structure and functions of Cholesterol and Vitamin D.

(d). Nucleic acids as drug targets

Structure and composition of RNA and DNA
Classes of drugs that interact with DNA: DNA intercalators (amsacrine), Groove binders (netropsin), DNA alkylators(amines: mechlorethamine; nitrosoureas: carmustine)
Concept of antisense therapy

Unit II - Transcription:Eukaryotic transcription of mRNA, tRNA and rRNA

(a). Mechanism of Transcription

Basic transcription apparatus
Initiation, elongation and termination of transcription
Types of RNA polymerases, transcription factors
Inhibitors of transcription - rifampicin and α -amanitin

(b). Post-Transcriptional Modifications

Split Genes, Concept of introns and exons
RNA splicing, Spliceosomes and Self splicing introns
Alternative splicing and exon shuffling, mRNA transport
Post-Transcriptional Modifications – micro RNAs
miRNA, long non-coding RNA
PIWI Interacting RNAs
Role for DNA methylation on neurocognitive dysfunctions
Role of RNA methylation on neurocognitive dysfunctions

(c). - Translation

Mechanism of Translation

Features of genetic code and exceptions in some systems

Ribosome structure- rRNA and proteins

Charging of tRNA, aminoacyl-tRNA synthetases

Proteins involved in initiation in prokaryotes

Proteins involved in the initiation of eukaryotes

(d). Elongation and termination of polypeptides

Fidelity of translation

Inhibitors of protein synthesis – tetracyclins, aminoglycosides

Chloramphenicol and aminoglycosides

Post-Translational Modifications

Phosphorylation, Acetylation, Hydroxylation, Methylation

Unit III-Variation in chromosomal number:

(a). Mutations: Mutagens (Physical and chemical). Types of mutations.

Gene mutations- Substitutions and Frame shift mutations

Molecular Basis of Gene mutations.

(b). Chromosomal aberrations: Numerical Variation in chromosomal number

Euploidy, Aneuploidy, Polyploidy.

Structural changes in chromosomes- Deletions, Duplications, translocations, inversions.

Significance of mutations.

(c). Chromosomal abnormalities in humans: Inborn errors in humans-Klinefelter's syndromes,

Turner's syndrome, Down's syndrome, Patau's syndrome.

Diagnosis genetic abnormalities (Amniocentesis).

(d). Inherited human diseases: Haemophilia, Sickle cell anemia

Muscular dystrophy (MD)

Cystic fibrosis

Unit – IV Principles of Diseases and Epidemiology

(a). Relationship between Normal microbiota and host, Opportunistic microorganisms

Nosocomial infections

Development and spread of infectious diseases

Invasion, pathogen, parasite, pathogenicity, virulence, carriers and their types

(b). Bacterial and fungal diseases with reference to etiology, clinical symptoms

Etiology of diseases

Clinical symptoms

Respiratory tract infections like Diphtheria and Tuberculosis

- (c). **Gastrointestinal tract and urinary tract infections**
Staphylococcal food poisoning and *E. coli* gastroenteritis
Microbiome and its role in human health
Probiotics and their role in human health
Urinary tract infections: gonorrhea and syphilis
Involvement of bacterial toxins or virulence factors in the Mechanisms of Pathogenesis
Viruses, viroids, prions
- (d). **General characteristics of viruses**
Structure, isolation, cultivation and identification of viruses
Viral multiplication, one step multiplication curve
Lytic and lysogenic phages (lambda phage), concept of early and late proteins
Clinical virology with reference to HIV virus and hepatitis virus (life cycles)

B.Sc(Hons.)– Biomedical Sciences - Practicals for the Semester I
Paper I - Medical Biochemistry, Molecular Biology, Genetics, Microbiology
(BMS-C101)

(All practical classes are compulsory for all papers)

An option to the students may be given to go to any Diagnostic Center for the Estimation of these Molecules if the Students are interested.

1. Estimation of total sugars by Anthrone, Amino acids by Ninhydrin method (Colorimetric or Spectrophotometric).
2. Estimation of urea from the blood or urine.
3. Demonstration of chromosomal banding techniques (C & Q).
4. Understanding about biosafety cabinet and Level-II Level III facilities
5. Staining and morphological characterization of *Aspergillus* species *Penicillium* species and *Saccharomyces* species
6. Demonstration of Pathogenic Bacterial Culture
7. Demonstration of Swab preparation from the throat and for DNA isolation from the Swab or Bacterial colonies
8. Detection and Diagnosis of Malaria, and Typhoid using the Rapid Kit Method
9. Diagnosis of *Corynebacterium diphtheria*, *Bordetella pertussis*, and COVID19 (Corona virus) detection by Real Time-PCR (RT-PCR)
10. Isolation of genomic DNA from blood/tissue
11. Demonstration of Polymerase Chain Reaction (PCR) technique.

B.Sc(Hons.)– Biomedical Sciences – Semester I - Suggested Books
Paper I - Medical Biochemistry, Molecular Biology, Genetics, Microbiology

1. Lehninger: Principles of Biochemistry, 5th edition (2008), David L. Nelson and Michael M. Cox; Prentice Hall Publishers, ISBN-13: 978-0321707338
2. Biochemistry, 4th edition (2003), Campbell, M. K. and Farrel, S. O.; Brooks/Cole, Cengage Learning (Boston), ISBN: 0030348498.
3. An Introduction to Practical Biochemistry, 3rd edition (1987), Plummer, McGraw-Hill College; ISBN-13: 978-0070841659.
4. Human Molecular Genetics, 3rd edition (2003) by Tom Strachan and Andrew Read; Garland Science Publishers, ISBN -13: 978-0815341826.
5. Concepts of Genetics, 10th edition, (2011). William S. Klug, Michael R. Cummings, Charlotte A. Spencer, Michael A. Palladino; Pearson Education, ISBN-13: 978-0321724120.
6. Principles of Genetics, 8th edition (2005), Gardner EJ, Simmons MJ, Snustad DP. John Wiley and Sons, Inc. ; ISBN-13: 978-9971513467.
7. Principles of Genetics, 6th edition (2011), Snustad DP and Simmons MJ, John Wiley and Sons, Inc; ISBN-13: 978-0470903599

8. Microbiology: An Introduction, 9th edition (2008), Gerard J. Tortora, Berdell R. Funke, Christine L. Case; Benjamin Cummings. ISBN-13: 978-0321733603.
9. Prescott, Harley, and Klein's Microbiology, 8th edition, (2011), Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton, McGraw Hill International. ISBN-13: 978- 0071313674.
10. Bailey and Scott's Diagnostic Microbiology, 12th edition (2007), Betty A. Forbes, Daniel F. Sahm and Alice S. Weissfeld; Mosby Elsevier Publishers, ISBN-13: 978-0808923640.
11. Microbiology, 6th edition (1993), Pelczar, Chan and Krieg; McGraw Hill International, ISBN-13: 978-0070492585.
12. Brock Biology of Microorganisms, 13th edition (2010), Michael T. Madigan, John M. Martinko, David Stahl and David P. Clark, Pearsons, Benjamin Cummings, ISBN-13: 978- 0321649638.
13. Microbiology: A Laboratory Manual, 10th edition, (2013), James Cappuccino and Natalie Sherman, Benjamin Cummings. ISBN-13: 978-0321840226.
14. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978- 0805395921.
15. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737.

B.Sc (Hons.) – Biomedical Sciences - Semester - I
Paper II - Medical Endocrinology, Medical Diagnostics (BMS-C102)

Unit – I - Introduction to Endocrinology

- (a). **Types of hormones**
Functions of hormones in human body
Basic concepts about hypo and hyper secretion of hormones and their diseases
Types of endocrine cells: Alpha, Beta and Delta cells
- (b). **Pathways of hormonal synthesis**
Hormone receptors / receptor biology
General mechanism of hormonal action
- (c). **Hormonal Assays**
Hormonal assays and their clinical relevance
Disorder of growth and sexual differentiation
- (d). **Endocrine disorders in childhood and adolescence**
Endocrine disorders during adolescence
Cushing's disease
Irregular menses, amenorrhea
Precocious puberty, premature thelarche

Unit II – Regulation of Glands and their secretion

- (a). Structure, function and regulation of glands and their secretions:
Pituitary, Hypothalamus, Pineal, Thyroid, Parathyroid, Adrenal glands
- (b). **Insulin, Importance**
Deficiency leading to Diabetes Mellitus
Insulin-receptor disorders
Inherited diabetes, insulin resistance (IR)
Thymus and Pancreas
- (c). **Hypothalamo – pituitary disorders**
Autoimmune thyroid disorders
Hyperthyroidism - Graves' disease
Thyroidism and arrhythmia (irregular heartbeat), weight loss, protruding eyes and nervousness
- (d). **Reproductive hormone disorders and problems of menopause**
Low estrogen including hot flashes, night sweats, poor sleep, vaginal dryness
The post-menopausal period and associated loss of bone density
Bone and mineral metabolism

Unit III - Fundamentals of Clinical Diagnostics

- (a). Introduction to clinical laboratory principles and procedures
Concept of GLP and ISO labs
Quality control and laboratory safety
Regulation of diagnostic labs and accreditation methods
Guidelines for proper discard of biological waste and chemical wastes

- (b). **Sample collection**
Guidelines for sample collection
Transport
Preservation
Processing and analysis
- (c). **Blood and Phlebotomy**
Composition and general function of blood
Description of blood cells - normal counts and function
Steps of blood coagulation, anticoagulants
Overview of phlebotomy (the surgical opening or puncture of a vein in order to withdraw blood)
- (d). **Hematology and other body fluid analysis**
Hemoglobin estimation, anemia classification
Blood group ABO/Rh typing complications of mismatch
transfusion, selection of donor, mandatory tests, comb's test, component separation, preservation and uses.
Analysis of Urine, Serum, Saliva and Cerebrospinal fluid

Unit IV: Approaches to diagnosis of infectious diseases

- (a). **Sterilization Techniques**
Physical methods
Chemical methods
- (b). **Molecular Diagnosis – An overview**
Diagnosis of Bacterial and Viral Diseases using PCR and RT-PCR
(Diphtheria, Pertussis, COVID-19 and others)
Bright field microscope, Fluorescence microscope
ELISA reader, Autoanalyser
UV-VIS Spectrophotometer
Gel Electrophoresis
- (c). **Isolation of bacteria from mixed culture**
Study of morphological, cultural, biochemical characteristics of common bacterial pathogens
Observing Virus under the microscope
Isolation and identification of common microorganisms using microbiological, biochemical and PCR techniques
- (d). **Composition of culture media and Culture methods**
Media for identification of pathogenic bacteria EMB agar
McConkey agar, Inoculation, incubation and purification methods in bacterial cultures
Preservation of bacterial culture

B.Sc (Hons.) – Biomedical Sciences - Semester - I
Paper II - Medical Endocrinology, Medical Diagnostics (BMS-C102)
Practicals

1. Estimation of any one hormone
2. Demonstration of CT scan
3. Demonstration of dual-energy X-ray absorptiometry (DXA)
4. Demonstration of nuclear medicine studies
5. Demonstration of parathyroid or thyroid ultrasound
6. Estimation of troponin as a biomarker of choice for the detection of cardiac injury
7. Single or double radial immuno-diffusion test
8. Agglutination inhibition assay
9. Sandwich ELISA or Dot ELISA test
10. Widal test
11. Immunoprecipitation
12. Western Blotting
13. Differential and Total Leukocyte Counts

B.Sc (Hons.) – Biomedical Sciences - Semester - I
Paper II - Medical Endocrinology, Medical Diagnostics (BMS-C102)
Suggested Books

1. Text book of Endocrinology by Williams
2. Diabetes Mellitus by Joslin
3. Textbook of Diabetes by Holt's
4. Metabolic basis of inherited disease by Stanbury
5. The Thyroid by Ingbar
6. RIA – Principles and practices by Pillai and Bhandarkar
7. Reproductive Endocrinology by Speroff
8. Textbook of Clinical Chemistry by Tietz
9. Nutritive value of Indian Foods by Gopalan, ICMR
10. Endocrinology by Leslie J DeGroot
11. Pediatric Endocrinology by Hindmarsh and CGD Brook
12. Metabolic Bone Diseases and Disorders of Mineral Metabolism
13. Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.
14. Microbiology, 7th edition, (2008), Prescott, L., John Li Harley, Donald A. Klein, McGraw Hill. ISBN-13: 978-0071102315.
15. Roitt's Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833.
16. An Introduction to Immunology, Immunochemistry and Immunobiology, 5th edition, (1988), Barrett, James T., Mosby Company, St. Louis. ISBN-13: 978-0801605307.
17. Immunology: An Introduction, 4th edition, (1994), Tizard, I.R., Saunders College Publishing, Philadelphia. ISBN-13: 978-0030041983.

B.Sc (Hons) – Biomedical Sciences - Semester II - Theory
Paper III - Integrated Human Physiology, Anatomy, and Pathology
(BMS-C103)

Preamble: To create a consolidated and focused curriculum that merges key aspects of human physiology, anatomy, and pathology with an emphasis on relevance to healthcare and the pharmaceutical industry, we will integrate the most essential and complex topics from the given syllabi. This will ensure students grasp the fundamental and advanced principles necessary for roles in biomedical sciences, particularly those focusing on clinical research, drug development, and pathology. This merged syllabus provides a comprehensive view that bridges human physiology and pathology with a specific emphasis on areas critical to healthcare and pharmaceutical sectors, preparing students for advanced studies and professional roles in these fields.

Unit I - Human Anatomy and Physiology: Focus on Immunological and Hematological Systems

(a). Body organization and basics of the system

General anatomy, body planes, cavities, tissues, and an introduction to the immune system focusing on innate and adaptive immunity.

(b). Blood Composition and Hematopoiesis

Detailed study of blood components (WBC, RBC, platelets)

Hemoglobin structure, functions, and blood coagulation mechanisms

(c). Immune Response and Blood Disorders

Immune response phases, basic concepts of anemia

Sickle cell anemia, leukemia, and other hematological disorders

(d). Lymphoid System and Its Clinical Significance

Overview of lymphoid tissue, lymph system, blood groups,

And blood banking with relevance to transfusion medicine

Unit II - Nervous System and Sensory Organs: Physiology and Pathology

(a). Neurophysiology and Membrane Potentials

Structure and function of neurons, action potential, electrophysiology of ion channels and nerve impulse conduction

(b). Central and Peripheral Nervous System

Detailed anatomy and functions of the CNS and PNS

including the autonomic nervous system

(c). Neurotransmission and Neurological Disorders

Synapses, types of neurotransmitters, organization of the nervous system, and basic aspects of neurological disorders

(d). Sensory Systems and Disorders

Physiology of special senses (vision, hearing, taste, smell, touch), and common disorders affecting these senses

Unit III - Musculoskeletal System and Associated Pathologies

(a). Muscle and Skeletal System Functionality

Functional anatomy of the muscular system, neuromuscular transmission

Muscle contraction mechanisms, and bone structure/function

Importance of calcium

(b). Muscle and Joint Disorders

Overview of muscular dystrophy, polymyositis

Myasthenia gravis, ALS, osteoporosis, and arthritis

(c). Wound Healing and Tissue Repair

Mechanisms of tissue regeneration, role of extracellular matrix, healing, and fibrosis

(d). Systemic Impact of Musculoskeletal Disorders

Detailed discussion on systemic lupus erythematosus

Sjogren's syndrome, and the genetic basis of musculoskeletal disorders

Unit IV - Pathological Mechanisms and Diagnostic Techniques

(a). Foundations of Human Pathology

Introduction to pathology, cellular adaptations, injury, death,

and responses including hyperplasia, hypertrophy, atrophy

Metaplasia, necrosis, and apoptosis

(b). Inflammation, Healing, and Chronic Diseases

Acute and chronic inflammation processes, healing,

Fibrosis, and granulomatous inflammation

(c). Principles of Hemodynamic and Nutritional Pathologies

Hemodynamic disturbances such as edema, hyperemia

Congestion, hemorrhage, and nutritional diseases

(d). Modern Diagnostic and Research Techniques

Advanced diagnostic and research techniques including immunofluorescence

PCR diagnostics, tissue processing

Staining of cells and tissues for various diseases

B.Sc (Hons) – Biomedical Sciences
Semester II - Practicals
Paper III - Integrated Human Physiology, Anatomy, and Pathology
(BMS-C103)

1. Estimation of hemoglobin and determination of blood groups.
2. Examination of blood smear preparations.
3. Analysis of nerve function tests and sensory response evaluations.
4. Muscle strength and fatigue testing.
5. Diagnostic imaging for bone and muscle disorders.
6. Biopsy techniques and histological analysis of pathological samples.
7. C-Reactive Protein (CRP) test
8. Venereal Disease Research Laboratory test (VDRL), and other relevant clinical tests

B.Sc (Hons) – Biomedical Sciences
Semester II – Suggested Books
Paper III - Integrated Human Physiology, Anatomy, and Pathology
(BMS-C103)

1. Guyton and Hall Textbook of Medical Physiology by J.E. Hall
2. Robbins and Cotran Pathologic Basis of Disease by Vinay Kumar, Abul K. Abbas, Jon C. Aster
3. Principles of Anatomy and Physiology by Gerard J. Tortora and Bryan H. Derrickson
4. Pathophysiology: The Biologic Basis for Disease in Adults and Children by Kathryn L. McCance and Sue E. Huether

B.Sc (Hons) – Biomedical Sciences
Semester II - Theory

Paper IV - Applied Biostatistics for Pharmaceutical Sciences (BMS-C104)

Objective: Equip students with the theoretical knowledge and practical skills in biostatistics necessary for analyzing and interpreting data in preclinical and clinical research settings within the pharmaceutical industry. To design a comprehensive undergraduate course in biostatistics tailored to meet the needs of those entering roles in biostatistics within clinical and non-clinical settings in the pharmaceutical industry, we will integrate the elements from both models provided. The course will focus on the statistical principles required for analyzing preclinical and clinical data, using both parametric and non-parametric tests, and will include practical applications relevant to the industry. This course design not only covers essential statistical techniques but also integrates practical applications using software tools relevant to the pharmaceutical industry, thus preparing students effectively for biostatistical roles in a regulatory, research, or clinical setting.

Unit 1- Foundations of Biostatistics and Data Analysis

(a). Introduction to Statistics in Pharma

Role and uses of statistics in pharmaceutical research
Basic statistical concepts; types of data

(b). Descriptive Statistics

Measures of central tendency (mean, median, mode)
Measures of dispersion (variance, standard deviation, range, coefficient of variation)

(c). Probability and Distributions

Basic probability concepts; common probability distributions
Applications to normal distribution

(d). Data Visualization

Construction and interpretation of graphs, histograms,
Pie charts, scatter plots, and semi-logarithmic plots

Unit II - Inferential Statistics and Hypothesis Testing

(a). Sampling Techniques

Simple random sampling and other sampling procedures
Sampling distributions of means and proportions

(b). Estimation and Hypothesis Testing

Point and interval estimation, hypothesis testing basics
Type I and II errors, significance levels

(c). Parametric and Non-Parametric Tests

Student t-tests, Chi-square tests, ANOVA

Unit III - Clinical Data Analysis and Experimental Design

(a). Clinical Study Design

Overview of case studies, observational studies

Interventional studies, parallel and crossover designs

(b). Experimental Design and Analysis

Concepts of randomized control trials, factorial design

Analysis of variance, Duncun's multiple range test

(c). Biostatistics in Clinical Trials

Statistical methods for design and analysis in clinical trials

(d). Dose-response studies, and bioequivalence

Unit IV- Regulatory Compliance and Reporting Theoretical Topics

(a). Regulatory Frameworks and Biostatistics

Understanding the role of biostatistics in meeting Food and Drug Administration (FDA)

(b). European Medicines Agency (EMA)

International Council for Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use(ICH) guidelines

(c). Report Writing and Data Presentation

Best practices in presenting data results and writing reports for regulatory submissions

(d). Emerging Trends in Biostatistics

Introduction to advanced methods like real-world data analysis

Predictive modeling

B.Sc (Hons) – Biomedical Sciences
Semester II – Practical Exercises

Paper IV - Applied Biostatistics for Pharmaceutical Sciences (BMS-C104)

1. Statistical Software Training
2. Introduction to open-source statistical tools like R and Python (Jupyter Notebooks, Pandas, SciPy for statistical analysis).
3. Descriptive Statistical Analysis Using R or Python to summarize pharmaceutical data sets with descriptive statistics and visualizations
4. Applying Statistical Tests
5. Conducting parametric and non-parametric tests on sample data using R or Python.
6. Power and Sample Size Determination
7. Using software to calculate sample size and power for hypothetical studies
8. Designing a Clinical Study
9. Crafting a study design using software simulations to understand the implications of design choices
10. Analyzing Clinical Trial Data
11. Hands-on analysis of clinical trial data using SAS or an open-source alternative like R
12. Regulatory Submission Workshop
13. Creating a mock regulatory submission that includes statistical analysis reports using templates aligned with ICH guidelines.
14. Advanced Data Analysis Projects
15. Using advanced statistical models and real-world datasets to prepare analyses as would be required in industry settings.

B.Sc (Hons.) – Biomedical Sciences
Semester II – Suggested Books

Paper IV - Applied Biostatistics for Pharmaceutical Sciences (BMS-C104)

1. Biostatistics for the Biological and Health Sciences by Marc M. Triola and Mario F. Triola
2. Fundamentals of Biostatistics by Bernard Rosner
3. Design and Analysis of Experiments by Douglas C. Montgomery
4. Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines by Tom Brody
5. Applied Biostatistics for the Health Sciences, By Rossi Richard J
ISBN 10-1119722691, ISBN 13-9781119722694, Medford, New York, USA
6. Biostatistics: An Applied Introduction for the Public Health Practitioner, By Bush Heather M
ISBN:10-1111035148; ISBN 13: 9781111035143, EB-Books, Rockford. Illinois. USA