UNIVERSITY OF THE PUNJAB

NOTIFICATION

The Syndicate at its meeting held on 15-11-2021 has approved the recommendations of the Academic Council made at its meeting dated 07-10-2021 regarding grant of Permission to Start BS Biostatistics (4-years) Program for Morning with effect from the Academic session, 2021 and Evening Program from the Academic Session, 2022 at the College of Statistical and Actuarial Sciences alongwith approval of its Syllabi and Courses of Reading/Scheme of Studies.

The Syllabi and Courses of Reading/Scheme of Studies for BS (4 years) Bio-Statistics is attached herewith as Annexure 'A'.

Sd/-
Dr. Muhammad Khalid Khan
Registrar

Admin. Block,
Quaid-i-Azam Campus,
Lahore.
No. D/ 12245 /Acad. **Dated:28-12-2021.**

Copy of the above is forwarded to the following for information and further necessary action: -

1. Dean, Faculty of Sciences.
2. Principal, College of Statistical & Actuarial Sciences.
3. Chairperson, DPCC.
4. Controller of Examinations
5. Director, Quality Enhancement Cell
6. Director, IT.
7. Admin. Officer (Statutes)
8. Secretary to the Vice-Chancellor.
9. Secretary to the Pro-Vice Chancellor
10. P.S. to the Registrar
11. Assistant Syllabus.

Assistant Registrar (Academic)
for Registrar

Scheme of Studies

BS Biostatistics

College of Statistical and Actuarial Sciences

University of the Punjab, Lahore.

Program Title: BS Biostatistics

Department: College of Statistical and Actuarial Sciences

Faculty: Faculty of Science

1. College Mission

The mission of the College is to facilitate the highest quality biostatistics education through teaching, research, and industrial collaboration. Moreover, the college's mission is to ensure that our graduates are nurtured to be sensitive, tolerant, humane, and carry the wisdom of knowledge, creative thinking, and research skills for their holistic development. This will hone their potential for assuming leadership roles in diverse fields of the health sector.

2. Introduction

Biostatistics is a union of Statistics and Public Health comprised methods used to analyze the huge volume of data and mine the information it contains from the health sector. The discipline has progressed from statistics and normal data management sciences but due to revolutionary developments in the subject make it consider a distinct discipline. One aspect of biostatistics is how to deal with big data and the techniques used in dealing with big data problems make it different from the traditional data management methods. The tasks experienced in biostatistics cover various aspects of data from a medical perspective that might include data capture, storage, curation, storage, sharing, search, transfer, visualization, and analysis. So, biostatistics is considering now an evolutionary extension of Statistics in the health sector where it is impressively proficient in medical science with the huge volume of data generated today. The subjects like computing, machine learning, and algorithm construction and the tools like R, Python, health inventory management, global public health, DNA forensics, bioinformatics, survival analysis, statistical genetics, health project management, epidemiology, infectious disease modeling in biostatistics makes a biostatistician apart from a statistician. Globally, biostatisticians are achieving significant contributions in commercial and noncommercial settings from the health sector. The growth in the volume of data in the health sector is continuously on an increasing trend and the need to leverage it becomes more important in today’s world.

3. Program Introduction (BS Biostatistics)

Biostatistics is a multi-disciplinary field, linked with investigating data and extracting expedient knowledge from unstructured datasets by using scientific methods, processes, algorithms, and systems from the health sector. Building predictive models are usually the most important activity for a biostatistician.

Biostatistics is a blend of various tools, algorithms, and machine learning principles to discover hidden patterns from the raw data in medical science. How is this different from what statisticians have been doing for years? The answer lies in the difference between explaining and predicting.

Statisticians usually explain what is going on by processing the history of the data from a general perspective. On the other hand, Biostatisticians not only do the exploratory analysis to discover insights from it but also use various advanced knowledge of types of medical problems to model the healthcare data in a better way. A Biostatistician will look at the data from a medical perspective, analyze and interpret it. So, Biostatistics is primarily used to make decisions and predictions making use of predictive causal analytics, prescriptive analytics (predictive plus decision science), and advanced statistical tools in medical science to understand it quantitatively.

4. Program Objectives

1. The BS program in Biostatistics integrates scientific methods from statistics, computer science, and medical science to extract knowledge from data and drive decision making. Graduates are prepared to meet the challenges at the intersection between big data, health analytics, and other emerging fields.
2. To meet the growing demands for high-level information systems/science skills from quantitative medical science.
3. To provide a path for individuals from diverse fields to rapidly transition to Biostatistics careers.
4. Prepare graduates to apply Biostatistics techniques for knowledge discovery and dissemination to assist researchers, physicians, or health policy makers in achieving public health objectives.

5. Market Need/Rationale of the Program

a) Potential Students for the program: Biostatistics has recorded exceptional growth than the average growth rate of statistics in the past couple of years. According to the market experts, it would sustain the momentum and continue to outpace other statistics sectors by a significant margin in the years to come. If you are looking to make a career in one of the fastest-growing quantitative health sectors, there is no better alternative than biostatistics. The program is suitable for individuals who have completed their higher secondary education with and without a pre-medical group.

b) Potential Employers: There has been a steady increase in the number of job postings for skilled professionals in biostatistics. While the demand is going up rapidly, the no. of skilled professionals is quite low. The following are some examples of job titles in the biostatistics field and their typically associated education requirements:

- Clinical researcher – MD, Ph.D., or PharmD
- Professor of biostatistics – Doctoral degree in biostatistics, data science, applied mathematics, or statistics
- Senior epidemiologist – Doctoral degree in biostatistics or epidemiology
- Research associate with a public health department or pharmaceutical company – Doctoral degree in biostatistics or statistics

- Public health statistician – Doctoral degree in biostatistics or statistics
- Senior biostatistician – Ph.D. in biostatistics or statistics
- Epidemiology and information science fellow with the Centers for Disease Control and Prevention – Doctoral degree in fields like computer science, life health sciences, medical sciences, mathematics, or statistics

c) Academic Projections: The following national and international institutes are offering graduate and postgraduate degree programs in Biostatistics:

1. Institute of Public Health, Govt. of Punjab, Pakistan.
2. College of Statistical and Actuarial Sciences, University of the Punjab Lahore, Pakistan.
3. Department of Statistics, BZU Multan, Pakistan.
4. Khyber Medical University, Peshawar, Pakistan.
5. The Agha Khan University, Karachi, Pakistan.
6. Simmons University Boston, United Kingdom.
7. Saint Louis University, United States.
8. University of Waterloo, Canada.
9. Rollins School of Public Health, USA.
10. University of Buffalo, New York, USA**.**

d) Faculty: The college has the following faculty with respective specializations.

Degree	Area /Specialization	Total
PhD	1. Prof. Dr. Sohail Chand (Statistical Modeling) 2. Dr. Rehan Ahmad (Applied Statistics) 3. Dr. Maryam Ilyas (Statistical Modeling) 4. Dr. Sana Saeed (Data Science) 5. Dr. Nadia Saeed (Applied Statistics) 6. Dr. Samar Abbas (Computer Science and Data Science)	(06)
M.Phil	1. Mr. Munawar Iqbal (Mathematical Statistics) 2. Ms. Irum Sajjad Dar (Applied Statistics) 3. Ms. Aasma Riaz (Applied Statistics) 4. Ms. Shumaila Abbas (Applied Statistics)	(09)

	5. Mr. Ghulam Nabi (Finance) 6. Ms. Huma Shakeel (Applied Statistics) 7. Ms. Wajiha Batool (Applied Statistics) 8. Ms. Maham Faheem (Applied Statistics) 9. Ms. Deeba Akhter (Business Statistics)	

e) Physical Facilities: The College has the largest state-of-art academic building for statistics community in the country. College consists of academic blocks, administration block, cafeteria, lawns and play grounds. The four academic blocks of the college consist of more than thirty lucarative class rooms, seminar halls and workshop rooms to meet the modern era requirements. The college has sufficient parking space for the students, faculty and the visitors. The College Library is well equipped with the latest books on Statistics, Biostatistics and the related fields. The computer lab of the college has more than 70 latest computers available for computational purposes.

6. Admission Eligibility Criteria

- Intermediate or Equivalent.
- The students from any discipline can apply for the admission in the program.
- The minimum marks required for admission in BS Biostatsitics is 45%.

7. Duration of the Program

Semesters	Years	Credit Hours
8	4	133

8. Categorization of Courses as per HEC Recommendation and Difference

Semester	Courses	Category (Credit Hours)					
		Core Courses	Basic Courses	Major Electives	Minor Electives	Any Other	Semester Load
1	6	4	2	-	-	-	17
2	6	3	2	-	1	-	17
3	6	1	3	-	2	-	18
4	6	1	4	-	1	-	18
5	6	-	-	6	0	-	18
6	6	-	-	5	0	-	18
7	5	-	-	3	2	-	15
8	4	-	-	2	2	-	15
HEC Guidelines	40-44	9	9-10	15-17	7-8	-	124-136
Difference b/w HEC & PU	+1	0	+1	0	0	-	0

**** List of Core, Basic, Major Electives and Minor Electives.***

Core	Basic	Major Electives	Minor Electives
Islamiat / Ethics	Biostatistics I – Introduction	Applied Multivariate Analysis	Introduction to Sociology
English-I	Introduction to Biology	Design and Analysis of Medical Studies	Introduction to Health Economics
Mathematics I – Linear Algebra	Biostatistics II – Distribution Theory	Statistical Quality Control	Operations Research
Introduction to Computer	Demography	R-Programming	Mathematics IV – Financial Mathematics
Pakistan Studies	Biostatistics III – Decision Making	Database and SQL	* List of Rest of the Minor Elective is attached at the end of the Table.
English-II	Mathematics III – Numerical Analysis	Hospital and Healthcare Management	
Mathematics II – Calculus	Introduction to Epidemiology	Modeling Categorical Data	
English-III	Categorical Data Analysis	Design and Analysis of Experiments	
English-IV	Statistical and	Machine Learning and	

	Mathematical Computing	Python	
	Introduction to Biomedical Research	Analysis of Repeated Measurements	
	Regression and Time-Series Models	Survival Analysis and Modeling	
		Statistics and Medical Diagnostics	
		Health Insurance and Health Laws	
		Infectious Diseases and Modeling	
		Spatial Modeling	
		Thesis	

**** List of Minor Electives***

Biostatistical Consulting		Structural Equation Models
Multi-level Modeling		Qualitative Research Methods in Health
Generalized Linear Models		Academic Writing
Exploratory and Robust Data Analysis		Meta-Analysis and Systematic Reviews
Bio-Informatics		Health Inventory Management
Statistical Genetics		Health Project Management
Advanced Survival Analysis		Statistics & DNA Forensics
Crop and Animal Experiments		Global Public Health
Predictive Modeling in the Health Sciences		Biosafety and Ethics
Clinical Decision Making and Cost Effectiveness		Data Management for Clinical Research
Advanced Biostatistical Techniques for Observational Studies		Mathematical Biostatistics
Population and Family Health		Hospital Waste Management
Pharmaceutical Statistics		Public Health Issues in Abuse and Addiction

9. Scheme of Studies / Semester-wise workload

Years	Semesters	Courses	Credit Hours
4	**8**	**45**	**133**

#	Code	Course Title	Course Type	Prerequisite	Credit Hours
		SEMESTER-I			
1.	ISE-101	Islamiat / Ethics	Core	N / A	2
2.	ENG-101	English-I	Core	N / A	3
3.	BSTA-101	Biostatistics I – Introduction	Basic	N / A	3
4.	MATH-101	Mathematics I – Linear Algebra	Core	N / A	3
5.	BIOS-101	Introduction to Biology	Basic	N / A	3
6.	COMP-101	Introduction to Computer	Core	N / A	3
		Semester's Total Credits			**17**
		SEMESTER-II			
1.	PST-101	Pakistan Studies	Core	N / A	2
2.	ENG-102	English-II	Core	ENG-101	3
3.	BSTA-102	Biostatistics II – Distribution Theory	Basic	BSTA-101	3
4.	MATH-102	Mathematics II – Calculus	Core	MATH-101	3
5.	STAT-101	Demography	Basic	BSTA-101	3
6.	SOCI-101	Introduction to Sociology	Elective	N / A	3
		Semester's Total Credits			**17**
		SEMESTER-III			
1.	ENG-201	English-III	Core	ENG-102	3
2.	BSTA-201	Biostatistics III – Decision Making	Basic	BSTA-101, BSTA-102	3
3.	MATH-201	Mathematics III – Numerical Analysis	Basic	MATH-102	3
4.	BSTA-202	Introduction to Epidemiology	Basic	BSTA-101	3
5.	ECON-201	Introduction to Health Economics	Elective	N / A	3
6.	STAT-201	Operations Research	Elective	BSTA-101	3
		Semester's Total Credits			**18**

#	Code	Course Title	Course Type	Prerequisite	Credit Hours
		SEMESTER-IV			
1.	ENG-202	English-IV	Core	ENG-201	3
2.	BSTA-203	Categorical Data Analysis	Basic	BSTA-201	3
3.	BSTA-204	Statistical and Mathematical Computing	Basic	BSTA-101, BSTA-102, BSTA-201	3
4.	BSTA-205	Introduction to Biomedical Research	Basic	BSTA-203	3
5.	STAT-202	Regression and Time-Series Models	Basic	BSTA-201	3
6.	MATH-202	Mathematics IV – Financial Mathematics	Elective	N/A	3
		Semester's Total Credits			**18**
		SEMESTER-V			
1.	BSTA-301	Applied Multivariate Analysis	Major Elective	BSTA-204	3
2.	BSTA-302	Design and Analysis of Medical Studies	Major Elective	BSTA-205	3
3.	STAT-301	Statistical Quality Control	Major Elective	N/A	3
4.	STAT-302	R-Programming	Major Elective	N/A	3
5.	COMP-301	Database and SQL	Major Elective	COMP-101	3
6.	BIOS-301	Hospital and Healthcare Management	Major Elective	N/A	3
		Semester's Total Credits			**18**
		SEMESTER-VI			
1.	BSTA-303	Modeling Categorical Data	Major Elective	BSTA-203	3
2.	BSTA-304	Design and Analysis of Experiments	Major Elective	BSTA-201	3
3.	STAT-303	Machine Learning and Python	Major Elective	STAT-302	3
4.	BSTA-305	Analysis of Repeated Measurements	Major Elective	BSTA-203	3
5.	BSTA-306	Survival Analysis and Modeling	Major Elective	BSTA-204	3
		Semester's Total Credits			**15**

#	Code	Course Title	Course Type	Prerequisite	Credit Hours
		SEMESTER-VII			
1.	BSTA-401	Statistics and Medical Diagnostics	Major Elective	N/A	3
2.	BSTA-402	Health Insurance and Health Laws	Major Elective	N/A	3
3.	BSTA-403	Infectious Diseases and Modeling	Major Elective	N/A	3
4.		Elective-I	Minor Elective	-	3
5.		Elective-II	Minor Elective	-	3
		Semester's Total Credits			**15**
		SEMESTER-VIII			
1.	BSTA-404	Spatial Modeling	Major Elective	BSTA-301	3
2.	BSTA-405	Thesis	Major Elective	N/A	6
3.		Elective-III	Minor Elective	-	3
4.		Elective-IV	Minor Elective	-	3
		Semester's Total Credits			**15**

List of Elective Courses:

#	Code	Course Title	Course Type	Prerequisite	Credit Hours
1.	BSTA-406	Biostatistical Consulting	Minor Elective	N/A	3
2.	STAT-401	Multi-level Modeling	Minor Elective	STAT-202	3
3.	STAT-402	Generalized Linear Models	Minor Elective	STAT-202	3
4.	BSTA-407	Exploratory and Robust Data Analysis	Minor Elective	BSTA-301	3
5.	BSTA-408	Bio-Informatics	Minor Elective	N/A	3
6.	BSTA-409	Statistical Genetics	Minor Elective	N/A	3
7.	BSTA-410	Advanced Survival Analysis	Minor Elective	BSTA-306	3
8.	BIOS-401	Crop and Animal Experiments	Minor Elective	N/A	3
9.	BSTA-411	Predictive Modeling in the Health Sciences	Minor Elective	BSTA-303	3

#	Code	Course Title	Course Type	Prerequisite	Credit Hours
10.	BSTA-412	Clinical Decision Making and Cost Effectiveness	Minor Elective	N/A	3
11.	BSTA-413	Advanced Biostatistical Techniques for Observational Studies	Minor Elective	BSTA-301	3
12.	BIOS-402	Population and Family Health	Minor Elective	STAT-101	3
13.	BSTA-414	Pharmaceutical Statistics	Minor Elective	N/A	3
14.	STAT-403	Structural Equation Models	Minor Elective	BSTA-301	3
15.	BSTA-415	Qualitative Research Methods in Health	Minor Elective	BSTA-302	3
16.	BSTA-416	Academic Writing	Minor Elective	N/A	3
17.	BSTA-417	Meta-Analysis and Systematic Reviews	Minor Elective	N/A	3
18.	BSTA-418	Health Inventory Management	Minor Elective	N/A	3
19.	BSTA-419	Health Project Management	Minor Elective	N/A	3
20.	BSTA-420	Statistics & DNA Forensics	Minor Elective	N/A	3
21.	BIOS-403	Global Public Health	Minor Elective	N/A	3
22.	BIOS-404	Biosafety and Ethics	Minor Elective	N/A	3
23.	BSTA-421	Data Management for Clinical Research	Minor Elective	COMP-301	3
24.	BSTA-422	Mathematical Biostatistics	Minor Elective	BSTA-201	3
25.	BIOS-405	Hospital Waste Management	Minor Elective	N/A	3
26.	BIOS-406	Public Health Issues in Abuse and Addiction	Minor Elective	N/A	3

* Elective courses will be offered on the availability of the faculty.

Research Thesis / Project / Internship

Thesis is a major elective course with the credentials of six credit hours. The student will be assigned a research problem under the supervision of assigned supervisor. The student will study the theoretical and / or applied aspects of statistics and write a thesis. The thesis will be evaluated by an external examiner appointed as per Punjab University rules.

10. Award of Degree

As per Punjab University Rules & Regulations

Minimum requirements for the award for the award of 3.5 – 4 years Bachelors Degree

i. A candidate must have qualified in accordance with the existing Rules and Regulations in each one of the semesters from I to VIII separately, i.e. by securing at least a 'D' in the course(s) as to fulfill the requirements laid down in (ii & iii) below:

ii. He / She must have earned the prescribed number of credits required for the 3.5 – 4 years Bachelors degree i.e. 130 -136 credits.

iii. He / She must have obtained minimum Cumulative Grade Point Average of 2.00.

11. NOC from Professional Councils (If Applicable)

(Not Applicable)

12. Faculty Strength

Degree	Area /Specialization	Total
PhD	1. Prof. Dr. Sohail Chand (Statistical Modeling) 2. Dr. Rehan Ahmad (Applied Statistics) 3. Dr. Maryam Ilyas (Statistical Modeling) 4. Dr. Sana Saeed (Data Science) 5. Dr. Nadia Saeed (Applied Statistics) 6. Dr. Samar Abbas (Computer Science and Data Science)	(06)
M.Phil.	7. Mr. Munawar Iqbal (Mathematical Statistics) 8. Ms. Irum Sajjad Dar (Applied Statistics) 9. Ms. Aasma Riaz (Applied Statistics) 10. Ms. Shumaila Abbas (Applied Statistics) 11. Mr. Ghulam Nabi (Finance) 12. Ms. Huma Shakeel (Applied Statistics) 13. Ms. Wajiha Batool (Applied Statistics) 14. Ms. Maham Faheem (Applied Statistics) 15. Ms. Deeba Akhter (Business Statistics)	(09)

13. Present Student Teacher Ratio in the Department

No. of Students: 350
No. of Permanent Faculty Members: 15
Student Teacher Ratio: 1 : 24

14. Course Outlines Separately for each course

* Core courses are according to undergraduate scheme

COURSE OUTLINES
FOR
SEMESTER – I

Course Title:	**Islamiat/Ethics**
Course Code:	**ISE-101**
Semester:	**I**
Credit Hours:	**02**

Learning Outcomes

By the end of this course, students will be able to:

1. promote feelings of love, grandeur, and obedience for Allah;
2. strengthen the belief of fundamental tenets of Islam in the minds and hearts of students, and to explain the importance and benefits of faith in their practical lives
3. aware of the greatness of the Holy Qur'ān and Ḥadīth and to create the ability to read and understand the Holy Qur'ān.
4. understand the Islamic Culture & Civilization, Islam & Science, Islamic Economic System, Political System of Islam, Social System of Islam.
5. aware of the magnificent and glorious history of the Muslims and their achievements in educational, spiritual, political, and military fields and to create a sense of restoration of the dignity of the past and renaissance of Islam.

Course Outline

Unit – I

1.1 Introduction to Quranic studies
Basic Concepts of Quran, History of Quran, Uloom-ul-Quran.

1.2 Study of the selected text of Holly Quran
Verses of Surah Al-Baqra Related to Faith (Verse No-284-286), Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18) Page 63 of 84, Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11), Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77), Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154), Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6, 21, 40, 56, 57, 58.), Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment, Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14).

Unit – II

2.1 Seerat of Holy Prophet (S.A.W)
Muhammad Bin Abdullah (Before Prophet Hood), Life of Holy Prophet (S.A.W) in Makkah, Important Lessons Derived from the life of Holy Prophet in Makkah, Life of Holy Prophet (S.A.W) in Madina, Important Events of Life Holy Prophet in Madina, Important Lessons Derived from the life of Holy Prophet in Madina.

2.2 Introduction to Sunnah

Basic Concepts of Hadith, History of Hadith, Kinds of Hadith.

2.3 Uloom –ul-Hadith
Sunnah & Hadith, Legal Position of Sunnah. The selected study from the text of Hadith.

Unit – III

3.1 Introduction to Islamic Law & Jurisprudence

Basic Concepts of Islamic Law & Jurisprudence, History & Importance of Islamic Law & Jurisprudence, Sources of Islamic Law & Jurisprudence, Nature of Differences in Islamic Law, Islam, and Sectarianism.

3.2 Islamic Culture & Civilization

Basic Concepts of Islamic Culture & Civilization, Historical Development of Islamic Culture & Civilization, Characteristics of Islamic Culture & Civilization, Islamic Culture & Civilization, and Contemporary Issues.

3.3 Islam & Science

Basic Concepts of Islam & Science, Contributions of Muslims in the Development of Science.

3.4 Islamic Economic System

Basic Concepts of Islamic Economic System, Means of Distribution of wealth in Islamic Economics, Islamic Concept of Riba, Islamic Ways of Trade & Commerce.

3.5 Political System of Islam

Basic Concepts of Islamic Political System, Islamic Concept of Sovereignty, Basic Institutions of Govt. in Islam.

3.6 Islamic History

Period of khilafat-e-Rashida, Period of Umayyads, Period of Abbasids.

3.7 Social System of Islam

Basic concepts of the social system of Islam, elements of family, ethical values of Islam.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Ahmad, K. (2020). *Islam: its Meaning and Message*. The Islamic Foundation.
2. Thomas, D., & Draper, M. (2011). *Islamiyat, a core text for Cambridge O Level, Karachi* (Rev. ed.). Oxford University Press.

Suggested Readings:

1. Ahmad, F. (2016). *The Four Caliphs of Islam*. Taj Company.
2. Bhatia, H.S. (2020). *Studies in Islamic Law, Religion and Society*. Deep & Deep Publications.
3. Hamidullah, M. (2012). *Emergence of islam*. Adam Publishers.
4. Hasan, K. (2010). *Principles of Islamic Jurisprudence*. Islamic Research Institute, International Islamic University.
5. Ramadan, T. (2007). *The Messenger, the meanings of the life of Muhammad*. Allen Lane.
6. Sharaf, Y., & Ibrahim, I. A. D. (1977). *An-Nawawi's forty hadith*. Holy Koran Publishing House.
7. Waliullah, M. (2018). *Muslim Jurisprudence and the Quranic Law of Crimes*. Islamic Book Service.
8. Yahya, H. (2013). *The Basic Concepts in the Qur'an*. Goodword Books.
9. Yahya, H. (2013). *The Moral Values of the Qur'an*. Goodword Books.

Course Title:	**English – I**
Course Code:	**ENG-101**
Semester:	**I**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. review the grammatical forms of English and the use of these forms in specific communicative contexts, which include: class activities, homework assignments, reading of texts, and writing.
2. attain and enhance competence in the four modes of literacy: writing, speaking, reading and listening.
3. read excerpts of fiction, creative non-fiction, essays, and opinion while analyzing the structural and sentence level arrangement of the writing.
4. write in an effective manner that demonstrates an understanding of the basic concepts of grammar.
5. effectively express and exchange ideas through various modes of communication.

Course Outline

Unit – I

1.1 Prose Essay
The Damined Human Race, The Last Lesson, Bromides and Sulphites.

Unit – II

2.1 Short Stories
The Killers, Rappaccini's Daughter and The New Constitution.

Unit – III

3.1 Grammar
Tenses, Parts of Speech, Translation Urdu to English, Vocabulary Building.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Butt, R. N. (2020). *A selection of short stories and One Act Plays for B.A.* Caravan Book House.
2. Hashemi, L., & Murphy, R. (2004). *English Grammar in Use Supplementary Exercises with Answers*. Cambridge University Press.

Suggested Readings:

1. Chisty, B.A. (2020). *Polymer English grammar and composition for B.A students*. Polymer publishers.
2. Khan, N. (2019). *A selection of English Prose for a B.Sc. Students*. Caravan Book House.
3. Nunberg, G., Sag, I. A., & Wasow, T. (1994). *Idioms. Language*, *70*(3), 491-538.

Course Title:	**Biostatistics I – Introduction**
Course Code:	**BSTA-101**
Semester:	**I**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand the key concepts of Biostatistics.
2. compute various summary statistics and make use of the graphical techniques to represent data we come across in health sciences.
3. acquire the basic knowledge of Regression and its applications.

Course Outline

Unit – I

1.1 Introduction to Biostatistics

Introduction to biostatistics. Variables and types of variables, Variability in observations, studying the pattern of variability. Measurements and scales of measurements.

1.2 Presenting the data

Frequency distributions and graphical presentation of data, Stem and leaf displays, Box and Whisker diagrams, Histograms, Pie Charts, Bar Charts, Frequency Curves.

Unit – II

2.1 Descriptive Statistics

Averages and Measures of Dispersion, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode, Trimmed Mean, Winsorized Mean.

2.2 Measure of Dispresion

Quantiles i.e. Quartiles, Deciles, and Percentiles. Moments, Moments ratios, Symmetry and Kurtosis: theory and examples with reference to bio-statistics.

Unit – III

3.1 Simple Linear Regression

Simple Linear Regression: properties and inference based on regression.

3.2 Bivariate correlation

properties, Rank correlation: theory and examples with reference to bio-statistics, Analysis of categorized data, Chi-square test.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Dawson, B., & Trapp, R. G. (2019). *Basic and Clinical Biostatistics* (5th ed.). McGraw Hill.
2. Glover, T., & Mitchell, K. (2015). *An introduction to biostatistics* (3rd ed.). Boston: McGraw-Hill.

Suggested Readings:

1. Daniel, W.W. (2018). *Biostatistics: A foundation for Analysis in the Health Sciences* (11th ed.). John Wiley and Sons, Inc. New York.
2. Le, C. T. (2009). *Health and numbers: a problems-based introduction to biostatistics* (3rd ed.). New York: Wiley-Liss.
3. Zar J. H. (2020). *Bio-statistical Analysis* (6th ed.). Pearson Education Indian Branch.

Course Title:	**Mathematics I – Linear Algebra**
Course Code:	**MATH-101**
Semester:	**I**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. compute the inverse of an invertible matrix and find the null space of a matrix and represent it as the span of independent vectors.
2. find the matrix representation of a linear transformation given bases of the relevant vector spaces.
3. explain the concepts of base and dimension of vector space.
4. explain matrix representation of a linear transformation.
5. compute the eigenvalues and eigenvectors of a linear transformation.

Course Outline

Unit – I

1.1 Matrices and Determinates
Matrix Algebra, Elementary Matrices, Diagonal and Triangular Matrices, Triangular Factorization, Determinants of a Matrix, Properties of Determinant.

Unit – II

2.1 System of Linear Equations
Introduction to the system of linear equations, Cramer's Rule, Matrix Inverse Rule, Gaussian Elimination Rule, LU Decomposition Rule.

Unit – III

3.1 Vector Spaces
Definition and Examples, Subspaces.

3.1.1 Independence
Linear Independence, Spanning Set, Basis, and Dimension.

Unit – IV

4.1 Linear Transformation
Definition and Examples.

4.1.1 Orthogonally
The Scalar Product in R^n, orthogonal Subspace, Inner Product Spaces.

4.1.2 Eigen Values

Eigen Values and Eigen Vectors, Diagonalization.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bretscher, O. (2019). *Linear algebra with applications*. Prentice Hall.
2. Datta, B. N. (2010). *Numerical linear algebra and applications*. Siam.

Suggested Readings:

1. Edwards, C. H., Penney, D. E., & Calvis, D. (2001). *Differential equations & linear algebra*. London.
2. Gentle, J. E. (2012). *Numerical linear algebra for applications in statistics*. Springer Science & Business Media.
3. Leon, S. J., Bica, I., & Hohn, T. (2018). *Linear algebra with applications*. Prentice Hall.

Course Title:	**Introduction to Biology**
Course Code:	**BIOS-101**
Semester:	**I**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. provide an understanding about the structure.
2. explain the functions of the human body.
3. identify and address major organ related diseases.

Course Outline

Unit – I

1.1 Introduction to Biology

Introduction to Human Biology, Human Life cycle

1.1.1 Structure of Cell

Definition and Structure of Cell, Tissue Structure and Types

Unit – II

2.1 Anatomy of Human Being and Diseases

Anatomy and Physiology of Human Organ and Organ Related Diseases.

2.2 Digestive and Respiratory System

Complete details of Digestive System and Respiratory System, Diseases related to these systems.

2.3 Heart and Brain of Human Being

Heart and Cardiovascular System, Lymphoid and Haemopoietic System (circulatory) Nervous and the special senses, and Muscular and Skeletal system.

2.4 Reproductive System

Excretory system, Urinary system, Reproductive System (Female and Male).

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Solomon, E. P. (2015). *Introduction to human anatomy and physiology*. Elsevier Health Sciences.

Suggested Readings:

1. Hall, J. E., & Hall, M. E. (2020). *Guyton and Hall textbook of medical physiology e-Book*. Elsevier Health Sciences.
2. Purcell, A. (2018). *Basic Biology: An Introduction*. New Zealand ISBN Agency, National Library of New Zealand.

Course Title:	**Introduction to Computer**
Course Code:	**COMP-101**
Semester:	**I**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. develop an understanding of computer hardware, software, and networking.
2. develop basic skills in using windows and Microsoft office, and creating web pages.
3. use computers safely, and to consider ethical issues related to computer usage.

Course Outline

Unit – I

1.1 Introduction

Generations of computers, Classifications of computers, Users of computers, Computer professionals, Types of programming languages. Elementary Components, Categories, Input/Output Devices, Central Processing Unit, Buses, expansion Slots, Instruction cycle, Boot sequence, Why computers are fast, Factors that make computers fast. Motherboards and processors, Ports, Interfacing Cards, Modems.

Unit – II

2.1 Software and Hardware

Memory and Storage, Operating System, Installation of Microsoft Windows XP Professional What is the internet? Instructional Aids/Resources, Introduction To Information Technology, Computer Input, Computer Output, Storage & Memory, Processing Hardware, Operating Systems and Utility Programs /System Software, Operating Systems and Utility Programs /System Software, Application Software, Networking Essentials, Networking Essentials

Unit – III

3.1 MS Office

MS-Word, MS-Powerpoint, MS-Excel, MS-Access.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bini, D., & Pan, V. Y. (2012). *Polynomial and matrix computations: fundamental algorithms*. Springer Science & Business Media.
2. O'brien, J. A., & Marakas, G. M. (2005). *Introduction to information systems* (Vol. 13). New York City, USA: McGraw-Hill/Irwin.

Suggested Readings:

1. Stallings, W. (2016). *Computer organization and architecture: designing for performance*. Pearson Education.
2. Stroustrup, B. (2018). *The C++ programming language*. Pearson Education.
3. Williams, B., & Sawyer, S. (2015). *Using Information Technology* (11th ed.). McGraw-Hill.

COURSE OUTLINES
FOR
SEMESTER – II

Course Title:	**Pakistan Studies**
Course Code:	**PST-101**
Semester:	**II**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. explain the significance of ideology for a nation.
2. understand the key events that led to the creation of Pakistan.
3. analyze the current situation in light of the past.
4. identify the various perspectives and develop their own historical understandings.

Course Outline

Unit – I

1.1 The ideology of Pakistan

Definition of Ideology and the ideology of Pakistan, Two Nation Theory, Aims and Objectives of the creation of Pakistan. Quaid-i-Azam Muhammad Ali Jinnah and Ideology of Pakistan, Allama Muhammad Iqbal and Ideology of Pakistan.

1.2 Historical Background of Pakistan's Ideology

Impact of Islam, National Services of Mujadad Alaf Thani Milli, Services of Hazrat Shah Waliullah and Syed Ahmed Shaheed. 1757 to 1857 Era of East India Company. Educational and Religious Movements: Aligarh Movement, Darul Aloom Dauband, Nadwat ul Ullman. Hamiet-i-Islam etc. & Hindu Revivalist Movements.

Unit – II

2.1 The era of Political Awareness

Urdu Hindi controversy – Separate Electorate, Division of Bengal 1905, Simla Deputation 1906-Formation of Muslim League 1906, Minto Morley Reforms (1909).

2.2 Politics of Compromise and Conflicting

Lukhnow Pact 1916 – Reforms 1919 – Khilafat Movement, 1922, Nehro report 1928 – Fourteen Points of Jinnah 1929 etc.

Unit – III

3.1 Final Struggle for Pakistan

Allama Iqbal's Address 1930, Roundtable Conferences 1930-31,32; Government Act of 1935,

Congress Ministries – Dark Period for Muslims 1937-39, Pakistan Resolution 1940, Major Events from 1940 to 1946. Cabinet Mission Plan 1946.

3.2 Establishment of Pakistan

Emergence of Pakistan & Initial Problems after the creation of Pakistan, Quaid-e-Azam Services as a Governor-General Important Events 1947 to 1956.

Unit – IV

4.1 Islamization in Pakistan

Objective Resolution, Islamic Provision of 1956, 1962, 1973 Constitution, Zia-ul-Haq's steps for Islamization & Other steps taken by ruler till 2007.

Unit – V

5.1 Land of Pakistan and its Physical Features

Location of Pakistan & its importance, Natural Resources of Pakistan.

5.2 Economy, Population and Education of Pakistan

Economic Development – (Agricultural Industry Trade). Education System of Pakistan – Population of Pakistan, Pakistan & The World of Islam, Saudi Arabia, Iran, Afghanistan.

Unit - VI

6.1 Organizations of the Islamic World and Role of Pakistan

OIC, RCD Rabta Alim Islami, Motamir Almi Islami, ECO

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Jalal, A. (2016). *The struggle for Pakistan*. Harvard University Press.
2. Mujahid, S. (2019). *Ideological Orientation of Pakistan*. National Book Foundation.

Suggested Readings:

1. Jaffrelot, C. (2014). *A history of Pakistan and its origins* (1st ed.). Anthem Press.
2. Sarwar, M. (2020). *A textbook of Pakistan studies.* Illmi Kitab Khana.
3. Zaman, W. (2017). *Towards Pakistan.* Sheikh Ghulam Ali Sons.

Course Title:	**English II**
Course Code:	**ENG-102**
Semester:	**II**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. discriminate between formal and informal language use.
2. communicate effectively in speech and writing with different audiences for a variety of purposes.
3. communicate their own ideas clearly by applying their knowledge of grammar and usage in written and oral presentations.
4. identify the main stylistic features of descriptive, narrative, persuasive, and argumentative texts.

Course Outline

Unit – I

1.1. Prose Essay

How to live to be 200, The Open Window, The Place of Science in Liberal Education.

Unit – II

2.1 Short Stories

Breakfast, Take Pity, The Happy Prince.

2.2 Grammar

Report Writing, Letter Writing, Essay Writing, Translation Urdu to English, Comprehension.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Butt, R. N. (2020). *A selection of Short stories and One-Art Plays for (B.A Students).* Caravan Book House.
2. Hashemi, L., & Murphy, R. (2014). *English Grammar in Use Supplementary Exercises with Answers*. Cambridge University Press.

Suggested Readings:

1. Chisty, B.A. (2020). *Polymer English grammar and composition for ba students*. Polymer publishers.
2. Khan, N. (2019). *A selection of English Prose for a B.Sc. Students*. Caravan Book House.
3. Nunberg, G., Sag, I. A., & Wasow, T. (1994). *Idioms. Language*, *70*(3), 491-538.

Course Title:	**Biostatistics II–Distribution Theory**
Course Code:	**BSTA-102**
Semester:	**II**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn the basic concepts of Probability and its related terminologies.
2. derive the probability function and properties of various discrete and continuous distributions.
3. grasp the knowledge of the practical applications of these distributions in the field of health/medical sciences.
4. learn the relationship between different distributions.

Course Outline

Unit – I

1.1 Introduction to Probability and its Basic Techniques
Basic Terminology used in Probability. Set theory, Classification of events.

1.1.1 Probability

Definitions of Probability. Independence of events, Conditional Probability, Baye's rule.

Unit – II

2.1 Discrete Distributions
Discrete Random Variables, Probability Distribution, Mean and Variance of a discrete random variable. Bernoulli trials. Properties, applications and fitting of Binomial, Poisson, Hypergeometric, Negative Binomial and Geometric distributions with applications in the field of health sciences.

2.2 Continuous Distributions
Continuous Random Variable, probability density function and its properties. Normal Distribution and its properties, Standard Normal Curve, Normal approximation to Binomial and Poisson distributions. Exponential distribution. Central Limit Theorem, Approximation to distributions and real-world examples of these distribution in reference to Biostatistics.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Munro, B. H. (2012). *Statistical Methods for Health Care Research* (6th ed.). Lippincott, Philadelphia.
2. Walpole, R. E., Myers, R. H., Myers, S, L. & Ye, K. (2016). *Probability and Statistics for Engineers and Scientists* (9th ed.). Prentice Hall, New York.

Suggested Readings:

1. Fowler, J., Cohen, L. & Jarvis, P. (2018). *Practical Statistics for Field Biology* (2nd ed.). John Wiley and Sons, New York.
2. Lehman, E. L., & Casella, G. (2019). *Theory of Point estimation* (4th ed.). Springer, New York.

Course Title:	**Mathematics II – Calculus**
Course Code:	**MATH-102**
Semester:	**II**
Credit Hours	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. define the basic concepts and principles of differential and integral calculus of real functions and sequences and series.
2. analyze the properties of functions based on graphs obtained.
3. learn the limits of functions.
4. organize solution of complex problems by combining the acquired mathematical concepts and principles.

Course Outline

Unit – I

1.1 Introduction to functions and graphs
Functions and graphs, polynomial and rational functions, inverse functions.

1.1.1 Limits of functions
Limit of functions, limit at a finite point, limit at infinity, continuity.

Unit – II

2.1 Preliminaries of derivatives
The derivatives, power and sum rules, product and quotient rules.

2.1.1 Formal rules of derivatives
Chain rule and rules for trigonometric functions, exponential functions, logarithmic functions, hyperbolic functions and extreme functions.

Unit – III

3.1 Rules of integration
Techniques of evaluating the integrals, integration by substitutions, integration by parts, double integrals.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Larson, R., & Edwards, B. H. (2020). *Calculus: Early transcendental functions*. Cengage Learning.
2. Thomas, G. B., Finney, R. L., Weir, M. D., & Giordano, F. R. (2017). *Thomas' calculus*. Reading: Addison-Wesley.

Suggested Readings:

1. Leithold, L. (2015). *The calculus of a single variable with analytic geometry*. Harper & Row.
2. Silverman, R. A. (2002). *Modern calculus and analytic geometry*. Courier Corporation.
3. Stewart, J. (2015). *Single variable calculus: Early transcendentals*. Cengage Learning.
4. Swokowski, E. W. (2008). *Calculus with analytic geometry*. Taylor & Francis.

Course Title:	**Demography**
Course Code:	**STAT-101**
Semester:	**II**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. identify the key concepts of Demography and appropriate sources of data.
2. perform basic demographic analyses using various techniques and ensure their comparability across populations.
3. produce population projections and interpret the information gathered by the different demographic methods.

Course Outline

Unit – I

1.1 Introduction to Demography

Introduction to Demography and sources of demographic data, Components of population growth, Composition of population and vital events.

1.2 Population Censuses

The population censuses, Registration of vital events, Use of sampling in collection of demographic data

Unit – II

2.1 Methods of Enumeration and Demographic Surveys

Demographic surveys and other sources, Methods of enumeration, Demographic concepts and measures.

2.1.1 Analysis of Demographic Surveys

Current and Cohort methods of description and analysis, Testing the accuracy of demographic data, Types of sources of errors, General testing procedures.

Unit – III

3.1 Distribution and Methods of Standardization

Testing the accuracy of age and sex data, Checking the accuracy of graphs of single-year distributions, Checking the accuracy of graphed age data.

3.1.1 Demographic Measures

Basic demographic measures, Fertility and mortality measures, Total and general fertility rates, Standardized death and birth rates, Gross and net reproduction rates, Infant and maternal mortality rates and their applications to the data related to health/medical sciences.

Unit – IV

4.1 Life Tables

Life tables, Construction of complete and abridged life tables, Graphs of 1X, qX, and dX, Description and uses of life tables columns, Stationary population.

4.1.1 Population Projections and Analysis

Population estimates and projections, Intercensal estimates and postcensal estimates, Components and mathematical methods for intercensal and postcensal estimates.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Swanson, D.A., & Siegel, J.S. (2004). *Methods and Materials of Demography* (2nd ed.). Emerald Publisher.
2. Farhat, Y. (2020). *Demographic Techniques*. Pergamon Press: New York.

Suggested Readings:

1. Hinde, A. (2018). *Demographic Methods* (1st edition). Routledge.
2. Poston, D. L., & Bouvier, L. F. (2016). *Population and society an introduction to demography* (2nd ed.). New York: Cambridge University Press.
3. Srivastav, O.S. (1998). *Demography and Population Studies*. (2nd ed.). Vikas Dehli, India.

Course Title:	**Introduction to Sociology**
Course Code:	**SOCI-101**
Semester:	**II**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. discuss the social contexts of wellness and illness.
2. explain the patient's perspective on the experience of illness including meaning-making and interaction with care providers.
3. identify the socio-cultural aspects of health and illness, particularly as relating to the definitions of health, illness behavior and social epidemiology.
4. investigate the social causes of disease and illness related to disparities due to social stratification and unequal access.

Course Outline

Unit – I

1.1 Introduction to Sociology
Sociological Theory, Culture, Socialization, Race & Ethnicity. Evolution of Health & Healing. Body, Mind, Illness and Environment.

1.2 Medical Sociology
Theories, research, and debates of medical sociology. Social, environmental, and occupational factors in health and illness.

Unit – II

2.1 Health Profession
The historical transformation of the health professions and the health work force.

2.2 Social Factors and Diseases
The social and cultural factors surrounding the creation and labeling of diseases.

Unit – III

3.1 Healthcare
Disparities in health, access to healthcare, and the quality of healthcare received.

3.2 Rising Cost and Health Care Reforms
Organizational and ethical issues in medicine including rising costs and medical technology; and health care reform.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bird, C. E., Conrad, P., & Fremont, A. M. (2000). Medical sociology at the millennium. *Handbook of medical sociology*, 1-10.
2. Nettleton, S. (2020). *The sociology of health and illness*. John Wiley & Sons.

Suggested Readings:

1. Bhambra, G. K., & Santos, B. D. S. (2017). Introduction: Global challenges for sociology.
2. Carr, D. (2019). Medical Sociology. *Notes*, *56*(2).
3. Giddens, A., & Sutton, P. W. (2021). *Sociology*. John Wiley & Sons.
4. Link, B. G., & Phelan, J. (2010). Social conditions as fundamental causes of health inequalities. *Handbook of medical sociology*, *6*, 3-17.
5. Major, B., Dovidio, J. F., & Link, B. G. (Eds.). (2018). *The Oxford handbook of stigma, discrimination, and health*. Oxford University Press.
6. Ritzer, G., & Murphy, W. W. (2019). *Introduction to sociology*. Sage Publications.

Thompson, W. E., Hickey, J. V., & Thompson, M. L. (2016). *Society in focus: An introduction to sociology*. Rowman & Littlefield.

COURSE OUTLINES
FOR
SEMESTER – III

Course Title:	**English III – Communication Skills**
Course Code:	**ENG-201**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. improve their speaking ability in English both in terms of fluency and comprehensibility.
2. give oral presentations and receive feedback on their performance.
3. increase their reading speed and comprehension of academic articles
4. improve their reading fluency skills through extensive reading
5. enlarge their vocabulary by keeping a vocabulary journal

Course Outline

Unit – I

1.1. How Communication Works

Influence or Persuade?, Identifying and Adjusting your Communication Style, Five Communication Styles, The 6 Cs of Communication, The Four-Step Cycle of Communication, The Dynamics of Communication, Communication is a Two-Way Street.

1.2. Face-to-Face Communication

First Impressions, Appearance, On the Front Foot: Being Positive, Using the Right Words, The Three Components of Communication, Body Language, and Non-Verbal Messages.

1.3. Telephone Communication

Overcoming the Challenges of Telephone Communication, Improving Telephone Communication, Factors of Voice, Advantages of Telephone Communication, Disadvantages of Telephone Communication.

1.4. Written Communication

Quick Tips for Types of Messages, The Power of Words, Right First Time, Keep it Concise, Address your target, Keep it Simple, Your Three Stage Structure.

Unit – II

2.1 Questioning and Listening Skills

Verbal Signs of Active Listening, Non-Verbal Signs of Active Listening, Active Listening, The Five Levels of Listening, How Asking Question Helps You, Open and Closed Questions, The Funnel.

2.2 How to be an Effective Communicator

Your Level of Understanding, Dismantling your Assumptions, Prejudices, Your Preconceptions: Stereotyping, Your History & Experiences, Asking for Feedback, How to Find Out What Others Think About You, Is your Self-Image Correct?, Getting your Self-Image Right, The Wheel of Communication.

Unit – III

3.1 Overcoming Communication Problems

Four Tips for Delivering Difficult Messages, Delivering Difficult Messages, Dealing With Conflict, Dealing With Opposition, Barriers to Communication, Why Communication Goes Wrong.

3.2 Getting Better Outcomes

Best Practices For Communicating Effectively, Timing: What's Best For Them, The Effect of Location, Intimidation. Official Writings.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bovée, C. L., Thill, J. V., & Raina, R. L. (2016). *Business communication today*. Pearson Education.
2. Carnegie, D., & Carnegie, D. (2019). *The quick and easy way to effective speaking*. Random House.

Suggested Readings:

1. Ajmani, J. C. (2012). *Good English: getting it right*. New. Rupa Publications.
2. Carnegie, Dale. *The quick and easy way to effective speaking*. Pocket Books.
3. Fitikides, T. J. (1984). *Common Mistakes in English*. Orient Longman.
4. Patrick, C. (2009). *Speak with Power and Confidence*. Sterling.

Course Title:	**Biostatistics III – Decision Making**
Course Code:	**BSTA-201**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. apply basic statistical concepts commonly used in Health Sciences.
2. use basic analytical techniques to generate results.
3. interpret results of commonly used statistical analyses in written summaries; and
4. demonstrate statistical reasoning skills correctly and contextually.

Course Outline

Unit – I

1.1 Basic concepts of Statistics
Introduction to Biostatistics and Descriptive Statistics, Probability concepts; Laws of Probability, and Probability Distributions.

1.2 Statistical Inference
Sample statistics and population parameters, Sampling distributions, Confidence intervals
Null and alternative hypotheses and how to set up a statistical test.

Unit – II

2.1 Parametric Testing
Conducting a Z-test; the t-distribution; conducting a t-test for Independent Samples, Examples of Matching and Pairing; t-test for Dependent samples, and F-test.

2.2 Chi-Square Distribution
Tests based on Chi-Square distributions: Test of Association, Homogeneity test, and tests for the Equality of Population Variances.

Unit – III

3.1 Regression Analysis
Method of least squares; definition of residuals, Assumptions of simple linear regression model; assessing assumptions.

3.2 Correlation analysis
Pearson's correlation coefficient; inference and interpretation of correlation coefficients.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Longford, N. T. (2021). *Statistics for Making Decisions*. CRC Press.

Suggested Readings:

1. Chaudhry, S.M. & Kamal, S. (2021). *Introduction to Statistical Theory Part II*. Ilmi Kitab Khana, Urdu Bazar, Lahore.
2. Johnson, R.A. & Wichern, D.W. (2003). *Business Statistics: Decision making with data,* John Wiley & Sons Inc.
3. Levine, D.M., Kschbiel, T.C. & Berenson, M.L. (2009). *Business Statistics: A first course* (5^{th} ed.). Pearson Education.
4. Macfie, B.P. & Nufrio, P.M. (2006). *Applied Statistics for public policy*, Prentice Hall of India.
5. Suchmacher, M., & Geller, M. (2012). *Practical biostatistics: a friendly step-by-step approach for evidence-based medicine*. Academic Press.

Course Title:	**Mathematics III – Numerical Analysis**
Course Code:	**MATH-201**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. solve of the linear and non-Linear equation.
2. apply basic numerical methods and the theory behind them, related to interpolation and approximation, numerical integration, and solving first-order ordinary differential equations.
3. use Newton's forward and backward formulae for numerical differentiation.

Course Outline

Unit – I

1.1 Error Analysis

Errors, Absolute errors, Rounding errors, Truncation errors, Inherent Errors, Major and Minor approximations in numbers.

1.2 The Solution of Linear Systems

Jacobi iterative Method, Gauss-Seidel Method, Eigenvalue and eigenvector, Power method.

1.3 The Solution of Non-Linear Equation

Bisection method, Newton Raphson method, Secant method, Method of false position.

Unit – II

2.1 Difference Operators

Shift operators, Forward difference operators, Backward difference operators, Average, and central difference operators.

2.2 Interpolation

Lagrange's interpolation, Newton's divided difference interpolation, Newton's forward and backward difference interpolation.

2.3 Numerical Differentiation

Newton's Forward, Backward formulae for numerical differentiation.

2.4 Numerical Integration

Rectangular rule, Trapezoidal rule, Simpson rule, Boole's rule, Weddle's rule.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Chapra, S. C., & Canale, R. P. (2010). *Numerical methods for engineers*. McGraw-Hill Higher Education.
2. Ferziger, J. H. (2019). *Numerical methods for engineering application*. Wiley.

Suggested Readings:

1. Hamming, R. (2012). *Numerical methods for scientists and engineers*. Courier Corporation.
2. Mathews, J. H. (2017). *Numerical methods for mathematics, science and engineering*. Prentice-Hall International.
3. Neumaier, A. (2001). *Introduction to numerical analysis*. Cambridge University Press.

Course Title:	**Introduction to Epidemiology**
Course Code:	**BSTA-202**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. introduce the basic principles and methods of epidemiology and demonstrate their broad applicability to public health.
2. distinguish between descriptive and inferential statistics resulting from data analysis.
3. provide fundamental skills needed to interpret and critically evaluate literature relevant to public health professionals.
4. provide a structured method for organizing and analyzing raw data and to enable you to interpret and communicate the results to public health professionals and to the general public.

Course Outline

Unit – I

1.1. Introduction to Disease Occurrence

Measuring Disease Occurrence, Surveillance, Infectious Disease Epidemiology.

Unit – II

2.1 Measures of association

Different measures of association, Direct and Indirect Standardization.

2.1.1 Data Sources and Analysis

Data Sources and Secondary Analyses, Hypothesis Testing and Significance, Bias, Confounding, and Effect Modification, Causation and Risk.

Unit – III

3.1 Sampling Strategies

Sampling Strategies and Descriptive Studies (Ecological, Cross Sectional, and Qualitative).

3.1.1 Popular Epidemiological Study Types

Case Control and Nested Case Control Studies, Cohort Studies, Intervention Studies, Screening.

3.1.2 Specific Types of Epidemiological Studies

Environmental Epidemiology, Genetic and Molecular Epidemiology.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Antonisamy, B., Premkumar, P. S., & Christopher, S. (2017). *Principles and Practice of Biostatistics-E-book*. Elsevier Health Sciences.
2. Bojdani, E. (2017). *Essential Epidemiology: An Introduction for Students and Health Professionals* (3rd ed.). Cambridge, UK: Cambridge University Press.

Suggested Readings:

1. Brauer, F., Castillo-Chavez, C., & Feng, Z. (2019). *Mathematical models in epidemiology* (Vol. 32). New York: Springer.
2. Carneiro, I. (2018). *EBOOK: Introduction to Epidemiology*. McGraw-Hill Education (UK).
3. Carstensen, B. (2021). *Epidemiology with R*. Oxford University Press, USA.
4. Chen, X. (2020). *Statistical Methods for Global Health and Epidemiology: Principles, Methods and Applications*. Springer Nature.
5. Foti, C., Bonamonte, D., Bosco, A., & Angelini, G. (2021). *Introduction and Epidemiology: In Clinical Contact Dermatitis.* (pp. 1-9). Springer, Cham.
6. Liu, J., & Xia, S. (2020). *Computational epidemiology: From disease transmission modeling to vaccination decision making*. Springer Nature.
7. Merrill, R. M. (2019). *Introduction to epidemiology*. Jones & Bartlett Learning.

Course Title:	**Health Economics**
Course Code:	**ECON-201**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. analyse and manage the financing problems being faced by the health managers in routine as well as in special circumstances.
2. apply the management functions such as planning, organizing, staffing controlling and evaluating interventions in health care settings.
3. construct budgets, undertake financial costing and cost effectiveness of healthcare services.
4. evaluate different economic approaches for better priority setting in health care.

Course Outline

Unit – I

1.1 Health Economics

Introduction to Health Economics, Application of economics.

1.1.1 Health System

Marketing tactics in health system, Economics and health system, Key economic concepts and health, Money, health care services, behavior and health.

1.1.2 Demands and Supply

Wants, Needs, Demands and Supply estimations for health, Economic, Cost, Choices, Benefits and Efficiency.

Unit – II

2.1 Building and Infrastructure

Health economics of Building & infrastructure, Supplies and Utilities.

2.1.1 Human recourses with Research

Planning for Rainy days, Planning for special demands, The health economy team.

Unit – III

3.1 Health Economics

Health economics of Pakistan, Health Care Financing, Health and Markets.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bhattacharya, J., Hyde, T., & Tu, P. (2013). *Health economics*. Macmillan International Higher Education.
2. Guinness, L., & Wiseman, V. (2011). *Introduction to health economics*. McGraw-Hill Education (UK).

Suggested Readings:

1. Henderson, J. W. (2014). *Health economics and policy*. Cengage Learning.
2. Jack, W. (1999). *Principles of health economics for developing countries*. World Bank Publications.
3. Olsen, J. A. (2017). *Principles in health economics and policy*. Oxford University Press.
4. Phelps, C. E. (2017). *Health economics*. Routledge.
5. Sloan, F. A., & Hsieh, C. R. (2017). *Health economics*. MIT Press.
6. Wonderling, D. (2011). *Introduction to health economics*. McGraw-Hill Education (UK).

Course Title:	**Operations Research**
Course Code:	**STAT-201**
Semester:	**III**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. analysis and planning of complex systems.
2. apply mathematical modeling the real world scenario.
3. apply Linear and Integer Programming.
4. build their own formulations, to expand existing formulations.
5. evaluate the impact of model assumptions.

Course Outline

Unit – 1

1.1 Introduction

Definition and nature of Operations Research (OR) Major Phases of an OR study.

1.2 Modeling

Modeling, constraints, objective and criterion. Problems of multiple criteria.

Unit – II

2.1 OR Methodology

Mathematical programming; optimum seeking; simulation etc. Examples of OR Applications. Linear Programming, Feasible and Optimal Solutions.

2.2 Types of Models

Linear Programming Techniques, Graphical Solution of two-variable linear model, simplex method. Theory of Simplex Method, foundation of simplex method, revised simplex method.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

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3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Hillier, Frederick S., & Gerald J. Lieberman (2020). *Operation Research* (15th ed.). Inc. San Francisco, California.

Suggested Readings:

1. Richard, B., & Costa, G. B. (2014). *Schaum's Outline of differential equations*. McGraw-Hill Education.
2. Taha, H. A. (2016). *Operations Research: An Introduction (*14th ed*).* Macmillan Publishing Company, New York.

COURSE OUTLINES
FOR
SEMESTER – IV

Course Title:	**English IV**
Course Code:	**ENG-202**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. develop skills in listening, reading, viewing, speaking, writing, and presenting.
2. effectively convey meanings and intentions through language.
3. form critical ideas, authentic opinions and expressing them effectively.

Course Outline

Unit – I

1.1 Short Stories
A conversation with my Father, The Fly, A Passion in the Dessert, The Little Willow.

1.2 Poetry
Leisure, New Years Resolutions, The Solitary Reaper, All the World's at stage, A Poison Tree, Because I could not stop here for Death, After Apple Picking.

Unit – II

2.1 Grammar
Idioms, use of tenses, use of adverbs, questions without auxiliaries.

2.2 Skill enhancement
C.V. making, application writing, paragraph writing, presentation.

2.3 Vocabulary
Words relating to places; words that come together (Collocations), words relating to jobs and professions, relationships and free time, and transport and tourism.

2.4 Pronunciation
Improving fluency and pronunciation through focus on stressed words and verbs with –Ed endings, syllables and fast speech with 'going to', compound nouns, linking the word 'Can' in sentences, weak forms of 'Have' and 'Have to', weak forms of was and were.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary).

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Tallerman, M. (2015). *Understanding syntax*. Routledge.
2. Wren, P. C., & Martin, H. (2000). *English grammar and composition*. New Delhi: S Chand & Company Ltd.

Suggested Readings:

1- Kim, J. B., & Sells, P. (2007). *English syntax: An introduction*. *Centre for the Study of Language and Information*.
2- Lessard-Clouston, M. (2013). *Teaching vocabulary*. TESOL International Association.
3- Purpura, J. E. (2004). *Assessing grammar*. Cambridge.

Course Title:	**Categorical Data Analysis**
Course Code:	**BSTA-203**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. know the nature of categorical variables and their measurement scales.
2. ascertain the knowledge of sampling distributions for categorical variables and learn the methods of testing hypothesis with applications.
3. learn various tools and techniques to analyze categorical data and their applications to the real-world problems of medicine.

Course Outline

Unit – I

1.1 Categorical Data and its Sampling Distributions

Introduction & Historical Background of Categorical Data, Categorical Response Data.

1.1.1 Types and Scale

Types of Categorical Variables, Measurement Scales Distinction, Sampling distributions.

1.1.2 Test of Independence

Testing goodness of fit and independence, Large Sample confidence intervals.

Unit – II

2.1 Tests of Association for Categorical Data

Chi-square Test for Categorical Data with its Assumptions, Kendall's Tau b Statistic, Inference for two-way tables.

2.2 Relative Risk and Odds Ratio

Concepts and estimation of Relative Risk and Odds Ratio with its Confidence Limits, Testing of Statistical Significance of Relative Risk and Odds Ratio.

2.3 Meta Analysis and Testing

Meta Analysis for (2x2xk) Tables and Cochran-Mantel-Haenszel Test, Matched Samples and McNemar Test.

Unit – III

3.1 Sensitivity and Specificity of Diagnostic Tests

Introduction of Sensitivity, Specificity and Kappa Statistic with examples.

3.2 Categorical Models

Biostatistics and Models for Binary Response Variables.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Agresti, A. (2012). *Categorical data analysis* (3rd ed.). John Wiley & Sons.
2. Lloyd, C. J. (2019). *Statistical analysis of categorical data* (2nd ed.). John Wiley & Sons.

Suggested Readings:

1. Agresti, A. (2010) *Analysis of Ordinal Categorical Data* (2nd ed.). John Wiley & Sons.
2. Leonard, T., & Papasouliotis, O. (2000). *A course in categorical data analysis*. Boca Raton, Fla: Chapman & Hall/CRC Press.
3. Powers D. A., & Xie Y. (2008). *Statistical Methods for Categorical Data Analysis* (2nd ed.). Emerald Group Publishing.

Course Title:	**Statistical and Mathematical Computing**
Course Code:	**BSTA-204**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand data analysis.
2. deal with issues related to data entry.
3. apply analysis, and methods of evaluation related to business.
4. implement and evaluate primary and secondary data during their professional career.

Course Outline

Unit – I

1.1 Introduction

Variables their types and scales of measurement. Introduction to SPSS package: structure of windows, procedures, abilities and limitations, Editing and manipulating files. Applications of Compute, Recode, select cases Command. Library Functions.

1.2 Exploring data

Frequency distributions, descriptive statistics, and graphical representation of a Data. Statistical Assumptions (Normality, Randomness, Homogeneity).

Unit – II

2.1 Applications of Probability Distributions

Binomial, Hypergeometric, Poisson, Normal in Business. Computation of Mean, Variance and Standard deviation for these distributions.

2.2 Statistical Inference

Tests about Mean/Median (Parametric and Non-Parametric): i) Single sample ii) Two samples for dependent and independent Cases, iii) More than two Samples for dependent and independent cases. Tests about Proportions: i) Single Proportion ii) Several proportions for equal and unequal cases. Tests about Homogeneity (Variance): i) Two Samples ii) More than Two Samples.

Unit – III

3.1 Cross-tabulation of distribution

Studying the relationship between two categorical variables. Cell statistics and table statistics. Applications of Regression and Correlation in Business. Statistical Quality Control Charts and their applications in Business.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Field, A. P. (2020). *Discovering statistics using SPSS* (3rd ed.). London, England: SAGE.
2. Hinton, P. R., & McMurray, I. (2017). *Presenting your data with SPSS explained*. Taylor & Francis.

Suggested Readings:

1. Baarda, B., & van Dijkum, C. (2019). *Introduction to Statistics with SPSS*. Routledge.
2. Denis, D. J. (2018). *SPSS data analysis for univariate, bivariate, and multivariate statistics*. John Wiley & Sons.
3. Morgan, G. A., Barrett, K. C., Leech, N. L., & Gloeckner, G. W. (2019). *IBM SPSS for introductory statistics: Use and interpretation*. Routledge.
4. Stockemer, D., Stockemer, & Glaeser. (2019). *Quantitative methods for the social sciences*. Springer International Publishing.

Course Title:	**Introduction to Biomedical Research**
Course Code:	**BSTA-205**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. recognize the experimental design, experimental implementation, data evaluation and communication in modern biomedical research, and discuss these concepts in an ethical context.
2. distinguish between the scientific and technical basis of selected advanced techniques in biomedical research.
3. comprehend the competency in statistical analysis, hypothesis testing and data presentation.
4. understand the need for the active management of intellectual property issues, scientific integrity and conflict of interest in a contemporary biomedical research context.

Course Outline

Unit – I

1.1 Overview of biomedical research
Formulating research question, literature review, measures of disease frequency.

1.2 Study designs
Descriptive study designs, analytical study designs, experimental study designs, clinical trials, validity of epidemiological data.

Unit – II

2.1 Sampling
Choosing the study subjects, specifications of research subjects, sampling and recruitment of research subjects.

2.2 Statistical analysis
Hypothesis testing, data presentation.

2.3 Intellectual property issues
Scientific integrity, conflict of interest in biomedical research.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Daniel, W. W., & Cross, C. L. (2019). *Biostatistics: A foundation for analysis in the health sciences*. Wiley.
2. Indrayan, A., & Malhotra, R. (2018). *Medical biostatistics*. Chapman and Hall/CRC.

Suggested Readings:

1. Berger, M. P., & Wong, W. K. (2009). *An introduction to optimal designs for social and biomedical research*. John Wiley & Sons.
2. Capaldi, M. (2019). *Data science and predictive analytics: Biomedical and health applications using R*. Springer.
3. Pagano, M., & Gauvreau, K. (2018). *Principles of biostatistics*. Chapman and Hall/CRC.
4. Pilkington, T. C., Loftis, B., Palmer, T., & Budinger, T. F. (2020). *High-performance computing in biomedical research*. CRC Press.
5. Pitt, S. J., & Cunningham, J. (2009). *An introduction to biomedical science in professional and clinical practice*. John Wiley & Sons.
6. Rosner, B. (2016). *Fundamentals of biostatistics*. Cengage Learning.

Course Title:	**Regression and Time Series Models**
Course Code:	**STAT-202**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. select, implement and interpret appropriate regression models to explain real-world phenomena.
2. demonstrate an understanding of the limitations and uncertainties associated with regression models.
3. state the assumptions of regression models and investigate these assumptions using appropriate plots and statistics.
4. demonstrate a command of the mathematical foundations of regression models.
5. grasp the basic concept of Time Series and its components.

Course Outline

Unit – I

1.1 Simple and Multiple Regression

Inference about regression coefficient for simple and multiple linear regression up-to three regressors. Standard error of estimate. Coefficient of determination. Linear correlation. Multiple and partial correlation. Matrix approach to linear regression.

1.2 General Linear Models and Diagnostics

General Linear Models, Least Squares procedure, Inferences in regression, Model selection procedures and Analysis of residuals: Assumptions and Diagnostics. Confidence intervals for regression and correlation coefficients.

1.3 Testing Procedures

Testing linearity of regression. Partial F-test, Sequential test, Test for Proportion, Test for standard deviation.

Unit – II

2.1 Introduction to Time Series and its Components

Introduction and Objectives of time series analysis, Components of time series, time series plots, time series and stochastic processes, means and convergences.

2.2 Descriptive Techniques and Methods of Analyzing Time Series

Simple Descriptive Techniques: Stationary time series, transformations, Analyzing the secular trend, filtering, Differencing, Analyzing Seasonal Variations, Analyzing Cyclical Variations, Analyzing Irregular Variations, Auto-correlation (correlogram) and other tests of randomness.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Chatfield, C. (2004). *The analysis of time series: an introduction* (6th ed.). Boca Raton, FL: Chapman & Hall/CRC.
2. Peck, E. A., Vining, G., & Montgomery, D. C. (2012). *Introduction to Linear Regression Analysis* (5th ed.). Wiley.

Suggested Readings:

1. Chatterjee, S., Hadi, A. S., & Price, B. (2013). *Regression Analysis by Example* (5th ed.). John Wiley and Sons, N. Y.
2. Cryer, J. D. (2008). *Time series analysis* (2nd ed.). Boston: Duxbury Press.
3. Dupont, W. D. (2009). *Statistical Modeling for Biomedical Researchers* (2nd ed.). Cambridge University Press.
4. Gunst, R. F. (2018). *Regression analysis and its application: a data-oriented approach. New York*. Routledge
5. Montgomery, D. C., & Jennings, C. (2008). *Forecasting and time series analysis*. New York: Wiley.
6. Zar J. H. (2004). *Bio-statistical Analysis* (4th ed.). Pearson Education, Indian Branch.

Course Title:	**Financial Mathematics**
Course Code:	**MATH-202**
Semester:	**IV**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. demonstrate understanding of basic concepts in linear algebra, relating to linear equations, matrices, and optimization.
2. demonstrate understanding of concepts relating to functions and annuities.
3. employ methods related to these concepts in a variety of financial applications.
4. use appropriate technology to aid problem solving and demonstrate skills in writing mathematics.

Course Outline

Unit - I

1.1 Cash Flow Models

Generalized cash flow model, cash flow process, cash inflow and cash out flow for fixed and uncertain amounts, cash flow in zero coupon bond.

1.2 Securities

Fixed interest securities, index linked securities, cash on deposit, an equity, interest only loan, repayment loan, an annuity certain.

1.3 Interest

Accumulation with simple and compound interest, present value, simple discount rate. Interest rates: interest rates in different terms, yearly, monthly interest rates, effective and nominal interest rates, equivalent annual rate of interest over a specified period. Real and money interest rates.

Unit - II

2.1 Discounting and accumulating

Constant and variable interest or discount rates, force of interest, present values of equal and unequal payments, deferred and not deferred payments, Annuities, Loan schedules.

2.2 Project appraisal

Discounted cash flow techniques in investment projects, net present value and accumulated profits of receipt and payments, internal rate of return, payback period and discounting payback periods, money weighted rate of returns, the time weighted rate of returns, linked internal rate of return on investment or fund.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bowers, N. L., Gerber, H. U., Hickman, J. C. et al. (2015) *Actuarial mathematics* (2nd ed.). Institute of Actuaries.
2. Butcher, M. V. & Nesbitt, C. J. (2007). *Mathematics of compound interest*. Ulrich's Books

Suggested Readings:

1. Garrett, S. J. (2013). *An introduction to the mathematics of finance*: *a deterministic approach* (2nd ed.). Butterworth-Heinemann.
2. Gerber, H. U. (1996) *Life insurance mathematics* (3rd ed.). Springer; Swiss Association of Actuaries.
3. Kellison, S. G. (2008). *The Theory of interest* (3rd ed.). Irwin.

COURSE OUTLINES
FOR
SEMESTER – V

Course Title:	**Applied Multivariate Analysis**
Course Code:	**BSTA-301**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. gain the knowledge of the basic concepts underlying the most important multivariate techniques.
2. learn different types of distributions under multivariate setting.
3. understand different multivariate techniques with an overview of actual applications in the field of health and medicine.

Course Outline

Unit – I

1.1 Review of Matrix Algebra and Descriptive Statistics
Review of matrix algebra with reference to multivariate analysis.

1.2 Descriptive Statistics
Mean vector, covariance matrix, correlation matrix, linear combinations, quadratic form.

Unit – II

2.1 Multivariate Distributions

Introduction to multivariate normal distribution, Wishart and Hotelling's T^2 distributions.

2.2 Multivariate Techniques

Principal component analysis, common factor analysis, canonical correlation analysis, discrimination and classification. Applications of these techniques to the real-world data related to biostatistics.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Anderson, T.W. (2003). *An introduction to multivariate statistical analysis*. New York: John Wiley & Sons.
2. Johnson, R.A., & Wichern, D.W. (2008). *Applied multivariate statistical analysis.* Singapore: Pearson Education.

Suggested Readings:

1. Bhuyan, K.C. (2008). *Multivariate analysis and its applications*. New Central Book Agency.
2. Morrison, D.F. (2004). *Multivariate statistical methods*. New York: McGraw Hill.
3. Rencher, A.C. (2012). *Methods of multivariate analysis*. New York: John Wiley & Sons.
4. Tabachnick, B.G., & Fidell, L.S. (2018). *Using multivariate statistics*. Boston: Allyn & Bacon.

Course Title:	**Design and Analysis of Medical Studies**
Course Code:	**BSTA-302**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. derive a valid and meaningful scientific conclusion using appropriate statistical methods.
2. identify the terminology used in clinical trials and the several common designs used for clinical trials, such as parallel and cross-over designs.
3. evaluate new interventions to prevent or treat disease in humans.
4. identifying the risk factors that may be associated with a disease condition.

Course Outline

Unit – I

1.1 Clinical Designs
Clinical Trial Designs, Bias and Random Error, Objectives and Endpoints, Sample Size and Power, and The Study Cohort.

1.2 Treatment Allocation
Treatment Allocation and Randomization, Interim Analyses and Stopping Rules, Missing Data and Intent-to-Treat, Estimating Clinical Events.

Unit – II

2.1 Regression Models
Prognostic Factors and Regression Models, Reporting and Publishing.

2.2 Factorial Designs
Factorial Designs, Cross-Over Designs.

2.3 Meta-Analysis
Overviews and Meta-Analysis, Diagnostic Testing, Measures of Agreement.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Matsui, S., Buyse, M., & Simon, R. (Eds.). (2015). *Design and analysis of clinical trials for predictive medicine*. CRC Press.

Suggested Readings:

1. Chow, S. C., & Liu, J. P. (2008). *Design and analysis of clinical trials: concepts and methodologies* (Vol. 507). John Wiley & Sons.
2. Everitt, B., & Pickles, A. (2004). *Statistical aspects of the design and analysis of clinical trials*. World Scientific.
3. Friedman, Lawrence M. (2015). *Fundamentals of Clinical Trial* (5th ed.). Springer. ISBN: 978-3-319-18538-5
4. Matsui, S., Buyse, M., & Simon, R. (Eds.). (2015). *Design and analysis of clinical trials for predictive medicine* (Vol. 72). CRC Press.
5. Shih, W. J., & Aisner, J. (2015). *Statistical design and analysis of clinical trials: principles and methods*. CRC press.
6. Thall, P. F., & Simon, R. M. (2012). 3. Recent developments in the design of phase II. *Recent Advances in Clinical Trial Design and Analysis*, *75*, 49.

Course Title:	**Statistical Quality Control**
Course Code:	**STAT-301**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn the basics of quality management and its key concepts.
2. discover the various techniques for continuous process improvement.
3. develop and critically analyze statistical control charts.
4. get a vast knowledge of different types of sampling plans and quality management systems.

Course Outline

Unit – I

1.1 The Basics of Total Quality Management
Defining Quality. Different views of Quality. Dimensions of Quality. Eras of Quality Management, Introduction to Total Quality Management, Basic concepts, Purpose, benefits and framework of TQM, Implementation of TQM. Barriers to TQM implementation.

1.1.1 Gurus of TQM
Gurus of TQM, their Philosophies and Pioneering Works.

1.1.2 Cost of Quality and Functions
Costs of Quality, The PDSA Cycle, Kaizen, Six Sigma, Quality Function Deployment.

1.2 Benchmarking
Introduction of Benchmarking, Types, Advantages and Limitations.

Unit – II

2.1 Statistical Process Control
Introduction of Statistical Process Control.

2.1.1 Control Charts
Statistical Control Charts, Statistical basis of the Control Chart, Steps in the development of control charts, Types of control charts, Process Capability.

Unit – III

3.1 Acceptance Sampling
Introduction of Lot by lot Acceptance Sampling for attributes.

3.1.1 Types of Sampling Plans

Single Sampling Plans: Construction of OC-curve, Rectifying Inspection. Double and Multiple Sampling Plans.

Unit – IV

4.1 Quality Management Systems
Introduction of International Standard Organization of Quality Management Systems.

4.1.1 ISO-9000 Series
ISO 9000 Series of Standards: Requirements, Implementation & Benefits.

4.1.2 ISO 14000 Series
Environmental Management System: ISO 14000 series of Standards: Requirements, Implementation and Benefits.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Besterfield, D.H., Michna, C.B., Besterfield, G.H., & Sacre, M.B. (2003). *Total Quality*

Management (3rd ed.). Pearson Education.
2. Montgomery, D.C. (2019). *Statistical Quality Control* (8th ed.). John Wiley & Sons, New York.

Suggested Readings:

1. Evans, J.R., & Lindsay, W.M. (2005). *The Management and Control of Quality* (6th ed.). Thomson South-Western.
2. Grant, E.L., & Leaven-worth, R.S. (2016). *Statistical Quality Control Handbook* (9th ed.). McGraw-Hill Book Company, New York.
3. James, P. (1996). *Total quality management*. Prentice Hall.
4. Oakland, J.S. (2003). *Total Quality Management* (3rd ed.). Butterworth-Heinemann.

Course Title:	**R Programming**
Course Code:	**STAT-302**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand data analysis.
2. deal with issues related to data entry.
3. apply analysis, and methods of evaluation related to business.
4. implement and evaluate primary and secondary data during their professional career.

Course Outline

Unit – I

1.1 Introduction

Introduction to R programming and scripting, Overview of R, R data types and objects, reading and writing data.

1.2 Control Statement

Control structures, functions, scoping rules, dates and times, Loop functions,

Unit – II

2.1 Code Debugging and Profiling

Debugging tools, code profiling, Refactoring R scripts.

2.2 Simulation

Bootstrapping, simulation of stochastic process and physical world.

2.3 Documenting Functions & Developing R packages

Writing and documenting R functions, writing unit tests and running those in an automated way.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Crawley, M. J. (2020). *The R book*. John Wiley & Sons.

Suggested Readings:

1. Andrie, D. & Meys, J. (2015). *R for Dummies*. John Wiley & Sons.
2. Matloff, N. (2011). *The art of R programming: A tour of statistical software design*. No Starch Press.

Course Title:	**Database and SQL**
Course Code:	**COMP-301**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. evaluate the role of database management systems in information technology applications within organizations.
2. design and implement properly structured databases that match the standards based under realistic constraints and conditions.
3. use Structured Query Language (SQL) to define and manipulate database information.
4. apply the principle of transaction management design and work in a group on the design, and implementation of a database system project.

Course Outline

Unit – I

1.1 Database Basics

Introduction, Database Environment, Database Development Process. Modeling Data in the Organization

1.2 Database Design

Enhanced E-R Model and Business Rules, Logical Database Design and the Relational Model. Physical Database Design and Performance, The Software Engineering Process and Relational Databases.

Unit – II

2.1 SQL Basics

SQL, Advanced SQL, Getting Started with SQL in Access, Beginning SQL Commands in Access. Client/Server Database Environment, Internet Database Environment.

2.2 SQL Joins

Data Warehousing, Creating and Populating Tables. SQL Joins, SQL Functions. SQL Query Development and Derived Structures, SQL Set Operations. SQL Joins versus Subqueries, SQL Aggregation and GROUP BY. SQL Correlated Subqueries, SQL Indexes and Constraints on Tables.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Molinaro, A. (2015). *SQL Cookbook: Query Solutions and Techniques for Database Developers*. O'Reilly Media, Inc.

Suggested Readings:

1. Beaulieu, A. (2019). *Learning SQL: master SQL fundamentals*. O'Reilly Media, Inc.
2. Hoffer, Prescott & McFadden, (2005). *Modern Database Management* (7th ed.) Prentice-Hall, Inc. ISBN: 0-13-145320-3.

Course Title:	**Hospital and Healthcare Management**
Course Code:	**BIOS-301**
Semester:	**V**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. recognize the significance of the hospital and healthcare management.
2. distinguish between hospital and healthcare management.
3. comprehend the hierarchy for governance of healthcare management system.
4. understand the medical staff, nursing services, clinical support services, and community health functions of healthcare delivery organizations.

Course Outline

Unit – I

1.1 Preliminaries of healthcare management
The environmental context for healthcare administration, administration in healthcare organizations.

1.2 Healthcare organizations
Administrative support in healthcare organizations, clinical care in healthcare organizations.

Unit – II

2.1 Frames of management
The structural frame of management, the political frame of management, the cultural frame of management.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.

2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Amelung, V. E. (2019). *Healthcare management*. Springer.
2. NordstrandBerg, L. (2019). *The use of comparative research design in studying hospital management*. SAGE Publications Ltd.

Suggested Readings:

1- Burke, D., Godbole, P., & Cash, A. (Eds.). (2019). *Hospital transformation: From failure to success and beyond*. Springer.
2- McLaughlin, D. B. (2008). *Healthcare operations management*. AUPHA.
3- Pfannstiel, M. A., & Rasche, C. (2017). *Service business model innovation in healthcare and hospital management*. Springer.
4- Spath, P., & Kelly, D. L. (2017). *Applying quality management in healthcare: A systems approach*. Chicago: Health Administration Press.
5- Walshe, K., & Smith, J. (Eds.). (2011). *Healthcare management*. McGraw-Hill Education.

COURSE OUTLINES
FOR
SEMESTER – VI

Course Title:	**Modeling Categorical Data**
Course Code:	**BSTA-303**
Semester:	**VI**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. gain the knowledge of different types of distributions for categorical data.
2. learn in detail the specifications and applications of Logistic Regression Model.
3. understand the different types of Generalized Linear Models.

Course Outline

Unit – I

1.1 Distributions for Categorical Data

Experiments with binary outcomes, Binomial distribution, Negative binomial distribution, Geometric distribution and Multinomial distribution, Fitting binomial distribution.

1.2 Testing of Categorical Data

Testing two proportions, Methods of estimation of parameters of the Bernoulli and binomial distribution, Profile and conditional likelihood, Models for binary data.

Unit – II

2.1 Logistic Regression

Introduction and General Model of Logistic Regression, Fitting the Logistic Regression Model.

2.1.1 Significance of the Coefficients

Testing for the Significance of the Coefficients, The Hosmer-Lemeshow Tests, Other summary Statistics, Logistic Regression Diagnostics.

Unit – III

3.1 Multiple Logistic Regression Model

Fitting the Multiple Logistic Regression Model, Other Methods of Estimation. Interpretation of the Coefficients of the Logistic Regression Model.

Unit – IV

4.1 Generalized Linear Models

Log Linear Models and Fitting of Log-linear and Logit Models.

4.1.1 Higher Dimensions Models and Plots

Logit models for Higher Dimensions, Goodness of Fit as a Likelihood Ratio Test, Binomial and Normal Probability Plots.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Agresti, A. (2012). *Categorical Data Analysis* (3rd ed.). John Wiley and Sons.
2. Hosmer, D. W., & Lemeshow, S. (2013). *Applied Logistic Regression* (3rd ed.). John Wiley and Sons.

Suggested Readings:

1. Christensen, R. (2017). *Log-linear models and Logistic regression* (4th ed.). Springer, NewYork.
2. Kllinbaum, D. G., & Klein, M. (2002). *Logistic Regression* (2nd ed.). Springer, New York.
3. Leonard, T., & Papasouliotis, O. (2000). *A course in categorical data analysis*. Boca Raton, Fla: Chapman & Hall/CRC Press.
4. Lloyd, C. J. (1996). *Statistical Analysis of Categorical Data*. John Wiley and Sons.

Course Title:	**Design and Analysis of Experiments**
Course Code:	**BSTA-304**
Semester:	**VI**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand the basic principles of experimental design.
2. apply ANOVA and various multiple comparison tests.
3. learn the layout factorial experiments.
4. know the construction of Split-plot designs.

Course Outline

Unit – I

1.1 Introduction and Principles of Experimental Design

Concept of experiment. Planning of experiment. Design of experiment and its terminology, Treatment arrays. Principles of experimental designs: Logical control on error. Basic methods for increasing the efficiency of experiments, Estimation of treatment contrasts and their precision, treatment structure, comparison with a control.

1.2 Analysis of Variance (ANOVA)

Analysis of Variance (ANOVA). Inference about means after ANOVA. Multiple comparison tests: LSD test, Tukey's test, Scheffe's test, Orthogonal contrast test along with the applications of all these techniques to the data based on health sciences.

Unit – II

2.1 Layout and Analysis of Experimental Design

Layout and analysis of Completely Randomized, Randomized Complete Block, Latin Square designs. Estimation of missing observations. Relative efficiency of these designs. Fixed, Random and Mixed effect models.

Unit – III

3.1 Factorial Experiments

Factorial experiments and its layout, advantages and analysis. Yates' method of computing factorial effect totals. Construction and analysis of Split-plot designs.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Montgomery, D.C. (2020). *The Design and Analysis of Experiments* (5th ed.). John Wiley and Sons, New York.

Suggested Readings:

1. Clewer, A. G., & Scarisbrig, D. H. (2013). *Practical Statistics and Experimental Design for Plant and Crop Science*. John Wiley and Sons, New York.
2. Cochran, W.C., & Cox, G.M. (2012). *Experimental Design* (3rd ed.). John Wiley and Sons, New York.
3. Steel, R.G.D., Torrie, J.H., & Dickey, D.A. (2008). *Principles and Procedures of Statistics: A Biometrical Approach*. McGraw-Hill, Michigan, USA.

Course Title:	**Machine Learning & Python**
Course Code:	**STAT-303**
Semester:	**VI**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand basics of machine learning
2. apply supervised and unsupervised algorithm
3. apply Bayesian approach to solve problem
4. use python as a machine learning platform

Course Outline

Unit – I

1.1 Overview of Machine Learning Concepts

Course Introduction, Machine Learning Overview, Supervised Learning: Formulation, Setup, Train-test split, Generalization, k-Nearest Neighbor (kNN) Algorithm, Algorithm Formulation, Distance Metrics, Choice of k, Algorithm Convergence, Storage, Time Complexity Analysis, Fast kNN.

1.2 Dimensionality Reduction

The Curse of Dimensionality and Connection with kNN, Dimensionality Reduction: Feature Selection and Extraction, Principal Component Analysis.

1.3 Evaluation Metrics

Classifier Performance Evaluation: Confusion Matrix Sensitivity, Specificity, Precision Trade-offs, ROC, AUC, F1-Score and Matthew's Correlation Coefficient.

Unit – II

2.1 Classification and Regression

Multi-class Classification, Evaluation, Micro, Macro Averaging, Regression: Linear Regression, Polynomial Regression, Overfitting.

2.2 Gradient Descent

Gradient Descent Algorithm, Regularization.

2.3 Bayesian Classifier

Probability Review, Bayesian Learning Framework, MAP and ML Hypothesis, Linear Regression as ML estimation, Naive Bayes Classifier, Naïve Bayes Classifier for Text Classification, Bayesian Networks Introduction.

2.4 Logistic Regression

Logistic Regression: Mathematical Model, Decision Boundaries, Loss/Cost Function, Gradient Descent, Multi-class Logistic Regression.

2.5 Support Vector Machine
SVM Overview, Hard SVM, Soft SVM, Kernel Trick.

2.6 Neural Network
Neural Networks Introduction, Model, Forward Pass, Neural Networks: Back Propagation.

2.7 Clustering
Unsupervised Learning, Clustering Overview, K-means Clustering, Agglomerative Clustering.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Bishop, C. M. (2006). Pattern recognition. *Machine learning*, *128*(9).
2. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An introduction to statistical learning* (Vol. 112). New York: Springer.

Suggested Readings:

1. Friedman, J., Hastie, T., & Tibshirani, R. (2001). *The elements of statistical learning* (Vol. 1, No. 10). New York: Springer series in statistics.
2. Mitchell, T. M. (2006). *The discipline of machine learning* (Vol. 9). Pittsburgh: Carnegie Mellon University, School of Computer Science, Machine Learning Department.
3. Robert, C. (2014). *Machine learning, a probabilistic perspective*.

Course Title:	**Analysis of Repeated Measurements**
Course Code:	**BSTA-305**
Semester:	**VI**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. identify clusters and potential dependency by inspecting the design and/or viewing the resulting data set.
2. understand the principles of experimental design in which experimental factors vary both between and within clusters.
3. perform simple, descriptive analyses such as obtaining sample covariance and correlation, and corresponding graphical plots such as scatter plots, to illuminate key features of data with clustered and/or repeated observations.

Course Outlines

Unit – I

1.1 Preliminaries
Repeated measurements, advantages and disadvantages of repeated, measurements designs.

1.2 Univariate analysis
Sample size estimation, univariate analysis for one sample and multiple samples.

Unit – II

2.1 Multivariate Analysis
Multivaraite normal distribution theory, one sample repeated measurements, two sample repeated measurements.

2.2 Multivariate General Linear Model
Parameter estimation, hypothesis testing, comparisons of test statistics, profile analysis, growth curve analysis.

2.3 Repeated Measures ANOVA Model
The fundamental model, one sample and multiple samples cases, the linear mixed model.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Hershberger, S. L., & Moskowitz, D. S. (2013). *Modeling intraindividual variability with repeated measures data: Methods and applications*. Psychology Press.
2. Islam, M.A., & Chowdhury, R.I. (2017). *Analysis of repeated measures data.* Springer Nature Singapore.

Suggested Readings:

1. Davis, C. S. (2002). *Statistical methods for the analysis of repeated measurements*. Springer Science & Business Media.
2. Dupont, W. D., & Dupont, W. D. (2009). *Statistical modeling for biomedical researchers: A simple introduction to the analysis of complex data*. Cambridge University Press.
3. Goldstein, H. (2018). *Multilevel statistical models*.3rd ed. Arnold.
   Munro, B. H. (2001). *Statistical methods for health care research*. Lippincott Williams & Wilkins.

Course Title:	**Survival Analysis and Modeling**
Course Code:	**BSTA-306**
Semester:	**VI**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. build and apply different types of survival models along with their applications.
2. know in detail about the Markov jump process as well its practical framework.
3. learn about different graduation methods and census formulae for various variables.

Course Outline

Unit – I

1.1 Survival Models and their Principles

Principles of actuarial modeling, estimating the lifetime distribution function-the Kaplan-Meier and Nelson-Aalen Models. The Cox regression model, the two stat Markov Model, concept of survival model, two stat model of a single decrement and compare its assumption with random lifetime model.

1.2 Transitions Intensities

Derivation of maximum likelihood estimators for the transition intensities in the model of transfers between states with piecewise constant transitions intensities.

Unit – II

2.1 Markov Jump Process

Essential features of a Markov process model, Poisson process and derive the distribution of the number of events in a given interval, drive Kolmogorov equations for a Markov process with time independent and time/age dependent transition intensities.

2.2 Survival Model using Markov Processes

Simple survival model, sickness model, and marriage model in term of Markov processes.

Unit – III

3.1 Methods of Graduation

Methods of graduation for parametric formula, standard table, graphical, Binomial and Poisson models, Graduation and statistical test.

3.2 Exposed to Risk

Homogeneous classes including subdivision by age and sex, calculation of central exposed to risk, Assumptions underlying the census approximation of waiting time, concept of rate interval,

census formula for age birthday, age at specific calendar date, age at a specified policy anniversary.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Gerber, H.U. (2017). *Life insurance mathematics* (5th ed.). Springer Swiss Association of Actuaries.

Suggested Readings:

1. Haberman, S., & Pitacco, E. (1999). *Actuarial models for disability insurance*. Chapman & Hall.
2. Marubini, E., & Valsecchi, M.G. (1995). *Analysing survival data from clinical trials and observational studies*. John Wiley and Sons, New York.

COURSE OUTLINES
FOR
SEMESTER – VII

Course Title:	**Statistics and Medical Diagnostics**
Course Code:	**BSTA-401**
Semester:	**VII**
Program:	**03 Credit Hours**

Learning Outcomes

By the end of this course, students will be able to:

1. recognize the significance of the statistics in medical diagnostic procedures.
2. distinguish between differential and discriminant diagnosis.
3. comprehend the diagnostic probabilities on the basis of diagnostic data.
4. understand how to measure and design diagnostic accuracy.

Course Outline

Unit – I

1.1 Preliminaries
Overview of the diagnostic test accuracy studies, sensitivity and specificity, combined measures of sensitivity and specificity, Receiver Operating Characteristic (ROC) curve.

1.2 Comparison of prediction models
Likelihood ratios, C-statistics and other measures to compare prediction models.

Unit – II

2.1 Designing of diagnostic accuracy studies
Estimation and hypothesis testing in a single sample, comparing the accuracy of two diagnostic tests, sample size calculations

2.2 Meta-analysis
Introduction to meta-analysis for diagnostic accuracy studies, regression analysis for independent ROC data, methods for correcting verification bias, statistical analysis for meta-analysis.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Campbell, M. J., Machin, D., & Walters, S. J. (2010). *Medical statistics: A textbook for the health sciences*. John Wiley & Sons.
2. Sprent, P. (2019). *Data driven statistical methods*. Routledge.

Suggested Readings:

1. Armitage, P., Berry, G., & Matthews, J. N. S. (2008). *Statistical methods in medical research*. John Wiley & Sons.
2. Chakraborty, B. (2013). *Statistical methods for dynamic treatment regimes*. Springer.
3. Held, L., Hens, N., D O'Neill, P., & Wallinga, J. (Eds.). (2019). *Handbook of infectious disease data analysis*. CRC Press.
4. Peat, J. K., Mellis, C., Williams, K., & Xuan, W. (2020). *Health science research: A handbook of quantitative methods*. Routledge.
5. Woolson, R. F., & Clarke, W. R. (2011). *Statistical methods for the analysis of biomedical data*. John Wiley & Sons.
6. Yan, P., & Chowell, G. (2019). *Quantitative methods for investigating infectious disease outbreaks*. Springer.
7. Zhou, X. H., McClish, D. K., & Obuchowski, N. A. (2009). *Statistical methods in diagnostic medicine*. John Wiley & Sons.

Course Title:	**Health Insurance and Health Laws**
Course Code:	**BSTA-402**
Semester:	**VII**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. apply the fundamentals of Healthcare Law.
2. operate HIPAA and how to implement privacy best practices within your organization.
3. implement, protect and distribute intellectual property.
4. describe how different countries address the healthcare needs of their populations.

Course Outline

Unit – I

1.1 Introduction

Introduction to Health Insurance Policies, Health Insurance Coverage, Pre-Existing Conditions

1.2 Insurance

Bad Faith and Health Insurance Portability, Health Insurance Claims and Denials

Unit – II

2.1 Advanced Topics

Special Topics in Health Insurance. The Patient Protection and Affordable Care Act, Health Care Decisions & Bioethics,

2.2 Legal Issues

Public Health Law, Disability Law, Health Care Transactions, Mental Health Law, Policy & Ethics, regulation of drugs and devices, Contract Drafting, Patent Law.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Berman, P., & Bir, A. (1995). *Health Sector Reform In Developing-Countries-Making Health Development Sustainable-Introduction.*
2. Gostin, L. O. (Ed.). (2010). *Public health law and ethics: a reader* (Vol. 4). Univ of California Press.

Suggested Readings:

1. Abel-Smith, B. (1994). *An introduction to health: policy, planning and financing*. London: Longman Group Ltd.
2. Alice, G. Gosfield. (2020). *Health law Handbook*. Thomson Reuters.
3. Bennett, S., McPake, B., & Mills A. (1997). *Private health providers in developing countries*: serving the public interest? London, UK: Zed Books.
4. Detels, R., McEwen J., Beaglehole, R., & Tanaka H, (eds.). (2002). *Oxford textbook of public health: the practice of public health*, 4th ed. Oxford: Oxford University Press.
5. Hunter, D. J. (2003). *Public health policy. Cambridge*, MA: Polity Press.

Course Title:	**Infectious Diseases and Modeling**
Course Code:	**BSTA- 403**
Semester:	**VII**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. recognize the basics of infectious disease modeling.
2. distinguish between theoretical analysis of mathematical disease models and control strategies.
3. comprehend the interface mathematical modeling, infectious disease data retrieval and analysis.
4. understand the infectious disease model for better detection, prevention and control of disease.

Course Outline

Unit – I

1.1 Preliminaries
Overview of the important concepts in mathematical modeling of infectious diseases.

1.2 Models
Five classic epidemic models and their Analysis.

Unit – II

2.1 Theories of mathematical background
Basic mathematical tools and techniques.

2.2 More formal models
Hybrid and switched systems, the switched SIR models, epidemic models with switching, switching control strategies, pulse control strategies, parameter estimation and non-linear least-square methods.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Brauer, F., Castillo-Chavez, C., & Feng, Z. (2019). *Mathematical models in epidemiology*. Springer.
2. Britton, T., Pardoux, E., Ball, F., Laredo, C., Sirl, D., & Tran, V. C. (2019). *Stochastic epidemic models with inference*. Springer.

Suggested Readings:

1- Chen, X. (Ed.). (2020). *Statistical methods for global health and epidemiology: Principles, methods and applications*. Springer Nature.
2- Held, L., Hens, N., D O'Neill, P., & Wallinga, J. (Eds.). (2019). *Handbook of infectious disease data analysis*. CRC Press.
3- Hernandez-Vargas, E. A. (2019). *modeling and control of infectious diseases in the host: With MATLAB and R*. Academic Press.
4- Li, M. Y. (2018). *An introduction to mathematical modeling of infectious diseases*. Springer.
5- Liu, J., & Xia, S. (2020). *Computational epidemiology: From disease transmission modeling to vaccination decision making*. Springer Nature.

COURSE OUTLINES
FOR
SEMESTER – VIII

Course Title:	**Spatial Modelling**
Course Code:	**BSTA- 404**
Semester:	**VII**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. conceptualize models as representations of real life systems with inputs, outputs, and processes.
2. apply, integrate, and develop models with geospatial data.
3. utilize spatial models to make simulations and predictions of real life phenomena.
4. evaluate models in terms of accuracy, sensitivity, and uncertainty.
5. use a system-based approach for problem solving, with an emphasis on sustainability.

Course Outline

Unit – I

1.1 Preliminaries
Introduction to spatial and spatial temporal statistics.

1.2 Modeling
Modelling spatial and spatio-temporal structures, systems-based modeling, vector-based modeling regression analysis (linear and logistic), raster-based modeling map algebra, surface modeling.

Unit – II

2.1 More formal spatial modeling
Areal data, Gaussian Markov Random Field, spatial disease mapping, Bayesian and hierarchical models.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Blangiardo, M., & Cameletti, M. (2015). *Spatial and spatio-temporal Bayesian models with R-INLA*. John Wiley & Sons.
2. Cressie, N., & Wikle, C. K. (2015*). Statistics for spatio-temporal data*. Wiley.

Suggested Readings:

1. Carlin, B. P., Gelfand, A. E., & Banerjee, S. (2014). *Hierarchical modeling and analysis for spatial data*. CRC Press.
2. Chiles, J. P., & Delfinder, P. (2012). *Geostatistics: Modeling spatial uncertainty*. Wiley.
3. Gamerman, D., & Lopes, H. F. (2006). *Markov chain Monte Carlo: Stochastic simulation for Bayesian inference*. CRC Press.
4. Gilks, W. R., Richardson, S., & Spiegelhalter, D. (1995). *Markov chain Monte Carlo in practice*. CRC Press.

COURSE OUTLINES
FOR
ELECTIVES

Course Title:	**Biostatistical Consulting**
Course Code:	**BSTA- 406**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:
1. learn the key concepts of a research and its various types.
2. know the different kinds of survey and how to conduct them.
3. acquire the knowledge of sample selection with the help of examples.
4. develop a questionnaire for a real-world problem.

Course Outline

Unit – I

1.1 Medical Research and Statistics
Statistical Consulting: An overview of Statistical Consulting especially in the field of Medical Research.

1.2 Prior Information
Prior information required about project for providing consultancy. Financial issues and Documentation.

Unit – II

2.1 Project Analysis
Project analysis and communication skills as an integral part of consulting, verbal interaction.

2.1.1 Report Writing
Basic guidelines for reports writing and Effective presentations. Methodological aspects of research project.

2.1.2 Sample Size and Data Collection
Determination of sample size, Data collection and processing.

2.1.3 Statistical Analysis
Statistical methods used in consulting, Statistical methods, and analysis. Use of statistical software and computer languages. Presentation of results and preparing final report. Case studies.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Cabrera, J., & McDougall, A. (2002). *Statistical consulting*. Springer Science & Business Media.

Suggested Readings:

1. Boen, J. R. (1982). *The human side of statistical consulting* (No. 04; QA276. 17, B6.).
2. Chatfield, C. (2015). *Problem solving: a statistician's guide*. CRC Press.
3. Tighe, J. (2002). *Statistical Consulting: A Guide to Effective Communication*.
4. Tukey, J. W. (2018). *Teaching of Statistics and Statistical Consulting*. PRINCETON UNIV NJ.

Course Title:	**Multi-level Modeling**
Course Code:	**STAT-401**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

On successful completion of this course, students will be able to:

1. recognize a research problem requiring a multilevel modeling approach.
2. describe the technical and substantive advantages of multilevel models.
3. explain the basic principles of multilevel modeling using graphical, verbal, and statistical language for a range of multilevel models.
4. develop a variety of models that enable quantitative assessment of contextual effects.
5. apply multilevel models to a research problem according to a well-articulated research strategy.

Course Outline

Unit – I

1.1 Introduction
Concept of Aggregate and Disaggregate, Introduction to Multilevel Models, Difference Between Traditional Regression and Multilevel Models.

1.1.1 Multilevel Models Assumptions
Theory and Discussion on Assumptions underline Multilevel Models.

1.1.2 Types of Multilevel Models
Types of Multilevel Models (Linear & Non-linear).

1.2 Estimation of Multilevel Models
Maximum Likelihood and Restricted Maximum Likelihood Estimation Methods for Two-Level Models: Random Intercept Models, Random Slope Models, Random Intercept and Random Slope Models.

1.2.1 Goodness of Fit Criteria under Multilevel Models
Intraclass Correlation Coefficient, Likelihood Ratio Test.

1.2.2 Residual Analysis
Estimation of different types of residuals under multilevel models, Analysis of residuals for the model diagnostics.

1.3 Higher Order Multilevel Models
Three Levels Multilevel Models, Estimation and Goodness of Fit of Three Level Multilevel Models.

Unit – II

2.1 Software for Multilevel Models
Discussion on Software/Packages available for the estimation of Multilevel Models.

2.1.1 mLwin
Introduction to mLwin, Import and Export of Data Files, Data Editing Tools etc.

2.1.2 Multilevel Model via mLwin
Formulation of Multilevel Models in mLwin, Estimation of Multivelel Models via mLwin, Computation of Goodness of Fit Criteria via mLwin, How to Report and Interpret the Results from mLwin.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Goldstein, H. (2011). *Multilevel statistical models (4th Ed)*. John Wiley & Sons.
2. Hox, J. J., Moerbeek, M., & Van de Schoot, R. (2017). *Multilevel analysis: Techniques and applications*. Routledge.

Suggested Readings:

1. de Leeuw J. & Meijer, E. (2008). *Handbook of Multilevel Analysis*. New York: Springer-Verlag.
2. Gelman, A., & Hill, J. (2006). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press
3. Kreft, Ita G. G. & de Leeuw, J. (1998). *Introducing Multilevel Modeling*. Newbury Park: Sage Publications.
4. Leyland, A. H., & Goldstein, H. (2001). *Multilevel Modelling of Health Statistics*. New York: Wiley
5. Longford, N. T. (1993) *Random Coefficient Models*. Oxford: Clarendon Press.
6. Rabe-Hesketh, S., & A. Skrondal. (2012). *Multilevel and longitudinal modeling using Stata*. Third Edition Volume I: Continuous Responses. Volume II: Categorical Responses, Counts and Survival. Stata Press. (1st Edition 2005, 2nd Edition 2008.)
7. Raudenbush, S. W. & Bryk, A.S. (2001). *Hierarchical Linear Models: Applications and Data Analysis Methods*. Newbury Park: SAGE Publications.
8. Snijders, T. & Bosker, R. (1999). *Multilevel Analysis: An introduction to basic and advanced multilevel modeling*. Thousand Oaks, California: Sage Publications.

Course Title:	**Generalized Linear Models**
Course Code:	**STAT-402**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn different types of generalized linear models and their applications in biostatistics.
2. understand the various types of techniques to analyze binary and multicategory responses.
3. have sound knowledge of survival data and its related distributions.

Course Outline

Unit – I

1.1 Statistical Modeling and Inference

Definition of a model, MLE, Parameter estimation, Likelihood ratio test, Model simplification and criticism, Modeling binary response data, ML for Bernoulli and Binomial distribution.

1.2 Normal Regression and ANOVA

Normal distribution and Box-Cox transformation family, Factorial design, Cross-classifications, Missing data.

1.3 Binomial response data

Contingency table, Profile and conditional likelihood in 2 x 2 tables, Multidimensional contingency tables with binary response.

1.4 Multinomial and Poisson response data

Poisson distribution, Multicategory responses, Multinomial logit model, Ordered response categories.

Unit – II

2.1 Survival Data and its Various Distributions

Survival data, Exponential distribution, Censoring, Kaplan-Meier estimator, Gamma distribution, Weibull, distribution, Extreme value distributions, Cox proportional hazard model, Logistic and log-logistic distribution.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Agresti, A. (2012). *Categorical Data Analysis* (3rd ed). John Wiley and Sons.

Suggested Readings:

1. Aitkin, M., Francis, B., & Hinde, J. (2005). *Statistical Modeling in GLIM 4* (2nd ed.). Oxford: Oxford Science Publications.
2. Lloyd, C. J. (2016). *Statistical Analysis of Categorical Data*. John Wiley and Sons.
3. McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models* (2nd ed.). London: Chapman and Hall.

Course Title:	**Exploratory and Robust Data Analysis**
Course Code:	**BSTA-407**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. explore basic tools and techniques of exploratory data analysis.
2. understand the various methods of analysis for location models.
3. learn the key concepts of robustness and robust estimation along with its applications in the field of biostatistics.

Course Outline

Unit – I

1.1 Introduction to exploratory data analysis

Exploratory data analysis for the location model: Basic data displays: The box-plot, The empirical cumulative distribution plot, Some comments on order statistics, Transformation of data. And applications with reference to the field of Biostatistics.

1.2 Probability plotting and location models

The symmetry plot and probability plotting. Combining Exploratory and Confirmatory data analysis for the location model: Tests for normality, Review of some concepts of statistical theory, least squares and weighted least squares estimation in the location model along with examples from health sciences.

Unit – II

2.1The general concepts of robustness

Approximate variance of functions of random variables. Robust estimation in the location model: Parameters and the estimation as functional, the influence curve, robust efficiency.

2.2 Robust estimators

L-estimators, M-estimators, the Monte Carlo method, the Bootstrap method, the box-cox transformation, robust estimation in the simple linear, multiple linear and non-parametric regression.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Draper, N. R., & Smith, H. (2014). *Applied regression analysis*. Wiley.
2. Hoagling, D. C., Mosteller, F. and Tukey, J. W. (2000). *Understanding robust and exploratory data analysis*. John Wiley and Sons.

Suggested Readings:

1. Das, R. N. (2014). *Robust response surfaces, regression, and positive data analyses*. CRC Press.
2. Kutner, M. H., Nachtsheim, C. J., & Neter, J. (2004). *Applied linear statistical models*. McGraw-Hill.
3. Seber, G. A. F., & Lee, A. J. (2014). *Linear regression analysis.* Wiley.
4. Tukey, J. W. (1977). *Exploratory data analysis*. Addison-Wesley.

Course Title:	**Bio-Informatics**
Course Code:	**BSTA-408**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand the basic principles and concepts in exploring sequence storage, retrieval and analysis.
2. develop understanding of gene and protein at structural level using computational tools.
3. demonstrate the ability to apply skills in a professional environment via an industrial or academic internship.

Course Outline

Unit – I

1.1 Basic Concepts of Bio Informatics
Cell, Molecule, Gene, Chromosom, DNA, RNA, Protein, Connection DNA-RNA-Protein, Protein structures, Protein functions.

1.2 Bio-Chemical Properties
Bio-chemical properties of Amino Acids, Motif, Domain, Protein Families, Evolution, Similarity, Homology.

1.3 Optimal Search
Means-Ends Analysis, Problem Reduction, Goal Tree, DepthFSearch, BreadthFSearch, BestFSearch, Optimal Search, Branch and Bound, Dynamic Programming Principle, (Minimax-procedure, Alpha-Beta pruning).

Unit – II

2.1 Scoring System and Alignment
PAM-Matrices (Dayhoff), BLOSUM (Henikoff and Henikoff), Scoring Systems based on Amino Acid Classifications. Cost (measure) of Multiple Alignment, Dynamic Programming, Progressive Alignment (CLUSTAL), Use of Local Multiple Alignment.

2.2 Positions of DNA Sequence
Methods for finding Relative Positions of DNA Sequences on a Chromosome. (Small and Large scale). Construction using Character States, Construction using Distance Matrices.

Unit – III

3.1 Statistical Significance

Statistical significance, Dot matrix methods, Dynamic programming (MPSearch), FASTA, BLAST, Search with profiles. The PROSITE-database, Sequence Driven Methods, Pattern Driven Methods.

3.2 RNA Structure Prediction
Introduction to the RNA Secondary Structure Prediction and Protein Folding problems.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Lesk, A. (2019). *Introduction to bioinformatics*. Oxford university press.

Suggested Readings:

1. Bult, C. J. (1998). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*. *Science*, *282*(5389), 635-636.
2. Gibas, C., Jambeck, P., & Fenton, J. (2001). *Developing bioinformatics computer skills*. " O'Reilly Media, Inc.".
3. Gu, J., & Bourne, P. E. (Eds.). (2009). *Structural bioinformatics* (Vol. 44). John Wiley &

Sons.
4. Krane, D. E. (2002). *Fundamental concepts of bioinformatics*. Pearson Education India.
5. Su, C. (2006). Bioinformatics: *A Practical Guide to the Analysis of Genes & Proteins, (third editon)*. Edited by Andreas D. Baxevanis and BF Francis Ouellette New York: John Wiley & Sons.

Course Title:	**Statistical Genetics**
Course Code:	**BSTA-409**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. introduce statistical methods for genetic studies.
2. understand basic principles of inheritance and students will gain experience in variety of molecular techniques used in gene analysis.
3. learn basic quantitative genetics concepts and basic and advanced statistical methods for genetic data analysis.
4. understand the fundamentals of mice genetics, and other special topics.

Course Outline

Unit – I

1.1 Introduction to Genetics
Mendelian genetic traits. Population genetics; Hardy-Weinberg, allelic variation, subdivision.

1.2 EM Algorithm
Likelihood inference, information, and power; latent variables and EM algorithm.

1.3 Meiosis and Recombination
Pedigree relationships and gene identity. Meiosis and recombination.

Unit – II

2.1 Linkage Analysis
Linkage detection. Multipoint linkage analysis.

2.2 Trait Analysis
Statistical basis for describing variation in quantitative traits. Decomposition of trait variation into components representing genes, environment, and gene-environment interaction. Methods of mapping and characterizing quantitative trait loci.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Lange, K. (2003). *Mathematical and statistical methods for genetic analysis*. Springer Science & Business Media.

Suggested Readings:

1. Durrett, R. (2008). *Probability models for DNA sequence evolution*. Springer Science & Business Media.
2. Laird, N. M., & Lange, C. (2010). *The fundamentals of modern statistical genetics*. Springer Science & Business Media.
3. Neale, B., Ferreira, M., Medland, S., & Posthuma, D. (Eds.). (2007). *Statistical genetics: gene mapping through linkage and association*. Garland Science.
4. Neale, B., Ferreira, M., Medland, S., & Posthuma, D. (Eds.). (2007). *Statistical genetics: gene mapping through linkage and association*. Garland Science.
5. Stein, C. M., Morris, N. J., & Nock, N. L. (2012). *Statistical Human Genetics: Methods and Protocols*. Methods in Molecular *Biology, 850*.

Course Title:	**Advance Survival Analysis**
Course Code:	**BSTA-410**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. analyse data using Poisson, cox and parametric (e.g., Weibull) regression models.
2. describe the links between these approaches.
3. use flexible parametric survival analysis to improve model fit to the data.
4. analyse survival data with competing outcomes.

Course Outlines

Unit – I

1.1 Introduction of Survival Analysis
Survival analysis, pitfalls and solutions, competing risks.

1.2 Covariates in Survival Models
Time-dependent covariates in Cox regression models and land marking, Non-proportional hazards/pseudo-observations.

Unit – II

2.1 Multi-state Models
Introduction of Multi-state models, Dynamic prediction, Frailty models.

Unit – III

3.1 Clinical Trials
Survival analysis in clinical trials, Informative censoring/IPW, Estimands in competing risks, Poisson models, multiple timescales, Relative survival.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. David, G. K., & Mitchel, K. (2012). *Survival Analysis: A Self Learning Text*. Springer.
2. Klein, J. P., Van Houwelingen, H. C., Ibrahim, J. G., & Scheike, T. H. (2016). *Handbook of survival analysis*. CRC Press.

Suggested Readings:

1. Legrand, C. (2021). *Advanced Survival Models*. CRC Press.
2. Moore, D. F. (2016). *Applied survival analysis using R*. Switzerland: Springer.

Course Title:	**Crop and Animal Experiments**
Course Code:	**BIOS-401**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understanding of agriculture as a dynamic and interactive system that uses plants and animals to produce food, fiber, and other derivatives.
2. experience aspects of an agricultural lifestyle through direct contact with plants and animals and a variety of outside activities.
3. develop knowledge, understanding and skills in the management of plant and animal enterprises, the technology associated with these enterprises and the marketing of products.
4. provide opportunity for students to make responsible decisions about the appropriate use of agricultural technologies.

Course Outline

Unit – I

1.1 Plots and Blocks
Selection of site, Size, shape and orientation of plots and blocks, Uniformity trials, Systematic spacing design.

1.2 Designing an intercropping Experiments
Design and analysis of intercropping experiments, use of control, choosing levels of a factor, Number of replications.

Unit – II

2.1 Curves and Modelling
Yield density models, Growth curves, Sequential and particle S.S., Particle correlation, Step wise regression, Serial correlation, Use of multivariate techniques in agricultural experimentation,

2.2 Nonlinear Regression
Nonlinear regression, Experimentation with vegetables, fruits, and tree crops.

Unit – III

3.1 Animal Experiments
Experimental units (large and small animals), Selection of animals for experimentation, Adaptation period, Preliminary and sample collection period, Carry over effects, herd %, year %, Seasonal effect, Choice of covariate in animal experimentation.

3.2 Growth curves and Regression for Animals

Non- linear regression, lactation curves, growth curves etc. Intra class correlation among full and half sibs, Introduction to sensory evaluation techniques.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Fehr, W. (2019). *Principles of cultivar development: theory and technique*. Macmillian Publishing Company.

Suggested Readings:

1. Clewer, A. G., & Scarisbrick, D. H. (2013). *Practical statistics and experimental design for plant and crop science*. John Wiley & Sons.
2. Fehr, W. R., & Justin, J. R. (1988). *Principles of cultivar development*, vol. 2, *crop species.* Soil Science, *145*(5), 390.

Course Title:	**Predictive Modeling in the Health Sciences**
Course Code:	**BSTA-411**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes
By the end of this course, students will be able to:

1. describe the changing context of healthcare services including the trend value-based healthcare systems and the role of data in promoting improved outcomes.
2. import data from electronic health record (EHR) systems into data warehousing system and use analytical tools.
3. design data models that integrate patient data from multiple sources to create comprehensive patient-centered views of data.
4. design an analytic strategy to frame a potential issue and solution relevant to the health improvement of patient populations.
5. discover meaningful patterns and trends in large-scale data systems.

Course Outline

Unit – I

1.1 Basics of data analysis for the healthcare system
Define the concept of clinical intelligence as compared with business intelligence and the role of analytics in supporting a data-driven learning healthcare system. Key topics include tactical BI vs strategic BI, operational BI, definitions of Big Data, Overview-Overwhelm framework, sample size selection, existing quality/performance measurement frameworks (HEDIS), existing Analytics maturity model (DELTA), comparing healthcare delivery, and attributes of high performing healthcare systems.

1.2 Healthcare Data Acquisition and Management
Learn to navigate complex data structures and efficiently retrieve the data needed to answer a question or solve a problem. This module explores the types and sources of healthcare data, along with methods for selecting, preparing, querying and transforming healthcare data. Common health data formats like CCD, CCR and terminologies used in the healthcare system and the basics of R language and XML.

Unit – II

2.1 Applied Statistics for Healthcare Analytics
Examine epidemiological concepts in healthcare analytics and their application to patient and population outcomes research. Topics include a basic health statistics primer (as refresher); mortality, morbidity, and risk adjustment; cost effectiveness analysis; and methods for evaluating population variation. Plotting and implementing data visualization in R.

2.2 Data Mining for Healthcare Analytics
The proliferation of data in the post-EHR era creates opportunities for large scale data analysis to discover meaningful patterns and trends. In this module, students explore the application of data mining techniques for purposes of big data analytics using administrative and clinical systems data. Topics include an overview of the data mining process, data mining standards and output protocols, and common techniques used in mining healthcare data. You will learn textual analysis and sentiment analysis of post-EHR era data.

Unit – III

3.1 Systems Medicine for Predictive Analytics
Stemming from systems biology, systems medicine incorporates diverse experimental data with interactions between all components of health and disease, including gene and gene product expression and behavioral and environmental factors. You will learn about integrating genotypic and phenotypic data into predictive models using classification and clustering techniques.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Dinov, I.D. (2018). *Data Science and Predictive Analytics: Biomedical and Health Applications using R*. Springer (ISBN 978-3-319-72346-4).
2. Strickland, J. (2014). *Predictive modeling and analytics*. Lulu. com.

Suggested Readings:

1. Madsen, L. (2012). *Healthcare business intelligence: a guide to empowering successful data reporting and analytics*. John Wiley & Sons.
2. Ng, S. K., Xiang, L., & Yau, K. K. W. (2019). *Mixture modelling for medical and health sciences*. Chapman and Hall/CRC.
3. Polgar, S., & Thomas, S. A. (2011). *Introduction to Research in the Health Sciences E-Book*. Elsevier Health Sciences.
4. Schreier, G., Ammenwerth, E., & Hörbst, A. (2016). *Health Informatics Meets EHealth: Predictive Modeling in Healthcare–From Prediction to Prevention. Proceedings of the 10th EHealth2016 Conference* (Vol. 223). IOS Press.
5. Siegel, E. (2013). *Predictive analytics: The power to predict who will click, buy, lie, or die* (Vol. 10). Hoboken: Wiley.
6. Van Belle, G., & Kerr, K. F. (2012). *Design and Analysis of Experiments in the Health Sciences*. Wiley.

Course Title:	**Clinical Decision Making and Cost Effectiveness**
Course Code:	**BSTA-412**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. demonstrate the ability to critically appraise and interpret decision and cost-effectiveness analyses
2. perform a "fold-back" of simple decision trees to calculate the expected utility of each strategy and explain which strategy is "best."
3. use decision analytic software and spreadsheets to calculate the base case results of decision models, perform sensitivity analyses, and interpret the meaning of these results.
4. explain the value of diagnostic tests with regards to their ability to discriminate between patients with and without disease, and describe how the test characteristics of diagnostic tests are used to develop receiver operator characteristic (ROC) curves.

Course Outline

Unit – I

1.1 Preliminaries
Principles of medical decision making, tree construction and fertilization.

1.2 Decision modeling
Patient values and preferences, Bayes' rule and the interpretation of diagnostic tests, test characteristics & Bayes' rule.

Unit – II

2.1 ROC curve analysis
Introduction to ROC curve analysis, a decision analytic approach to determining the optimal operating point on the ROC curve, a decision analytic approach to determining the optimal operating point on the ROC curve.

2.2 Cost-effectiveness analysis
Fundamentals of cost-effectiveness analysis, discounting, critical appraisal of health economic analyses, Markov modeling and its role in cost-effectiveness.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. (2015). *Methods for the economic evaluation of health care programmes*. Oxford university press.
2. Hunink, M. M., Weinstein, M. C., Wittenberg, E., Drummond, M. F., Pliskin, J. S., Wong, J. B., & Glasziou, P. P. (2014). *Decision making in health and medicine: integrating evidence and values*. Cambridge university press.

Suggested Readings:

1. Briggs, A., Sculpher, M., & Claxton, K. (2006). *Decision modelling for health economic evaluation*. Oup Oxford.
2. Drummond, M. F., & McGuire, A. (2001). *Economic evaluation in health care: Merging theory with practice*. OUP Oxford.
3. Fulop, N. (Ed.). (2001). *Studying the organisation and delivery of health services: research methods*. Psychology Press.
4. Johannesson, M. (1996). *Theory and methods of economic evaluation of health care*. Springer Science & Business Media.

Course Title:	**Advanced Bio-statistical Techniques for Observational Studies**
Course Code:	**BSTA-413**
Semester:	-
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn to identify key statistical issues in observational studies and methods and study designs to address issues of confounding.
2. become proficient with advanced statistical methods for observational studies: methods for missing data, matching based inference, sensitivity analysis, propensity score methods, instrumental variables.
3. understand which methods are useful in different situations, and which conditions have to be checked for the method to be applicable.
4. be able to perform detailed data analyses on a variety data using the statistical computation environment r. you should be able to implement all the methods presented in this course.

Course Outline

Unit – I

1.1 Motivation and Experiments

Observational vs. randomized fuss, Simple randomized experiments (theory and practice).

Unit – II

2.1 Causal Models

Rubin Causal Model, Randomized experiments (including Randomized Block and Matched Pairs Designs) and complications that make them look like observational studies.

Unit – III

3.1 Observational Studies and Covariates

Observational Studies and simple ways of adjusting for covariates, Propensity Score Approaches – Theory.

1.2 Instrumental Models

Instrumental Variables Models – Introduction and Theory, Difference in Differences/ Fixed Effects models, Regression Discontinuity.

Unit – IV

4.1 Causal inference and Bias
Potential outcomes framework for causal inference, Causal inference in randomized experiments, Controlling for measured confounders in observational studies.

4.1.1 Tests of Hidden Bias
The known effects and multiple control groups as tests of hidden bias.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Gelman, A., & Hill, J. (2006) *Data Analysis Using Regression and Multilevel/Hierarchical Models.* Cambridge University Press.
2. Holland, P. (1986). Statistics and causal inference (with discussion). *Journal of the American Statistical Association*, 81, 945-970.
3. Marubini, E., & Valsecchi, M. G. (2004). *Analyzing survival data from clinical trials and observational studies* (Vol. 15). John Wiley & Sons.

Suggested Readings

1. Morgan, S., & Winship, C. (2007) *Counterfactuals and Causal Inference: Methods and Principles for Social Research*, Cambridge University Press
2. Rosenbaum, P. R. (2010). *Design of observational studies* (Vol. 10). New York: Springer.
3. Rubin, D. B. (2006). *Matched sampling for causal effects*. Cambridge University Press.

Course Title:	**Population and Family Health**
Course Code:	**BIOS-402**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn about recent population dynamics and consequent social challenges.
2. learn an introduction to the basic key demography concepts, implemented in a variety of disciplines, including sociology, demography, economics and political sciences.
3. get an idea about the policy implications of research evidence on health inequalities, with a special focus on preventive public health measures at local, national and international levels.

Course Outline

Unit – I

1.1 Introduction of Demographic Trends

Introduction and description Demographic trends (aging, wellbeing, socioeconomic, gender and family).

1.2 Public Health

Public health relevance of the population change, Locating data on population and health

Unit – II

2.1 Aging Theories

Aging theories of mortality and morbidity: Theories on population change (demographic and epidemiologic transition).

2.2 Trends in Life Expectancy

Major trends in life expectancy, (un)healthy life expectancy, and causes of death by sex and over time, Compression and expansion of morbidity: impact of lifestyle, environmental, socio-economic and cultural factors (including institutional factors, such as characteristics of the health care system).

Unit – III

3.1 Health Inequalities

Researching Health Inequalities in Later Life: Determinants and consequences on health, Healthy Life Expectancy comparisons.

3.1.1 Contextual Factors in Health Inequalities

The role of Welfare Regimes, Quality of Life - Going beyond health: Measuring health subjective and objective indicators, Active Aging, Happiness, Life Satisfaction and well-being, Chronological versus subjective age; feeling old.

Unit – IV

4.1 Demography Data

Quality and types of demography data, Socio-economic aspects of health, Gender health inequalities perspective, Contextual aspects of health, The evolution of Family, Family and Health.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Jagger, C., Saito, Y., Yokota, R. T. D. C., Van Oyen, H., & Robine, J. M. (2020). *International handbook of health expectancies* (E. M. Crimmins Ed.). Springer

International Publishing.
2. Rogers, R. G., & Crimmins, E. M. (2011). *International handbook of adult mortality* (Vol. 2). Springer Science & Business Media.

Suggested Readings:

1. Oksuzyan, A., Gumà, J., & Doblhammer, G. (2018). Sex differences in health and survival. In A demographic perspective on gender, family and health in Europe (pp. 65-100). Springer, Cham.
2. Van Raalte, A. A., & Nepomuceno, M. R. (2020). Decomposing gaps in healthy life expectancy. In *International Handbook of Health Expectancies* (pp. 107-122). Springer, Cham.

Course Title:	**Pharmaceutical Statistics**
Course Code:	**BSTA-414**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. describe how basic pharmacokinetic processes, as absorption, distribution and elimination, are defined, expressed, calculated, affected, and how these processes in combination determine drug disposition in the organism over time
2. explain how pharmacokinetics together with pharmacodynamics determine the effect intensity and effect duration of a drug
3. establish dosing regimens for drugs based on their pharmacokinetic and pharmacodynamic characteristics, use given dosing regimens for calculation of concentrations, and describe how doses should be adjusted due to variability in pharmacokinetic parameters

Course Outline

Unit – I

1.1 Definitions and Terminology
Biopharmaceutics, Generic Equivalence, Therapeutic Equivalents, Bioavailability, Bioequivalence, Drug Disposition, Pharmacokinetics (LADMER; Liberation, absorption, distribution, metabolism, elimination and response).

1.2 Pharmacokinetics
Introduction, Linear and Non-linear Pharmacokinetics Application of pharmacokinetics in clinical situations.

Unit – II

2.1 Multiple Dosage Regimen
Introduction, principles of superposition. Factors: persistent, accumulation and loss factors. Repetitive Intravenous injections – One Compartment Open Model. Repetitive Extravascular dosing – One Compartment Open model. Multiple Dose Regimen – Two Compartment Open Model.

2.2Concept Of Compartment(S) Models
One compartment open model. a. Intravenous Injection (Bolus) b. Intravenous infusion. II. Multicompartment models. a. Two compartment open model. b. IV bolus, IV infusion and oral administration III. Non-compartmental Model. a. Statistical Moment Theory b. MRT for various compartment models c. Physiological Pharmacokinetic model.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Gibaldi M. (2008). *Biopharmaceutics and Clinical Pharmacokinetics* (4th ed.). Marcel & Dakker Inc;.
2. Ritschel W. A., & Kearns G. L. (2019). *Handbook of Basic Pharmacokinetics: Including Clinical applications* (9th ed.). American Pharmacists Association.

Suggested Readings:

1. Curry, S. H., & Whelpton, R. (2010). *Drug disposition and pharmacokinetics.* Wiley Publishers;.
2. Lewis, G. A., Mathieu, D., & Phan-Tan-Luu, R. (1998). *Pharmaceutical Experimental Design* (1st ed.). Informa HealthCare.
3. Macheras, P., & Iliadis, A. (2006). *Modeling in biopharmaceutics, pharmacokinetics, and pharmacodynamics* homogeneous and heterogeneous approaches (2nd ed.). Springer Verlag.
4. Rouland, M., & Tozer, T. N. (1995). *Clinical Pharmacokinetics* (1st ed.). William & Willkins.
5. Winter, M. E. (2009). *Basic Clinical Pharmacokinetics* (5th ed.). Lippincott Williams & Wilkins.

Course Title:	**Structural Equation Models**
Course Code:	**STAT-403**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand in detail the basic concepts and framework of structural equation models.
2. get the hands-on training of application of different techniques on AMOS.
3. learn path analysis and models for repeated observations.

Course Outline

Unit – I

1.1 Introduction to SEM
Introduction to SEM; Matrix Algebra. Sub-modules in SEM.

1.1.1 Confirmatory Factor Analysis
Confirmatory Factor Analysis, Assumptions, Model Fit Indices, Modification Indices,

1.1.2 Residual Analysis in SEM
Residuals, Standardized Residuals, Model re-specification.

Unit – II

2.1 Introduction to AMOS
Introduction to AMOS, Import and Export Files, Data Editing, AMOS tools for SEM Models.

2.2 SEM in AMOS
Model Fitting in AMOS, Modification Indices via AMOS.

2.3 Path Analysis

Regression analysis and path analysis with manifest variables. Measurement errors; path analysis with latent variables along with the applications in the field of Biostatistics.

Unit – III

3.1 Stacked Models and Models for Repeated Observations

Stacked models (multiple sample models). Models for repeated observations (Simplex models, autoregressive models etc.). Second order factor models, interactions in SEM

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Byrne, B. M. (2001). *Structural Equation Modeling with AMOS*. Abingdon: Psychology Press Imprint.
2. Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Publications.

Suggested Readings:

1. Bowen, N. K., & Guo, S. (2012). *Structural equation modeling.* Oxford: Oxford University Press.
2. Hancock, G. R., & Mueller, R. O. (2006). *Structural equation modeling: a second course.* Greenwich, Conn: IAP.
3. Hoyle, R. H. (2012). *Handbook of structural equation modeling.* New York: Guilford Press.
4. Kaplan, D. (2000). *Structural equation modeling: foundations and extensions.* Thousand Oaks, Calif.: Sage Publications.

Course Title:	**Qualitative Research Methods in Health**
Course Code:	**BSTA-415**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. learn the key concepts of a research and its various types.
2. know the different kinds of survey and how to conduct them.
3. acquire the knowledge of sample selection with the help of examples.
4. develop a questionnaire for a real-world problem based on biostatistics and perform analysis on SPSS.

Course Outline

Unit – I

1.1 Nature and Planning of Social Surveys
Historical background, definition of the population censuses and sample surveys. Classical poverty surveys and regional planning surveys. Planning: Preliminary study, main planning problems, pre-testing and pilot surveys.

1.2 Sampling and Various types of Sampling Designs
Sample size, random numbers, sampling frames, non-response error. Estimation and testing of hypothesis, accuracy, bias and precision. Sampling distributions and standard error. Significance tests, random, stratified and cluster sampling. Multistage and Multiphase Sampling. Sampling with varying probabilities. Area sampling, Multiple sampling, Replicated sampling, Quota Sampling.

Unit – II

2.1 Methods of Collecting the Information
Documentary Sources, Observation, Questionnaire and Interviewing methods.

2.2 Scaling Methods and Errors in Surveys
Types of scales, Reliability and Validity, Response bias and Non-response errors.

Unit – III

3.1 Analysis of Data and Presentation
Editing, Coding, Tabulation and Testing of hypothesis with Statistical Analysis on SPSS and presenting the results.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Creswell, J. W. (2018). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (5th ed.). Sage Publications.
2. Daniel, P. S., & Sam, A.G. (2011). *Research Methodology.* Kalpaz Publications, Delhi.

Suggested Readings:

1. Marsh, M. C. (1982). *The Survey Method: the contribution of surveys to sociological explanation*. Macmillan.
2. Moser, C. A., & Kalton, G. (1985). *Survey Methods in Social Investigation*. Heinemann Educational Books, London.
3. Rose, G. (1982). *Deciphering Sociological Research* (2nd ed.). Macmillan.
4. Newman, W. L. (2009). *Social Research Methods: qualitative and quantitative approaches* (7th ed.). Pearson.
5. Panneerselvam, R. (2014). *Research Methodology* (2nd ed.). Prentice Hall India.
6. Salkind, N. J. (2010). *Encyclopedia of Research Design.* Sage Publications, Inc
7. Saris, W.E. and Gallhoffer, I.N. (2014). *Design, Evaluation, and Analysis of Questionnaires for Survey Research* (2nd ed.). John Wiley & Sons, Inc, Hoboken, New Jersey.
8. Singh, Y. K. (2011). *Fundamental of Research Methodology and Statistics.* New Age International limited edition.

Course Title:	**Academic Writing**
Course Code:	**BSTA-416**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand and learn the application of key principles of effective and efficient academic writing.
2. know the key techniques, guidelines and suggestions to improve academic written communication.
3. get hands-on experience in drafting, organizing and revising academic texts.

Course Outline

Unit – I

1.1 Writing Process and strategy

Introduction to Scientific Writing: Purpose, Common Types, General Features and Types of Scientific Documents. Research planning (understand titles and plan the writing process and writing structure), summarizing, organizing, plagiarism, and proofreading.

1.2 Elements of Writing, Vocabulary and Language

Argument and discussion, cause and effect, definitions and style. Paragraph Structure-Development of ideas. Precision, clarity, conciseness, academic vocabulary and word choice.

Unit – II

2.1 Structure of scientific paper

Organizing the document, transition, data implementation and display (Students must be given an assignment of drafting a research document with reference to Biological and Medical Sciences).

2.2 References and Quotations

Bibliography and Research Citations: Purpose of references and citation. Main reference system Use of quotations. Organizing the references.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Mathews, J. R. (2017). *Successful Scientific Writing: A Step-by-Step Guide for the Biological and Medical Sciences* (6th ed.). Cambridge University Press.

Suggested Readings:

1. Bailey, S. (2011). *Academic Writing: A Handbook for International Students* (3rd ed.). Routledge.
2. Hofmann, A. (2016). *Scientific Writing and Communication* (3rd ed.). Oxford University Press.

Course Title:	**Meta-Analysis and Systematic Reviews**
Course Code:	**BSTA-417**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. describe the steps in conducting a systematic review
2. develop an answerable question using the "participants interventions comparisons outcomes" (PICO) framework
3. describe the process used to collect and extract data from reports of clinical trials
4. describe methods to critically assess the risk of bias of clinical trials
5. describe and interpret the results of meta-analyses.

Course Outline

Unit – I

1.1 Introduction
Introduction to Systematic Reviews, Introduction to Meta-Analysis, Producers and Users of Systematic Reviews.

1.2 Framing Question
Resources for How to Frame Your Question, Deciding the Type and Scope of Your Question, Elements of the Question, Refining the Question, Some Examples, Analytic Framework.

1.3 Searching Principles and Bias Assessment
Searching Principles and Assessing Bias, Finding the Evidence: Searching Principles, Identifying Key Sources and Techniques for Searching, Building a High-Quality Search Strategy, Documenting Your Search and Conclusions, Why Bias in the Individual Study is Important to a Systematic Review and Meta-Analysis, Selection Bias, Information Bias, Bias in the Analysis, Displaying Study "Quality" in Your Systematic Review.

1.4 Minimizing Metabias, Qualitative Synthesis, and Interpreting Results
Standards for Systematic Reviews, Selection Bias, Information Bias, Bias in the Analysis, Reporting Transparently, Qualitative Synthesis and Interpreting Results Section, What is Qualitative Synthesis.

1.5 Planning the Meta-Analysis and Statistical Methods
Planning Your Meta-Analysis Section, Introduction to Meta-Analysis, Why Do a Meta-Analysis?, Types of Data and Effect Measures, Fixed Effect Model, Random Effects Model, Random Effects Model.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Hartung, J., Knapp, G., Sinha, B. K., & Sinha, B. K. (2008). *Statistical meta-analysis with applications (Vol. 6)*. New York: Wiley.

Suggested Readings:

1. Card, N. A. (2015). *Applied meta-analysis for social science research*. Guilford Publications.
2. Chen, D. G. D., & Peace, K. E. (2013). *Applied meta-analysis with R*. CRC Press.
3. Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis*: Correcting error and bias in research findings. Sage.
4. Stangl, D., & Berry, D. A. (Eds.). (2000). *Meta-analysis in medicine and health policy*. CRC Press.

Course Title:	**Health Inventory Management**
Course Code:	**BSTA-418**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. optimize inventory levels.
2. build an inventory management plan.
3. design and manage warehouse operations.

Course Outline

Unit – I

1.1 Preliminaries

Introduction to inventory management. The financial implications of holding inventory: Inventory carrying cost, Effect on financial. The cost of not holding enough inventory.

1.2 Inventory management

Introduction to effective inventory management. Inventory management & the supply chain strategy. Demand forecasting. Lead time management.

Unit – II

2.1 Inventory planning

Introduction to inventory planning. Inventory categorization techniques: ABC analysis, fast & slow moving, excess, obsolete & defective stocks. Traceability and variety reduction. Inventory coding systems and bin card management. The inventory management plan.

2.2 Inventory operations

Introduction to inventory operations. Monitoring movements: Inventory accuracy. Measuring and valuation of inventory. Receipt and issuance of inventory. Systems to replenish inventory. Order planning (time, value & quantity). Storage of vaccines and perishable items. Inventory management of disposables.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Abdelhak, M., Grostick, S., & Hanken, M. A. (2014). *Health information-e-book: Management of a strategic resource*. Elsevier Health Sciences.
2. Wild, T. (2017). *Best practice in inventory management*. Routledge.

Suggested Readings:

1. Bose, D. C. (2006). *Inventory management*. PHI Learning.
2. Hoy, W. K., & Sabo, D. J. (1998). *Quality middle schools: Open and healthy*. Corwin Press.
3. Muller, M. (2019). *Essentials of inventory management*. HarperCollins Leadership.
4. Relph, G., & Milner, C. (2015). *Inventory Management: Advanced methods for managing inventory within business systems*. Kogan Page Publishers.
5. Waller, M. A., & Esper, T. L. (2014). *The definitive guide to inventory management: principles and strategies for the efficient flow of inventory across the supply chain*. Pearson Education.

Course Title:	**Health Project Management**
Course Code:	**BSTA-419**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. demonstrate knowledge of project management terms and techniques.
2. apply healthcare project management tools and techniques.
3. apply project management skills and tools to manage a project.

Course Outline

Unit – I

2.1. Introduction

Project Management Overview and Process (Initiating): An Introduction to Project, Program, and Portfolio Management in Healthcare. Project, Program, and Portfolio Selection. Introduction to Project Management Software. Initiating Projects.

Unit – II

2.1 Steps

The Project Management Process (Planning): Project Integration and Scope Management, Project Time and Cost Management, Project Quality, Human Resource, Communications, Stakeholder, Risk, and Procurement Management. The Project Management Process (Executing, Monitoring/Controlling & Closing)

2.2 Project Execution

Executing Projects, Monitoring and Controlling Projects, Closing Projects, Best Practices in Project Management, Case Studies.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Abdelhak, M., Grostick, S., & Hanken, M. A. (2014). *Health information-e-book: Management of a strategic resource*. Elsevier Health Sciences.
2. Kerzner, H. (2002). *Strategic planning for project management using a project management maturity model*. John Wiley & Sons.

Suggested Readings:

1. Edelman, C. L., Mandle, C. L., & Kudzma, E. C. (2017). *Health promotion throughout the life span-e-book*. Elsevier Health Sciences.
2. Gido, J., & Clements, J. (2014). *Successful project management*. Cengage Learning.
3. Higgs, J., Jones, M. A., Loftus, S., & Christensen, N. (Eds.). (2008). *Clinical reasoning in the health professions E-book*. Elsevier Health Sciences.
4. Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Sons.
5. Morris, R. A. (2008). *The Everything Project Management Book: Tackle any project with confidence and get it done on time*. Simon and Schuster.
6. Naidoo, J., & Wills, J. (2016). *Foundations for Health Promotion-E-Book*. Elsevier Health Sciences.
7. Schwalbe, K. (2009). *Introduction to project management*. Boston: Course Technology Cengage Learning.
8. Wood, N. (2002). *The Health Project Book: A Handbook for New Researchers in the Field*. Routledge.

Course Title:	**Statistics & DNA Forensics**
Course Code:	**BSTA-420**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. interpret the genetics of DNA-evidence, as well as the current methods for the analysis and interpretation of DNA traces.
2. use the forensic statistical methods used for the evaluation and combination of (biological) evidence, both at source and activity level.
3. acquire the basics of risks and benefits of using genetic profiles for human identification.

Course Outline

Unit – I

1.1 Profiling Basics

The genetic nature of forensic profiles: blood groups, STRs, SNPs. The elements of probability theory. The birthday problem. Presenting scientific evidence. Likelihood ratios. Common fallacies.

Unit – II

2.1 Profile Matching

Profile matching and partial matching within and between populations. Lineage markers: Y-STR and mtDNA profiles. Parentage calculations. Relatedness. Remains dentification. Cold hits. Familial searching. Wildlife forensics. Forensic Drugs Analysis. Ethical issues.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Fung, W. K., & Hu, Y. Q. (2008). *Statistical DNA forensics: theory, methods and computation*. John Wiley & Sons.
2. Huffman, J. E., & Wallace, J. R. (2012). *Wildlife forensics: methods and applications* (Vol. 6). John Wiley & Sons.

Suggested Readings:

1. Butler, J. M. (2009). *Fundamentals of forensic DNA typing*. Academic press.
2. Goodwin, W., Linacre, A., & Hadi, S. (2011). *An introduction to forensic genetics* (Vol. 2). John Wiley & Sons.
3. Lyle, D. P. (2019). *Forensics for dummies*. John Wiley & Sons.
4. Rapley, R., & Whitehouse, D. (Eds.). (2007). *Molecular forensics*. John Wiley & Sons.
5. Sammons, J. (2012). *The basics of digital forensics: the primer for getting started in digital forensics*. Elsevier.
6. Shewale, J. G., & Liu, R. H. (Eds.). (2013). *Forensic DNA analysis: current practices and emerging technologies*. CRC Press.

Course Title:	**Global Public Health**
Course Code:	**BIOS-403**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. use the international rules and regulations for travelers about the common internationally communicable diseases.
2. describe the importance of culture, class, and gender on perceptions of health and illness, on health status, and on access to services.
3. describe the health situation of a country using the concepts of demographic and epidemiological transition.
4. explain how international health status is measured and communicated.

Course Outline

Unit – I

1.1 Introduction

Introduction to the Concept of International Health, International Health Organizations, Strengthening Health Security by implementing the international health regulations,

Unit – II

2.1 Global System

Global System for Alert and Response, IHin Context of Multi-Hazard Dimension, Country Capacity Building for International Health, International Travel, Health & Mass Gatherings, Public Health at Ports, Airports, Entry and Exit Points on Borders, IHR Procedure and Implementations

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Chen, M. S. (2012). *Textbook of international health: Global health in a dynamic world*.
2. Kettl, D. F. (2006). *The global public management revolution: A report on the transformation of governance*. Brookings Institution Press.
3. McMurray, A., & Clendon, J. (2015). *Community health and wellness-e-book: Primary health care in practice*. Elsevier Health Sciences.

Suggested Readings:

1. Baum, F. (2016). *The new public health* (No. Ed. 4). Oxford University Press.
2. Beaglehole, R., Beaglehole, R., & Bonita, R. (Eds.). (2009). *Global public health: a new era*. Oxford University Press.
3. Bhalwar, R., Singh, M., Jayaram, J., Vaz, L. S., Bhatti, V. K., Agrawal, S., & Datta, A. (2009). *Text book of public health and community medicine. History*, *1*, 2.
4. Birn, A. E., Pillay, Y., & Holtz, T. H. (2009). *Textbook of international health: global health in a dynamic world*. OUP USA.
5. Garrett, L. (2003). *Betrayal of trust: The collapse of global public health*. Oxford University Press.
6. Kaul, I., Conceição, P., Le Goulven, K., & Mendoza, R. U. (Eds.). (2003). *Providing global public goods: managing globalization*. Oxford University Press.
7. Merson, M., Black, R. E., & Mills, A. (Eds.). (2006). *International public health: diseases, programs, systems and policies*. Jones & Bartlett Learning.
8. Tolley, E. E., Ulin, P. R., Mack, N., Robinson, E. T., & Succop, S. M. (2016). *Qualitative methods in public health: a field guide for applied research*. John Wiley & Sons.

Course Title:	**Biosafety and Ethics**
Course Code:	**BIOS-404**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. appreciate the range of competing considerations and interests at play in the ethics and regulation of biotechnology and the life sciences;
2. formulate well-reasoned and coherent arguments relating to biotechnology and bioethics;
3. show a solid understanding of current bioethical debates, concepts and arguments relating to bioethics, as well as their normative and regulatory implications where applicable.

Course Outline

Unit – I

1.1 Introduction

Introduction to Biosafety - definition, concept, uses and abuses of Genetic information, and Biohazards.

1.2 Laboratory Practices

Good Laboratory practices and risks related to genetically modified organisms (GMO).

1.3 Biosafety

International rules and regulations for biosafety and GMOs.

1.3.1 Bioethics

Introduction to Bioethics, Ethical issues related to GMOs, Euthanasia, Reproductive and Cloning technologies, Transplants, and Eugenics, Patenting, Commercialization, and Benefit sharing.

1.3.2 Bioethics Committees

Role of national bioethics committees; biosafety guidelines from a national perspective. Informed consents, Research misconducts and patenting, Conflict of interest, Environmental ethics, GMOs and synthetic organisms, Breaking bad news, Advance care planning, Stem cells and cloning.

Unit – II

2.1 Reproduction Technologies

Modern reproduction technologies, Truth telling and withholding information.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Wooley, D. P., & Byers, K. B. (Eds.). (2020). *Biological safety: principles and practices*. John Wiley & Sons.

Suggested Readings:

1. D'Angelo, J. G. (2018). *Ethics in science: Ethical misconduct in scientific research*. CRC Press.
2. Richardson, J. H., Vesley, D., Songer, J. R., Housewright, R. D., & Barkley, W. E. (1986). *Laboratory safety: principles and practices* (p. 56). B. M. Miller, & D. H. Gröschel (Eds.). Washington, DC: American Society for Microbiology.
3. Kelly, A. P. (2016). Biological safety considerations. In *The Physical Measurement of Bone* (pp. 35-71). CRC Press.
4. Luning, P. A., & Marcelis, W. J. (2009). *Food quality management: technological and managerial principles and practices*. Wageningen Academic Publishers.
5. Nordmann, B. D. (2010). Issues in biosecurity and biosafety. *International journal of antimicrobial agents*, *36*, S66-S69.

6. Sateesh, M. K. (2013). *Bioethics and biosafety*. IK International Pvt Ltd.
7. Schröder, I. (2019). Biological Safety: Principles and Practices.
8. Sensi, A., Brandenberg, O., Gosh, K., & Sonnino, A. (2011). Biosafety resource book.
Van der Burg, S., & Swierstra, T. (Eds.). (2013). *Ethics on the laboratory floor*. Springer.

Course Title:	**Data Management for Clinical Research**
Course Code:	**BSTA-421**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. design a survey to collect data from respondents.
2. manage data with the help of state of art technologies.
3. analyze and extract useful information from clinical data.

Course Outline

Unit – I

1.1 Research Data Collection Strategy

Defining the Space, Research Data Planning, Approaches to Data Collection.

1.2 Electronic Data Capture Fundamentals

Standardization of Study Processes, Validated Instruments, Data Standards: What Can Standards Do for You?
Data Standards: Basic Concepts and Overview, IRB, HIPAA, and FISMA, GCP and CFR,
Introduction to Electronic Data Capture (EDC): EDC Concepts: Data Exports, Logging, User Rights, Project Creation, EDC Concepts: Data Imports, Scheduling, Reports, Internationalization.

Unit – II

2.1 Planning a Data Strategy for a Prospective Study

Overview of the Study, Study Procedures, Baseline Data and Demographics, Visit Data, Review of Variables and Forms, Logging in to REDCap.
Walkthrough: Creating a Project and Adding the First Variables, Adding Fields to the Baseline Form, Walkthrough: Adding File Fields and Formatting.

2.2 Practical Implementation

Walkthrough: Creating Visit Forms, Copying Variables, Renaming Forms, Using the Shared Library, Longitudinal Events, Optional Modules**,** and User Rights, Testing the REDCap Project, Example Study Wrap-Up, Data Quality, Data Quality Monitoring.

Unit – III

3.1 Post-Study Activities and Other Considerations

Wrapping Up Your Study, Sharing Your Work, De-identifying Data, De-identifying Dates, Common Information Systems Used in Health Care, Neuroimaging Data Management, mHealth in Developing Countries, Data Management for Multi-Center or Network Studies, Resource-Limited Settings and Global Health, Challenges of Collecting Data in Resource-Constrained Settings, Data Privacy in Global Research, International Data Sharing.

3.2 Data Collection with Surveys

Benefits, Scope, and Validated Instruments, Survey Design, Survey Procedures and Implementation, Survey Testing, Administration, and Analysis, Survey Overview and REDCap Setup, Survey Testing and Distribution.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. McFadden, E. (2020) *Management of Data in Clinical Trials* (2nd ed). Susanne Prokscha. (1999) *Practical Guide to Clinical Data Management*. Interpharm Press (an IHS Health Group Company).

Suggested Readings:

1. Rondel, R. K., Varley, S. A., & Webb, C. F. (Eds.). (2000). *Clinical data management*. New York: Wiley.

Course Title:	**Mathematical Biostatistics**
Course Code:	**BSTA-422**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. understand the key concepts of statistics.
2. compute various summary statistics like confidence interval and interpret.
3. perform statistical hypothesis testing.
4. understand biostatistics.

Course Outline

Unit – I

1.1 Introduction, Probability, Expectations, and Random Vectors
Biostatistics and Experiments, Set Notation and Probability, Probability, Random Variables, PMFs and PDFs, CDFs, Survival Functions, and Quantiles, Expected Values, Rules About Expected Values, Variances and Chebyshev's Inequality, Random Vectors and Independence, Correlation, Variance Properties and Sample Variance.

1.2 Conditional Probability, Bayes' Rule, Likelihood, Distributions, and Asymptotics
Conditional Probabilities and Densities, Bayes' Rule and DLRs, Likelihood, Bernoulli Distribution and Binomial Trials, The Normal Distribution, Limits and LLN, CLT and Confidence Intervals.

Unit – II

2.1 Confidence Intervals, Bootstrapping, and Plotting
Confidence Intervals and CI for Normal Variance, Student's t Distribution and CI for Normal Means, Profile Likelihoods, T Confidence Intervals, Plotting, The Jackknife, Bootstrapping.

2.2 Binomial Proportions and Logs
Binomial Proportions and Logs.

2.3 Hypothesis Testing
Hypothesis Testing, More Hypothesis Testing, General Rules of Hypothesis Testing, Two-sided Tests, Confidence Intervals & P Values, Power, Calculating Power ,T Tests & Monte Carlo, Two Sample Tests - Matched Data, Two Sample Tests - Matched Data, Two Sample Tests - Regression to the Mean,Two Sample Tests - Two Independent Groups.

2.4 Two Binomial
Two Sample Binomial Tests - Score Statistic, Two Sample Binomial Tests - Exact Tests, Two Sample Binomial Tests - Comparing 2 Binomial Proportions, Relative Risks & Odds Ratios -

Relative Measures, Relative Risks & Odds Ratios - The Relative Risk, Relative Risks & Odds Ratios - The Odds Ratio, Delta Method, Delta Method & Derivation.

Unit – III

3.1 Discrete Data Setting
Fisher's Exact Test, Hyper-Geometric Distribution, Fisher's Exact Text in Practice & Monte Carlo, Chi Squared Testing, Testing Independence, Generalization, Goodness of Fit Testing.

3.2 Techniques
Simpson's Paradox, Simpson's Paradox, more examples, Weighting, CMH test, Case Control Sampling, Exact inference for The Odds Ratio, Matched 2x2 Tables, Dependence and Marginal Homogeneity, Estimation of the Marginal Difference in Proportions, Odds and Ends for Matched 2x2 Tables, the sign test,the sign rank test, the rank sum test, Poisson distribution, Poisson likelihood, Poisson P-value calculation.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Celik, Y. (2021). *The Science of Biostatistics in Decision Making within Health Sciences.*
2. Gurumani, N. (2002). *An introduction to Biostatistics*. MJP publisher.

Suggested Readings:

1. Bancroft, H. (1957*). Introduction to biostatistics.* A Hoeber-Harper Book.
2. Sakdeo, B. M. (2021*). Introduction to Biostatistics.m.*

Course Title:	**Hospital Waste Management**
Course Code:	**BIOS-405**
Semester:	**-**
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. acquaint students with the principles and applications of clinical waste management.
2. learn the techniques for waste minimization; waste sorting; anaerobic and aerobic compositing; industrial and hospital waste treatment processes.
3. learn about principles and applications of treatment systems for water, waste water and hazardous wastes.

Course Outline

Unit – I

1.1 Infectious Management
An introduction to the management of infectious materials/waste.

1.1.1 Types of Infectious Management
Various types of infectious material and methods of their handling and disposal; laboratory and hospital acquired infections - possible sources and causes.

Unit – II

2.1 Containment Rules
Hazardous microorganisms; basic containment rules and laboratory contamination levels, control measures; guidelines for workers in microbiology and pathology labs, and post-mortem rooms; rules for safe conduct during field work and outdoor activities.

Unit – III

3.1 Risk Assessment
Risk assessment including recognition of hazards; competence and elimination of hazards; collection of data, etc.; risk group personnel and their education, training and monitoring.

Unit – IV

4.1 Waste Sources
Radiation hazards and disposal of radioactive waste. Wastewater: sources, characteristics and management.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbooks:

1. Chandrappa, R., & Das, D. B. (2012). *Solid waste management: Principles and practice*. Springer Science & Business Media.
2. Chartier, Y. (2014). *Safe management of wastes from health-care activities*. World Health Organization.
3. Garvin, M. (1995). *Infectious waste management: A practical guide*. CRC Press.

Suggested Readings:

1. Metcalf & Eddy, (2003). *Waste water Engineering: Treatment, Disposal and Reuse* (4th ed.). McGraw-Hill.
2. Närvänen, E., Mesiranta, N., Mattila, M., & Heikkinen, A. (2020). *Food waste management*. Springer.
3. Reinhardt, P. A. (2018). *Infectious and medical waste management*. CRC Press.
4. Rhyner, C. R., Schwartz, L. J., Wenger, R. B., & Kohrell, M. G. (2017). *Waste management and resource recovery*. CRC Press.
5. Sengupta, D., & Agrahari, S. (2017). *Modelling trends in solid and hazardous waste management*. Springer Singapore.

6. Singhal, L., Tuli, A. K., & Gautam, V. (2017). Biomedical Waste Management Guidelines 2016: What's done and what needs to be done. *Indian journal of medical microbiology*, 35(2), 194-198.

Course Title:	**Public Health Issues in Abuse and Addiction**
Course Code:	**BIOS-406**
Semester:	-
Credit Hours:	**03**

Learning Outcomes

By the end of this course, students will be able to:

1. demonstrate a rudimentary understanding of the bio-psycho-social-spiritual process of addiction.
2. demonstrate a basic understanding of the DSM-IV-TR.
3. discuss controversial issues on the legalization, medicalization, and
4. decriminalization of illicit drugs identify treatment resources in the community.

Course Outline

Unit – I

1.1 Concept of Abuse and Addiction
Etiology of Substance Abuse and Addiction: History and Perspectives.

1.2 Models and Theories of Addiction
Models and Theories of Addiction. Drug Specific Information.

1.3 Public Health
Areas of public health impacted by drug use and exacerbating problems associated with drug use (e.g. poverty, HIV and other STD's, OD, violence, mental health, homelessness, child welfare, health service utilization and availability).

Unit – II

2.1 Impact of Addiction
The Impact of Addiction on the Family System. Co-Occurring Disorders. Public Health Intervention Options.

2.2 Treatment
What is Treatment? Is Treatment Effective? How do we know? Public Health Intervention Options Harm Reduction, Community Involvement, Self-help, and Self-Organization. Public Health Intervention Options.

2.3 Prevention
What is Prevention? How do we assess effectiveness? Why is DARE the most widely used drug abuse prevention program in the country? The problem of implementation fidelity versus adaptation.

2.4 Social Marketing
Social marketing. Truth Campaigns versus just say no. Thinking in terms of Costs and Benefits.

- **Teaching-learning Strategies:**

Class Lecture method, which includes seminars, discussions, assignments and projects. (Audio-visual tools are used where necessary)

- **Assignments-Types and Number with calendar:**

According to the choice of respective teacher.

- **Assessment and Examinations:**

According to the University's Semester Rules.

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	It takes place at the mid-point of the semester.
2.	Formative Assessment	25%	It is continuous assessment. It includes: Classroom participation, attendance, assignments, and presentations, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Textbook:

1. Greifinger, R. (Ed.). (2007). *Public health behind bars: from prisons to communities*. Springer Science & Business Media.

Suggested Readings:

1. Henningfield, J. E., Santora, P. B., & Bickel, W. K. (Eds.). (2007). *Addiction treatment: science and policy for the twenty-first century*. JHU Press.
2. Lesch, O. M., Walter, H., Wetschka, C., Hesselbrock, M. N., Hesselbrock, V., & Pombo, S. (2020). *Alcohol and tobacco: Medical and sociological aspects of use, abuse and addiction*. Springer Nature.
3. Miller, P. G., Strang, J., & Miller, P. M. (Eds.). (2010). *Addiction research methods*. John Wiley & Sons.
4. Stanton, M. D., & Todd, T. C. (Eds.). (1982). *The family therapy of drug abuse and*

addiction. Guilford Press.
5. Tucker, J. A., Donovan, D. M., & Marlatt, G. A. (Eds.). (2001). *Changing addictive behavior: Bridging clinical and public health strategies*. Guilford Press.
6. Vuchinich, R. E., & Heather, N. (Eds.). (2003). *Choice, behavioral economics, and addiction*. Elsevier.
Wekerle, C., & Wall, A. M. (Eds.). (2004). *The violence and addiction equation: Theoretical and clinical issues in substance abuse and relationship violence*. Routledge.