RULES, REGULATIONS
AND SYLLABUS
M.Sc. IN BIOSTATISTICS
AND EPIDEMIOLOGY

International Institute for Population Sciences
(DEEMED UNIVERSITY)
Deonar, Mumbai 400 088.
Website: http://www.iipsindia.org
About the Institute

The Institute was established in 1956 as the regional centre for training and research in Population Studies for the country of Asia and Pacific region. The International Institute for Population Sciences embraced the present name and was declared a “Deemed University” in 1985 by the Ministry of Human Resource Development, Government of India. The Institute is an autonomous body under the administrative control of the Ministry of Health and Family Welfare, Government of India. This is the only Institute of its kind in the world exclusively devoted to teaching and research in population sciences. Over the last fifty years, the Institute has helped in building a nucleus of professionals in the field of population in various countries in the ESCAP region. Many who were trained at the Institute now occupy key positions in reputed national and international organizations.

Learning Objectives

The Master of Science in Biostatistics and Epidemiology will provide students knowledge and understanding of modern statistical and epidemiological methods. The students will learn about their application in all areas of public health, health, demography, and social sciences aimed at understanding and improving human wellbeing. The course offers a thorough grounding in modern epidemiological research and the application of statistical methods to epidemiological investigation and practice. Students will be given the opportunity to apply research techniques to a variety of challenging epidemiological and biomedical problems. The course also aim at providing students scope for professional development in understanding and use of statistical software packages including SPSS, STATA, SAS, MLWin, GIS and R. In the second year of the course students shall write a dissertation on the basis of contemporary applications of epidemiological and statistical methods and statistical softwares in public health, health and demography. Opportunities are given to develop presentation and consultancy skills which are much valued by employers.

In India, there is a serious shortage of biostatisticians and epidemiologists trained to Master’s level, which is the entry level to a broad range of employment sectors including the pharmaceutical industry, medical research and health services. The aim of this Master’s course is to equip students with the required knowledge to follow careers in these areas. The Master of Science in Biostatistics and Epidemiology shall also be gateway to further pursue Ph.D.

Expected Outcomes of M.Sc. Biostatistics and Epidemiology

On completion of two years Master of Science in Biostatistics and Epidemiology the passing out students shall be able to:

- design, analyse, interpret and criticise epidemiological, health and public health research
- demonstrate an understanding of the essential principles of modern bio-statistical methods and statistical softwares and how to apply them
- employ basic mathematical and computational skills used in the analysis of disease pathogenesis, transmission and control
- undertake original research projects that makes a contribution to the body of knowledge for human wellbeing
• exhibit the ability to disseminate research findings to the scientific community and the general public
• prepare Statistical Analysis Plan (SAP)
• undertake analysis of clinical trials

Eligibility for admission and selection procedure

Candidates with a Bachelor’s degree from recognized universities in India or abroad in core subject of Mathematics or Statistics or with atleast two full papers of Mathematics or Statistics with a minimum of 55% marks or equivalent grade will be eligible for admission to the above programme. Candidates awaiting results of qualifying examination latest by 30th September of the admission year can also apply for consideration. The upper age limit is 25 years as on 30th June of the admission year. Marks and age are relaxable for candidates belonging to reserved categories as per GOI rules.

Selection Criteria for the M.Sc. in Biostatistics and Epidemiology Program

The selection will be made on the basis of a written test and personal interview. Only shortlisted candidates will be called for the test and interview. Shortlisted candidates appearing for admission test are entitled to claim sleeper class train fare by the shortest route on production of original tickets and in case of road journey normal fare will be paid only for travel by public transport run by a Government body.

Number of Seats and Award of Degrees

There are 50 seats available with the Government of India fellowship.

Fellowships

There are 50 Government of India Awards (Fellowships of Rs. 5000/- per month) available for M.Sc. in Biostatistics and Epidemiology programme. There are no other allowances.

Duration of the Course

The M.Sc. in Biostatistics and Epidemiology programme, which is of two academic years comprises four semesters, begins from the first week of August. The first semester ends in the month of December. The second semester starts in the last week of December and ends in month of June next year. The third semester begins again in the month of August and ends in the month of June next year completing of fourth semester.

Conditions for the Award

a) M.Sc. in Biostatistics and Epidemiology programme is a full time course. The student shall not accept or hold any appointment paid or otherwise or receive any emoluments, salary, stipend, etc., from any other source during the tenure of the award.
b) The student should also obtain prior permission of the Director in writing for appearing at any examination conducted by any other University/Institution.

c) The fellowship will be available from the onset of the course till the end of the course.

d) The fellowship may be terminated at any time if the Institute is not satisfied with the progress or conduct of the fellow.

e) The student will have to execute a bond requiring him/her to refund the fellowship received by him/her, if the fellow discontinues before the end of the prescribed period. The condition of the bond cannot be waived or relaxed except by the Director with the consent of the Executive Council of the Institute.

f) If a student’s performance in the first semester is not found satisfactory, or his/her conduct is found unsatisfactory on the basis of indiscipline of any act as is likely to undermine the prestige of the Institute, or endanger harmony of academic life of the Institute or is likely to violate the rules of the institute, his/her admission and fellowship will be terminated without any further notice. In case the fellowship is terminated, he/she will be required to refund the whole of the fellowship money drawn till that date provided the action against him/her has not been contemplated on the ground of unsatisfactory performance as stated above.

g) Fees: The candidates admitted to the programme will have to pay the fees as per schedule of the Institute on 1st January and 1st July every year regularly. For payment of fees, a grace period of 30 days shall be given without late fee. Thereafter, 5% on all dues will be charged extra as late fee, every month.

**Hostel Accommodation**

Accommodation in the hostel of the Institute will be provided to the students at the applicable rate, subject to availability.

**Medical Facilities**

The students of the Institute will have access to free medical advice from the medical officers of the Institute.

**Leave**

A student can take leave for a maximum of four working days in a semester on the recommendation of Course Co-ordinator and granted by the Director.

**Attendance**

1. Minimum of 95 percent of attendance in classes is compulsory to receive full fellowship.
2. Minimum of 75 percent of attendance in classes is compulsory to appear in exams.
**Dissertation**

A student is required to write a dissertation on some demographic or related problems under the guidance of a faculty member. The topics of the dissertation have to be submitted at the beginning of the Forth Semesters. The dissertation will be presented in formal seminar of the students and faculty members of the Institute. The content and presentation and participation in the seminar shall be subjected to assessment by a committee comprising of faculty members.

**Evaluation**

Grades obtained in all the subjects counted for determining the overall grade for M.Sc. in Biostatistics and Epidemiology programme. Minimum Grade required for passing is "B Minus" in each unit.

**Grading System**

The following ten points grading system is followed in the Institute:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Numerical Value</th>
<th>Equivalent Marks/ Qualitative Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>9</td>
<td>85 and above / Excellent</td>
</tr>
<tr>
<td>A</td>
<td>8</td>
<td>75-84 / Very Good</td>
</tr>
<tr>
<td>A-</td>
<td>7</td>
<td>65-74 / Good</td>
</tr>
<tr>
<td>B+</td>
<td>6</td>
<td>55-64 / Above Average</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>45-54 / Average</td>
</tr>
<tr>
<td>B-</td>
<td>4</td>
<td>35-44 / Below Average</td>
</tr>
<tr>
<td>C+</td>
<td>3</td>
<td>25-34</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>15-24 Poor/Fail</td>
</tr>
<tr>
<td>C-</td>
<td>1</td>
<td>1-14</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1. The teacher concerned will set the question paper and also evaluate the answer books as per grading pattern.
2. A final grade for each paper will be arrived by taking weighted average of grades given in different sections of the paper in case of questions of unequal weights. The weights can be given in proportion to the credit (i.e. number of hours) assigned for each section of the paper.
3. Overall Grade will be arrived on the basis of the number of credit hours and grade points for each subject.
4. A student securing a overall average grade points (OAGP) of less than B Minus, i.e. grade C Plus will not be eligible for the award of the degree.

**Written Examination**

Written examination will be conducted for all courses.
Re-evaluation of Answer Sheets

A student can have access to his/her examination papers in the form of xerox copies at a cost of Rs. 200/- per paper with prior approval of the Director.

A student can apply for re-evaluation of his/her answer sheet at a cost of Rs. 500/- per paper.

EVALUATION PROCEDURE FOR DISSERTATION

A. Dissertation

The dissertation will be of 16 credits. Guide and two faculty committee members for dissertation assessment and evaluation, Proposal presentation- 2 credits, and Synopsis presentation- 2 credits to be assessed and awarded by the two faculty committee members. Distribution of assessment credits: Guide- 6, two committee members- 3 credits each.

Re-Examination

(1) Re-examination will not be conducted during the course period.
(2) Those students who fail or could not appear in any examination will be allowed to re-appear in a paper in the next semester examinations.
(3) Those failing in any exam of final semester will not be awarded the degree in the same academic year. They can appear in the re-examination along with first semester of the next batch.
(4) Maximum of three attempts will be allowed including the first appearance in each paper.
(5) There will not be any down grading in re-examinations.
(6) 50 Percent of clearance of the total papers in each semester is compulsory to continue the study in next semester.
### COMPULSORY COURSES

#### SEMESTER I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course title</th>
<th>No. of credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basics of Statistical Methods and Human Biology</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Demographic Methods I</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Introduction to Biostatistics &amp; Epidemiology</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Demographic Methods II</td>
<td>4</td>
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</tbody>
</table>

**Total credits: 16**

#### SEMESTER II

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course title</th>
<th>No. of credits</th>
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<tbody>
<tr>
<td>5</td>
<td>Healthcare Systems and Policies</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Epidemiology</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Sampling Techniques in Health &amp; Demographic Surveys</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Application of statistical and demographic packages I</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Viva-voce</td>
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**Total credits: 18**

#### SEMESTER III

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course title</th>
<th>No. of credits</th>
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</thead>
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<tr>
<td>10</td>
<td>Research Methodology</td>
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</tr>
<tr>
<td>11</td>
<td>Statistical Inference</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Design &amp; Analysis of Experiments</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>Application of statistical and demographic packages II</td>
<td>4</td>
</tr>
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</table>

**Total credits: 12**

**Note I:** Selection of topic and supervisor and advisory committee for Dissertation to be decided and started in Semester III.

#### SEMESTER IV

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course title</th>
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<tbody>
<tr>
<td>14</td>
<td>Survival Analysis</td>
<td>4</td>
</tr>
<tr>
<td>15</td>
<td>Methods in Clinical Trials</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Optional Paper</td>
<td>4</td>
</tr>
<tr>
<td>17</td>
<td>Dissertation</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>Viva-voce</td>
<td>2</td>
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</tbody>
</table>

**Total credits: 30**

**Total credits: 76**

### OPTIONAL COURSE - One of the following:

1. Operations Research
2. Health Economics & Health Financing
3. Database Theory and Management of Biological Data

A one-unit course involves 48 hours of classroom lecture while a half-unit course is composed of 24 hours of lecture. A student is expected to take all the preparatory and main courses and one of the optional courses. The performance of a student is evaluated through a combination of assignments, written examination and comprehensive viva-voce.
### Schedule of Fees

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Indian Students (Rs.)</th>
<th>Foreign Students (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A: Non Refundable</strong></td>
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</tr>
<tr>
<td>Admission Fee</td>
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<tr>
<td>Tuition Fee (Per Year)</td>
<td>8000</td>
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<td>Computer Fee (Per Year)</td>
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<td>Examination Fee (Per Sem)</td>
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<tr>
<td>Re-examination Fee (Per Paper)</td>
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</tr>
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<td>Re-evaluation Fee (Per Paper)</td>
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<tr>
<td>Thesis Submission Fee</td>
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</tr>
<tr>
<td>Thesis re-submission Fee</td>
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<td>--</td>
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<tr>
<td>Provisional Certificate Fee</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>Degree Certificate Fee</td>
<td>200</td>
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</tr>
<tr>
<td>Library Fee (Per Year)</td>
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</tr>
<tr>
<td>Medical Examination Fee</td>
<td>200</td>
<td>--</td>
</tr>
<tr>
<td>Sport/Cultural Fee (Per Year)</td>
<td>1000</td>
<td>--</td>
</tr>
<tr>
<td>Duplicate Certificate Fee</td>
<td>800</td>
<td>--</td>
</tr>
<tr>
<td>Migration Certificate Fee</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>Transcript Fee (For Two Sets)</td>
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<td>50</td>
</tr>
<tr>
<td>Duplicate I-card Fee</td>
<td>100</td>
<td>--</td>
</tr>
<tr>
<td>Hostel Accommodation Charges (Per Month)</td>
<td>400</td>
<td>300</td>
</tr>
<tr>
<td><strong>Refundable Deposits</strong></td>
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<td></td>
</tr>
<tr>
<td>Library</td>
<td>2000</td>
<td>100</td>
</tr>
<tr>
<td>Dining Hall</td>
<td>2000</td>
<td>--</td>
</tr>
<tr>
<td><strong>B: Processing Fee (Non-Refundable)</strong></td>
<td>500</td>
<td>--</td>
</tr>
<tr>
<td>Convocation Charges</td>
<td>500</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: 50% Concession on Tuition Fees to students from SAARC Countries.
Semester I

Paper I: Basics of Statistical Methods and Human Biology (4 credits)

Course Objectives:

- To provide foundation on statistical methods to enable students to compute and interpret basic statistical measures.
- To provide an understanding about the structure and function of the human body and major organ related diseases.

Syllabus:

A: Statistics

1. Data representation and interpretation for Nominal, Ordinal and Interval scale variables, frequency distribution, histogram, frequency polygon, pie-diagram, bar, multiple bar charts, stack bar diagram, stem-leaf diagram.
2. Measures of location: Mean (arithmetic, geometric, harmonic) quartiles, quintiles, measures of dispersion: range, Variance, Standard Deviation, Coefficient of variation; Skewness and Kurtosis.
5. Introduction to the concept of correlation: Pearson correlation coefficient, and its properties; Spearman ranks correlation coefficient, regression coefficients, fitting of regression lines to bi-variate data.
6. Interpolation and extrapolation.

Reading List

Suggested Reading List


**B: Human Biology**

Objective: To provide an understanding about the structure and function of the human body and major organ related diseases.

I. Introduction to human Biology
   II. Human life cycle
   III. Definition & structure of cell, Tissue structure & Type
   IV. Anatomy and physiology of human organ and organ related diseases

1. Digestive system
2. Respiratory system
3. Cardiovascular System
4. Lymphoid & haemopoiteic system (circulatory)
5. Nervous & the special senses
6. Muscular and Skeletal system
7. Excretory System
8. Urinary system
9. Reproductive System (Female and Male)

**Reading List:**

Paper II: Demographic Methods-I (4 credits)

Course Objectives:

- To introduce students the basic concepts of demography.
- To impart skills in the basic measures of population growth, fertility, mortality, migration and urbanization.
- To understand socio-economic factors influencing fertility, mortality and migration.

Introduction to demography

Introduction to demography and the link with health sciences
Definition and Scope; historical trends in population situation in the world; Present population situation in the world and in developed countries

Sources of Demographic Data

Population census; Uses and limitations; various sources of nuptiality, fertility and mortality data and its quality; Vital registration, National Sample Survey Sample Registration System and Demographic Health Surveys (DHS) and other sources

Dynamics of Age-Sex

a. Importance of Age-sex structure in population dynamics
b. Role of sex ratio of India’s population and factors in changing sex structure of India’s population.

Concepts and Basic Measures of Fertility

a. Rates and ratios
b. Basic Concepts and Measures of Current/Period Fertility/Fecundity/Natural Fertility etc.
c. Measures of reproduction(GRR, NRR)
d. Age pattern of fertility and its importance in understanding fertility transition

Nuptiality

a. Introduction, Basic Concepts, Source of Nuptiality, measures and Indices of Nuptiality
b. Singulate Mean Age at Marriage (SMAM), marriage pattern and trend
Concepts and Basic Measures of Mortality

a. Some Fundamental definitions and Sources of Information
   Definition of deaths and fetal deaths according to WHO; Need and Importance of the study of Mortality;
   Introduction and basic measures: Concepts of person years lived;
   Some basic measures: - crude death rate (CDR) and Age-Specific Death Rates (ASDRs)- their relatives merits and demerits. Broad Age-group.

b. Techniques of standardization Rates/Ratio

c. Child and Infant mortality estimation procedure, calendar/cohort concept of rate

d. Measures of pregnancy wastage

e. Historic of pattern of age sex mortality

Migration and Urbanization

A. Migration
   a. Concept of mobility and migration, sources and quality of data, types of migration, census definition of migrants, limitations.
   b. Measures of Migration – Direct estimation of lifetime and inter-censal migration rates from census data
   c. International migration

B. Urbanization
   a. Spatial distribution: importance and pattern, factors affecting spatial distribution of population: physical, economic, social factors and Govt. policies.
   b. Selected measures of concentration of population-Density, percentage distribution and dissimilarity index; Selected measures of Degree and tempo of urbanization; Growth and distribution of urban population, Rank-Size rule and Primacy Index, Lorenz curve and Gini’s concentration ratio.

Reading List:

Paper III: Introduction to Biostatistics & Epidemiology (4 credit)

Course Objectives:
- To introduce basic measures of morbidity, concept of screening test, estimation of risks.
- To provide foundation of epidemiology, disease transmission, genetic and environmental factors.

A: Biostatistics

1. Measuring the occurrence of disease: Measures of morbidity - prevalence and incidence rate, association between prevalence and incidence, uses of prevalence and incidence, problems with incidence and prevalence measurements; Clinical agreement: kappa statistics, intra-class correlation; Surveillance;
2. Assessing the validity and reliability of diagnostic and screening test: Validity of screening test – sensitivity, specificity, positive predictive value and negative predictive value; Reliability; Relationship between validity and reliability; ROC curve and its applications; Overall accuracy
3. Issues in epidemiology: Association; causation; causal inference; Errors and bias; Confounding; Controlling confounding; Measurement of interactions; Generalizability
4. Estimating risk: Estimating association – absolute risk, relative risk, odds ratio; Estimating potential for prevention – attributable risk; comparison of relative risk and attributable risk; Odds ratios for retrospective studies; Odds ratios approximating the prospective RR; Exact inference for odds ratio analysis of matched case-control data
5. Statistical process control: special and common causes of variation, Shewhart, CUSUM and EWMA charts

B: Epidemiology

1. Introduction: Definition and objectives of epidemiology; Epidemiology and clinical practice; The epidemiologic approach; Infectious disease epidemiology, occupational epidemiology, disaster epidemiology
2. The dynamics of disease transmission: Modes of transmission; epidemic, endemic and pandemic; Disease outbreak; Determinants of disease outbreak; Herd immunity; incubation period; outbreak investigation; epidemiological modeling

3. Identifying the roles of genetic and environmental factors in disease causation: Association with known genetic diseases; Age at onset; Family studies; Interaction of genetic and environmental factors

4. Epidemiology and public policy: Epidemiology and prevention; Population versus high-risk approaches to prevention; epidemiology and clinical medicine; Risk assessment; Meta Analysis

5. Context of environmental epidemiological studies, impetus of study, multi-sectoral interaction: social, economic legal and policy aspects. Risk perception and communication; Biological basis of environmental epidemiology, exposure and response, exposure assessment, exposure pathways: air, water, soil, food; physical factors- noise, radiation, exposure measurement, exposure modeling.

Reading List:


Paper IV: Demographic Methods-II (4 credits)

Course Objective:

- To introduce students to the advance techniques of demography.
- To develop knowledge and skills of population projections.
- To give an overview of MDG goals.

**Evaluation and Adjustment of Demographic Data**

Appraisal of the quality of demographic data; types and sources of errors; sampling and non-sampling errors. Evaluation and measurement of errors in age reporting; methods of adjustment for age-sex data; method of graduation.

**Life Tables**

*a) Introduction*

Basic concept of a life table; types and forms of life table; Brief history of life tables; Model life tables; Anatomy of life table; uses of life table in demographic analysis

*b) Construction of Life tables based on Age-specific death Rates (ASDRs)*

Underlying assumptions of life table construction using ASDRs of a community during a specified period; Methods of life table Construction—Conventional approach, and those proposed by Greville and Chiang.

**Migration Analysis**

Indirect measures of net internal migration: Vital Statistics Method, National Growth Rate Method and Census and Life Table Survival Ratio methods

Linkage of migration with health

**Population Estimates and Projections**

Concepts of population projections; population estimates, forecasts and projections, uses of population projections.

Methods of interpolation; extrapolation using linear, exponential, polynomial, logistics, Gompertz curves and growth rate models
Cohort component method: basic methodology
Use of different demographic packages for population projection

**Gender Dimension of Health**

**Maternal and Obstetric Morbidity**

a. Measures of maternal mortality and morbidity
b. Cultural practices during pregnancy, childbearing and its impact on health of women
c. Safe motherhood programmes, emergency obstetric care
d. Strategies to reduce maternal morbidity and mortality

**Reading List:**

Course objectives:-

- To equip students with various components of the health care systems in India and abroad.
- To impart the interrelationships among the system’s components/structure/functions.
- Acquire the ability to apply this knowledge and understanding to important health issues and problems.
- To introduce students to a variety of perspectives, substantive areas and methodological approaches to health services and policy research.
- To familiarize the students with national and international health policies and programmes.

Teaching methods:

Class room lectures, seminar, group exercise, visit to health care facilities, evaluation of a health project/ programme.

Syllabus:

1. Identify the structure, components and characteristics of global health care system.
2. Understanding the needs and goals for various policies related to public health, policy environment, frameworks for policy analysis.
3. Basic models and functions of health services, health care systems, international experience.
4. Health infrastructure and health delivery system in India- public, private, NGOs, Indigenous health systems.
6. Public health system- A re-appraisal and SWOT analysis, a critique on the health delivery system- problems related to structural, functional and management of public health care services.
7. Health care system- stakeholders in health care system, human capital and health, role of government in providing health care, improving access to health care with quality.
8. Health care legislations in India: Legal aspect of health care, MTP Act, biomedical waste Rules, COPRA Act, PNDT Act, Transplantation of human organs Act, etc.
10. Health services- Community needs assessment, Decentralization of health facilities.
11. Sustainability of public health intervention- Concept and mechanism of sustainability, models and examples of sustainability, community ownership, Public-private mix.
12. Introduction to health services and research policies - Perspectives- methodological approach.


14. Major public health problems – A critical review and analysis, identification of major areas of public health requiring interventions, ongoing public health interventions in India. Health system reforms and their impact

**Reading List:**

4. Fort, Meredith, Mary Anne Mercer and Oscar Gish (Editors). *Sickness and Wealth: The Corporate Assault on Global Health*
Paper VI: Epidemiology (4 credits)

Course Objectives:

- To provide foundation on basics epidemiological study designs and analysis.
- To introduce infectious disease concept and appraise surveillance system in India.

Syllabus:

1. Application of epidemiology to identify the cause of disease – Cohort Studies; case-control and cross-sectional studies; nested case-control studies; comparing cohort and case-control studies; deriving inferences from epidemiologic studies
2. Analysis of unmatched case-control studies; stratified analysis; effect modification; analysis of matched case-control studies – conditional logistic regression models
3. Experimental epidemiology; Randomized trials
4. Infectious disease epidemiology – introduction; basic concepts; transmission dynamics models; SI, SIS, and SIR models; Kermack-McKendrick threshold theorem; Kermack-McKendrick threshold theorem epidemiology; basic reproductive number ($R_0$); what determines $R_0$; endemic vs. epidemic; effective reproductive number ($R_t$); eradication threshold; other considerations while vaccinating; estimating $R_0$
5. Surveillance of infectious diseases; guiding principles behind surveillance; uses of surveillance; surveillance of HIV/AIDS and malaria surveillance in India
6. Ethical and professional issues in Epidemiology
7. Meta Analysis
8. Application of epidemiology to evaluate health services

Reading List

Paper VII: Sampling Techniques in Health & Demographic Surveys (4 credits)

Course Objectives:

- To introduce basics of sampling, types of sampling, sample size estimation.
- To provide concepts of design weight, sampling and non-sampling errors.

Syllabus:

1. Concept of population and sample, need for sampling, sample survey verses census, elementary units, sampling units, assumptions of sampling from finite population, sampling frame, selection and inclusion probabilities, probability and non-probability sampling, concept of sampling mechanism and sampling design.
2. Simple random sampling with and without replacement, concept of unequal probability sampling with and without replacement.
3. Stratified random sampling, sample allocation methods, gain due to stratification, determination of strata boundaries, number of strata, allocations for multiple characteristics.
4. Concept of systematic sampling, comparison with simple random sampling, variance estimation, comparison with stratified random sampling, systematic sampling, selection procedure for fractional interval, circular systematic sampling.
5. Use of auxiliary information, ratio and regression methods of estimation under simple random sampling, bias, mean square error, and ratio and regression estimators in stratified random sampling.
6. Simple random cluster sampling for equal size and unequal size clusters, gain in efficiency of cluster sampling, concept of multi stage sampling, two stage equal probability sampling at both stages, comparisons with unistage unit sampling and cluster samplings, components of variance of two stage sampling and estimation, cost function and sample size determination.
7. Sampling weight concept and computation, sampling and sampling errors.

Reading List

Paper VIII: Application of statistical and demographic packages I (4 credits)

Course Objectives:

- To introduce statistical and demographic packages for data analysis.
- To train students in analysis of large scale data.

Syllabus:

1. Introduction to SPSS-facilities, creating database structure, data entry, specifying scales, validation of data entry, importing and exporting data.
2. Data Manipulation – recoding creating new variable, sorting, filtering and selection of specific data, generating simple frequencies, use of syntax editor.
4. Introduction to STATA, generating, variables, commands and do file editor. Survey analysis – estimation of mean, proportion, variance estimation, design effect
5. Multivariate analysis – concepts and interpretation of results of multiple regression, logistic regression, ANOVA, with and without interaction.
6. Large scale data handling – (using NFHS, DLHS, NSSO) Merging, splitting data and formatting
7. Multilevel analysis concepts and applications
8. Introduction to GIS and illustration
9. Basics of MORTPAK4, SPECTRUM and applications

References

2. *SPSS regression models 14.0* - SPSS Inc.
3. *SPSS advanced models 14.0* - SPSS Inc.
Course Objectives:

- To provide orientation in scientific research methods in Biostatistics and Epidemiology.
- To build skills to write research proposals and undertake research in Biostatistics and Epidemiology.

Syllabus:

1. Epidemiological Study design- Descriptive, Analytical and Experimental
2. Experimental designs – Repeated measures factorial, cross over
3. Reliability and validity of screening and diagnostic tests, ROC analysis
4. Development of research tools
5. Protocol preparation
6. Proposal writing
7. Report writing
8. Critical review of research report and journal article

Reading List

4. Douglas C. Montgomery: Design and analysis of Experiments
Paper X: Statistical Inference (4 credits)

Course Objectives:

- To provide foundation of statistical estimation procedures and their properties.
- To introduce concept of testing of hypothesis.

A: Estimation

1. Concept of population, random sample, parameter, statistic, estimator, sampling distribution of random sample, joint and marginal distribution of functions of random variables.
2. Role of normal distribution in statistical inference, law of large numbers, Central Limit Theorem, sampling from normal distribution- Chi-square distribution, F-distribution, Student’s t distribution and their properties.
4. Concept of confidence interval, confidence interval for mean, difference in means, variance, methods of finding confidence interval-pivotal quantity and statistical methods.

B: Testing of Hypothesis

1. Statistical hypotheses- simple and composite, statistical tests, critical region, Type I and Type II errors, size and power of test.
2. Definition of most powerful (MP), and uniformly most powerful (UMP) tests, power functions of tests with illustration, Neyman-Pearson lemma and its application in hypotheses testing regarding binomial, Poisson, normal and exponential distributions.
3. One sample and two sample test for mean, test for a binomial proportion; Score test versus Wald; Exact binomial test; Tests for differences in binomial proportions; Intervals for differences in binomial proportions.
4. Introduce Fisher’s exact test; Chi-squared test for equivalence of two binomial proportions; Chi-squared tests for independence; Chi-squared tests for goodness of fit; Hypothesis tests of marginal homogeneity; Estimating marginal risk difference; Estimating marginal odds ratios; Distinction between conditional and marginal odds ratios.
5. Need for non-parametric test, sign test for location of univariate and bivariate populations, Wilcoxon-Mann-Whitney test, run test, median test, and test based on Spearman’s rank correlation.

**Reading List**

Paper XI: Design of Experiments (2 credits)

Course objectives:
• To introduce basic principles of experimental designs.
• To provide foundation on types of experimental design.

Syllabus:

1. Need for design of experiments, fundamental principles of design of experiments, Basic designs- CRD, RBD and LSD, layouts and analyses, estimation of missing plot and analysis for RBD.
2. Factorial designs: $2^n$ designs, illustration, main effects, interaction effects and complete, partial confounding in $2^n$ designs in RBD and analysis, $3^2$ design, illustration, main effects and interaction effects.
3. Fractional factorial designs, orthogonal and balanced arrays and their connection with confounded and fractional factorial.
4. Factorial split plot and split block experiments, response surface experiments, first order design and orthogonal design.
5. Experiments with mixture- models, analysis and designs.

Reading List

Course Objectives:

- To introduce SAS software.
- To teach application of SAS for bio-statistical and epidemiological analysis.

Syllabus:

1. Introduction to SAS programs, running SAS programs, diagnosing and correcting syntax errors. Producing List Reports using PRINT procedure; sequencing and grouping observations, using special WHERE statement operators; customizing report appearance - formatting data values, creating HTML reports.

Programming with the DATA Step - reading SAS data sets and creating variables, executing statements conditionally, dropping and keeping variables.

Assigning and Changing variable attributes, Combining merging and SAS Data Sets Producing Summary Reports using REPORT procedure.


Controlling Input and Output - controlling when a record loads, reading hierarchical raw data files; outputting multiple observations, selecting variables and observations, writing to multiple SAS data sets, writing to external files.

Processing Data Iteratively using DO loop, SAS array processing.

3. Using SQL with SAS: Understanding the purpose, design, uses, and terminology of SQL; Basic Queries, using SQL procedure, summarizing data with column and row functions, grouping data, performing analyses on groups of data, subquerying, and remerging, ordering data, customizing query output.

Combining Tables - querying multiple tables using joins, using union, intersect, and other set operators to combine tables.

Creating and Modifying Tables and Views, using views to simplify queries and access changing data, creating and using indexes; maintaining tables, views, and indexes.

4. Introduction to the Macro Facility - purpose of the macro facility, program flow. Macro Variables and macro functions; defining and calling macros, macro parameters.
DATA Step and SQL Interfaces - creating macro variables in the DATA step, indirect references to macro variables, retrieving macro variables in the DATA step, creating macro variables in SQL.

5. EPI Info, HIV Surveillance

Reference:

Semester IV
Paper XIII: Survival Analysis (4 credits)

Learning Objectives:
The main objective of this course is to equip students with the basic concepts and methods employed in survival analysis. At the same time, the course aims to equip the student with recent advances in the field of Survival Analysis. The idea is to emphasize concepts over details, with recent applications in public health. After going through this course, the student should be capable enough to take up responsibility and actively participate in academics, government organizations, pharmaceutical companies, health organizations, etc. The introduction of such course is especially very important in India as there is very limited capacity in India at this moment.

Syllabus:

1. Introduction to survival analysis; motivating the need; concepts and definitions; concept of censoring and type of censoring.
2. Survival function, probability density function, hazard function; relationship between the three types of function; survival curve; estimating medium survival time; estimation of these function in the absence and presence of censoring; application of these functions in survival analysis.
3. Survival distributions- Weibull distribution; exponential distribution; lognormal distribution; gamma distribution.
5. Estimating survival rates using large scale data like DHS, NFHS, DLHS, etc.
6. Comparing survival curves- Generalized Wilconxon (Breslow, Gehan); logrank test
7. Regression methods for survival analysis- introduction to Cox-proportional hazard models; proportionality assumption in Cox-proportional hazard models; test of proportionality; interpretation of coefficients; application of Cox-proportional hazard models in Epidemiology and Public Health.
**Reading List**

Paper XIV: Methods in Clinical Trials

Learning Objectives:
The main objective of this course is to equip students with the basic concepts and methods employed in Clinical Trials. At the same time, the course aims to equip the students with recent advances in the field of Clinical Trials. The idea is to emphasize concepts over details, with recent applications in public health. After going through this course, the students should be capable enough to take up responsibilities and actively participate in academics, government organizations, pharmaceutical companies, health organizations, etc. The introduction of such course is especially very important in India as there is very limited capacity in India at this moment.

Syllabus:
1. Basic concepts of clinical trials: Basic concepts; Definitions; Historical perspectives
2. Classification of trials by design and purpose: Objectives and design of Phase I, II, III and IV trials; Use of control arms; Concepts of randomization and blinding
3. Clinical trial designs: Designs with reference to Completely randomized designs; Factorial designs; Crossover designs; Cluster randomized designs
4. Sample size determination: Concepts of factors influencing clinical trial size; Estimation of size for qualitative and quantitative outcome measurements
5. Planning and conduct of clinical trials: Protocol development; Multicentric trials; Deviations from protocol; Stopping rules; Considerations of adverse effects and non-compliance
6. Ethical issues: Ethical issues in clinical research; ICMR guidelines on ethical issues in medical research
7. Data safety and monitoring concepts
8. Analysis of data from clinical trials
Reading List


Paper XV: Optional Paper (Select one)

1. Operations Research

   Syllabus:

1. Definition of OR
   (a) What is Operations Research
   (b) Focus and Objective of Operations Research
   (c) Types and Examples of Operations Research

2. Role of Researchers and Managers

3. Components of OR proposal

4. Identification of Problem and Solution
   (a) Identification and Definition
   (b) Justification
   (c) Alternative Solution
   (d) Indicators- Outputs, Outcomes and Impacts

5. Causality (Randomize Experimental Design)
   (a) Pretest-Post test Control Group Design
   (b) Post test –only Control Group Design
   (c) Multiple Treatment Design

6. Quasi/Non-Experimental Design
   (a) Non-Experimental Control Design
   (b) Time Series, and Before and After Design

7. Inferential Statistics in Operations Research
   (a) \(X^2\), t, F)-tests
   (b) Deciding Sample Size in case of Different Experimental Design
   (c) Linking Different Design and Statistical Test

8. Study Design Exercises

9. Ethics in Operations Research
   (a) ICMR Guidelines
   (b) International Perspectives
   (c) Case Studies

10. Utilization and Dissemination, and Process Documentation
11. Critiques to OR proposal

Reading List:

2. Health Economics and Health Financing

Objectives:-

1. To familiarize the students with basic concepts, theories and models in health economics and how to apply the economic tools in analyzing the structure and performance of health care sector.
2. To provide an understanding on the functioning of health care markets and health care industry.
3. To orient and encourage the students to understand main economics of health and micro financing of health care.

Teaching Methods:

Class room lectures, group exercises, seminars and case studies

Syllabus:

1. Basic concepts in health economics-relationship between economics, economic development and economic aspects of health care- demand and supply in health care, health care market, market failure and public goods.
2. Production function, laws of production, production in health care, externalities in health care markets, resource allocation in health care- both in private and public sector.
4. Health output and input indicators- and their correlation with the level of economic development and with public expenditure on health.
5. Application of cost-benefit analysis and cost-effectiveness - the role of health in economic development- value of output lost due to number of sick days- a review of per capita private and public expenditure on health. Cost concept- short term and long -term costs, economies of scale, various types of economic evaluation used in health care, consumer impact assessment,
6. Measuring health outcomes-human life and quality adjusted years of life, cost-utility analysis, Quality adjusted life years( QALYs) and Health year equivalents (HYEs).Economics of prevention and public health, understand the principles of economic evaluation as applied to health care, quality of life and statistics in health economic evaluation( including QALY and DALY).
9. Health insurance- private health insurance, regulation of health insurance, government as health insurer in India, recent developments in developed and developing countries, Case studies - RSBY, Aarogyasree, etc.

10. Health sector reforms- International and Indian experiences, regulation of health sector including pharmaceutical industry, access to health care with quality, health care utilization.

**Reading List:**

   Methods for economic Evaluation of Health Care Programmes, Oxford University 
   Press.
22. Peters, et.al (2002), Better Health System for India’s poor: Findings, Analysis and 
   Options: The World Bank, New Delhi.
   World Bank, Washington, DC.
3. Database Theory and Management Biological Data

Syllabus:

1. Databases and their need, using computers for database management, database as a collection of one or more related tables, popular database systems.

Relation databases - Tables, Queries, Forms, and Reports; Understanding the importance of each database component. Creating a table, Understanding tables and relationships between them – Data types, Primary key, foreign key; Data validation.

Views, triggers, and stored procedures; Joins – inner joins, outer joins.

2. Introduction to SQL, structure of an SQL expression - select from, and where, clauses, the rename operation, string operations.

Set operations, aggregate functions, using group by clause, null values, nested sub-queries, in and not in predicates; Creating views with create view,.

SQL DDL: Domain types, Schema definition - create table, drop table, alter table

Modification of databases - delete, insert, update; transactions – commit, rollback.

Integrity: Domain constraints, referential integrity, foreign key; Assertions, triggers.

3. Design of relational databases as related to biological data management; Data cleaning, preprocessing and normalization.

The formats of common public repositories - NCBI, ENSEMBL; federation techniques between different types of data; methods of data transfer - BioPax, MLs, and others.


Sequence Retrieval System (SRS).

References:

1. John V Petersen (2002): Absolute beginners guide to databases, QUE (Techmedia)
2. The National Center for Integrative Biomedical Informatics (NCIBI)
3. National Center for Biomedical Ontology

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