Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

DIT UNIVERSITY
Dehradun

Detailed Course Structure & Syllabus
of
B.Sc. (Hons.) – Statistics

Approved by the Academic Council at its 17th Meeting held on 24.03.2021

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Introduction

The Ministry of Human Resource Development (MHRD), Govt. of India, has initiated development of a New Education Policy (NEP) to bring out comprehensive reforms in the Indian education system.

The University Grants Commission (UGC) has subsequently initiated several steps to foster academic excellence through introduction of paradigm shift in learning and teaching pedagogy, innovation and improvement in course curricula, examination and education system.

While a majority of education institutions have started following the semester-based system of education, it has been observed that this new system is still producing graduates who lack knowledge, values, skills and are not job ready professional. The reason for this lacking could be attributed to the rigidity of our program structures and lack of flexibility to have choices among core subject education, liberal arts, ability enhancement, skill development, etc., that is fundamental to overall development and employability of these graduates.

To make this possible, a fully flexible choice-based credit system (FFCBCS), a well-established internationally known system, is proposed. This fully flexible choice-based credit system allows students the flexibility to learn at their own pace, and register for both core subjects and a variety of courses from other areas, leading to holistic development of an individual. The FFCBCS will facilitate us to bench mark our programs with best international liberal arts based academic programs.

Advantages of the FFCBCS structure:

- Shift in focus from the teacher-centric to student-centric education. Student can curve out their program structure by choosing minimum number of credits from well-defined baskets.
- Student may undertake as many credits as they can cope with.
- FFCBCS allows students to choose courses from various baskets of inter-disciplinary, intra-disciplinary, skill oriented, ability enhancing, and from other disciplines.

Features unique to DIT University FFCBCS structure:

1. A minimum of 141 credits has to be earned by a student to be eligible for an Under Graduate Honours degree in Statistics. Each department will decide their total credits for each program, and it can vary across disciplines.

2. Courses are categorized into 9 baskets, and a student will have the option to choose courses in most baskets and earn ***minimum number of credits*** required in each basket for the award of his/her degree. For each basket, the departments have the flexibility to identify course(s) which will be a core requirement for their program.

3. An Academic Advisory Committee may be formed comprising all HoDs/ Programme Coordinator and one representative each from respective departments. Academic Advisory Committee will meet at the end of every semester after the completion of Board of Examination meeting to discuss and finalize course offerings by respective departments in the upcoming

semester. Academic Advisory Committee will be chaired by the Dean Academic Affairs/ Deans of respective Schools/ Competent Authority.

4. Project based learning has to be incorporated as a core component of evaluation in each course, and depending on the level and type of the course, the project can be of several types - Study Oriented Project, Lab Oriented Project, Projects of Organizational Aspects, Research Projects, or Entrepreneurship and Start Up Projects.

5. Courses under each basket may be updated on an annual basis.

6. Each student will be advised by a faculty advisor of his/her department for registration of courses from each basket in the beginning of semester, depending upon the availability of seats. A student advising centre may be formed where students will have access to department faculty advisers. Faculty advisers should have complete access to view individual student's academic transcript for advising purposes.

7. A student getting an F grade in a core course (departmental or otherwise) at the end of the semester will have to earn those credits by registering for the same course whenever it is offered in subsequent semesters. If the course is not a core course, the student may choose to register for any other course next semester in that basket as advised by the department faculty adviser. Additional fees for those number of credits may apply.

8. Students may opt for summer training/internships/industrial tours as advised by the department. However, these activities will not have credits.

Baskets of FFCBCS

9 baskets of courses have been identified to provide student comprehensive exposure to a large number of areas, leading to the holistic development of an individual. These baskets are as follows:

1. **Language and Literature:** These include courses related to English or other popular languages worldwide, communication skills, and literature. These courses are of 3 credits each.
2. **Generic Elective:** This basket includes courses from other disciplines of Science and Engineering like Mathematics, Chemistry and Computer Science.
3. **Discipline Core:** This basket includes compulsory courses in the discipline in which the student is admitted to the University. These courses are of 1-5 credits each.
4. **Discipline Elective:** This basket provides students courses other than discipline core, and are normally in certain specialized areas. These courses are of 4 credits each.
5. **Humanities and Liberal Arts:** This basket includes liberal arts courses in various disciplines like psychology, management, economics, etc., and are of 3 credits each.

6. **Skill Enhancement:** Courses in this basket are primarily hands-on and aims to allow students acquire skills required in certain disciplines that are currently in high demand in the job market. These courses are of 2-4 credits each.
7. **Ability Enhancement:** These courses aim to enhance knowledge and ability of an individual in certain required areas related to national and societal interest. Courses in this basket are of 2 credits each.
8. **Project:** Students will do one project in semester 6^{th}.
9. In addition to courses from above 9 baskets the student will register for any three Non-Credit courses**.**

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Basket/Area	Min Credits To be taken	Credit per course	Courses
Discipline Core (DC) Core: All Elective: None	74	1-5	**19**
Discipline Elective (DE) Core: None Elective: Choose any 2 courses as per your Specialization	8	4	2
Generic Elective (GE) Core: None Elective: Choose any 4 courses as per your Specialization	20	5	4
Language and Literature (LL) Core: None Elective: Choose any 1 from LL course	3	3	1
Humanities and Liberal Arts (HL) Core: None Elective: Choose any 2 HL Courses	6	3	2
Skill Enhancement Course (SEC)* Core: None Elective: Choose any 5 courses to complete credits	20	2-4	6
Ability Enhancement Course (AEC)* Core: Environmental Science Elective: Choose any 2courses to complete the credits	4	2	2
Project	6	6	1
Total Credits	141		37

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Course Structure

Year: 1st **Semester: I**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	SAF106	Statistical Methods I	3	0	2	4
DC	SAF107	Probability and Probability Distributions	3	0	2	4
DC	MAF108	Calculus - I	3	1	0	4
GE		GE-I	3	1	2	5
LL		LL-I	2	0	2	3
DC	MAF109	Programming in C and Introduction to MS Office	0	0	2	1
		Total	**14**	**2**	**10**	**21**

Course Category	Course Code	GE-I	L	T	P	Credit
GE	PYF102	Introduction to Mechanics	3	1	2	5
GE	CHF106	Inorganic Chemistry-I	3	1	2	5
GE	CHF107	Physical Chemistry-I	3	1	2	5
GE	CHF108	Basic Analytical Chemistry	3	1	2	5

Course Category	Course Code	LL-I	L	T	P	Credit
LL	LAF181	Professional Communication	2	0	2	3
LL	LAF182	Indian English Literature	3	0	0	3
LL	LAF183	English Language Teaching	3	0	0	3
LL	LAF184	Corporate Communication and Soft Skills	2	0	2	3

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Year: 1st **Semester: II**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	SAF116	Statistical Methods II	3	0	2	4
DC	SAF117	Sampling Distributions	3	0	2	4
DC	MAF117	Ordinary Differential Equations	3	1	0	4
DC	MAF119	Introduction to MATLAB	2	0	4	4
GE		GE-II	3	1	2	5
HL		HL-I	3	0	0	3
		Total	**17**	**2**	**10**	**24**

Course Category	Course Code	GE-II	L	T	P	Credit
GE	CHF116	Organic Chemistry-I	3	1	2	5
GE	CHF117	Physical Chemistry-II	3	1	2	5
GE	PYF103	Electricity and Magnetism	3	1	2	5
GE	PYF101	Wave and Optics and Introduction to Quantum Mechanics	3	1	2	5

Course Category	Course Code	HL-I	L	T	P	Credit
HL	LAF281	Introduction to Psychology	3	0	0	3
HL	LAF282	Human Values	3	0	0	3
HL	LAF283	Literature, Language & Society	3	0	0	3
HL	LAF284	Principles of Management	3	0	0	3
HL	LAF286	Youth Psychology	3	0	0	3
HL	LAF287	Sustainable Development	3	0	0	3

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Year: 2nd **Semester: III**

Course Category	Course Code	Course Title	L	T	P	Credit
GE	MAF206	Computer Based Numerical Techniques (CBNT)	3	1	2	5
DC	MAF207	Real Analysis- I	3	1	0	4
DC	SAF206	Demography and Vital Statistics	3	0	2	4
DC	MAF209	Linear Programming	3	1	0	4
GE		GE-III	3	1	2	5
HL		HL-II	3	0	0	3
AEC		Elective-III	0	0	0	2
Total			**20**	**4**	**6**	**27**

Course Category	Course Code	GE-III	L	T	P	Credit
GE	CHF206	Inorganic Chemistry-II	3	1	2	5
GE	CHF207	Organic Chemistry-II	3	1	2	5
GE	PYF209	Fundamentals of Thermal Physics	3	1	2	5

Course Category	Course Code	HL-II	L	T	P	Credit
HL	LAF381	Positive Psychology & Living	3	0	0	3
HL	LAF382	Engineering Economics	3	0	0	3
HL	LAF383	Introduction to Linguistics	2	0	2	3
HL	LAF385	Health Psychology	3	0	0	3
HL	LAF386	Ecology and Human Development	3	0	0	3

Course Category	Course Code	Elective-III	L	T	P	Credit
AEC	LAF285	Indian Constitution	2	0	0	2
AEC	MEF483	Entrepreneurship and Start-ups	0	0	4	2

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Year: 2nd **Semester: IV**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	SAF216	Statistical Quality Control	3	0	2	4
DC	SAF217	Statistical Inference	3	1	2	5
DC	SAF218	Design of Experiments	3	0	2	4
AEC	CHF201	Environmental Science	2	0	0	2
SEC		SEC-III	2	0	4	4
SEC		SEC-IV	3	0	0	3
Total			**16**	**1**	**10**	**22**

Course Category	Course Code	SEC-III	L	T	P	Credit
SEC	MAF246	Introduction to Mathematica	2	0	4	4
SEC	MAF248	Introduction to Python	2	0	4	4

Course Category	Course Code	SEC-IV	L	T	P	Credit
SEC	MAF249	Fundamentals of Advanced Mathematics-I	3	0	0	3
SEC	MAF256	Aptitude and Skill Enhancement-I	3	0	0	3
SEC	CSF356	Digital Image Processing	2	0	2	3

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Year: 3rd **Semester: V**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	SAF306	Multivariate Analysis and Nonparametric Methods	3	0	2	4
DC	SAF307	Linear Statistical Models	3	0	2	4
DC	SAF308	Sampling Techniques	3	0	2	4
DE		DE- I	3	1	0	4
SEC		SEC-V	2	0	4	4
SEC	MAF346	Technical Writing with LaTeX-I	0	0	4	2
SEC		SEC-VI	3	0	0	3
Total			**18**	**2**	**10**	**25**

DE- I						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
DE	SAF346	Financial Mathematics	3	1	0	4
DE	SAF347	Actuarial Statistics	3	0	2	4
DE	SAF348	Biostatistics	3	0	2	4

SEC- V						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
SEC	SAF349	Introduction to SPSS	2	0	4	4
SEC	SAF356	Introduction to R Programming	2	0	4	4

Course Category	**Course Code**	SEC - VI	L	T	P	**Credit**
SEC	MAF347	Fundamentals of Advanced Mathematics -II	3	0	0	3
SEC	MAF348	Aptitude and Skill Enhancement-II	3	0	0	3
		MOOC course-I				3

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Year: 3rd **Semester: VI**

Course Category	Course Code	Course Title	L	T	P	Credit
DC	SAF316	Time Series Analysis	3	0	2	4
DC	SAF317	Introduction to Stochastic Processes	3	0	2	4
DC	MAF318	Mathematical Modelling	3	1	0	4
DE		DE- II	3	1	0	4
PRJT	MAF339	Major Project	0	0		6
Total			**12**	**4**	**0**	**22**

DE- II						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
DE	MAF368	Integral Equations	3	1	0	4
DE	MAF369	Tensor & Differential Geometry	3	1	0	4
DE	MAF376	Introduction to Fuzzy Sets & Fuzzy Logic	3	1	0	4
DE	SAF357	Econometrics	3	0	2	4

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Summary of the Credit

Year	Semester	Credit
1	**1**	**21**
	2	**24**
2	**3**	**27**
	4	**22**
3	**5**	**25**
	6	**22**
Total		**141**

Category wise classification of the Credit

Category		Credit	Number of Subjects
LL	Language and Literature	3	1
GE	Generic Elective Course	20	4
DC	Departmental Core Course	74	19
DE	Discipline Elective	8	2
HL	Humanities & Liberal Arts	6	2
SEC	Skill Enhancement Course	20	6
AEC	Ability Enhancement Course	4	2
PRJT	Major Project	6	1
TOTAL		**141**	**37**

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	Basket for Minor in Pure Mathematics (min 18 credits to be taken)				
	Name of Courses	L	T	P	C
MAF207	Real Analysis- I	3	1	0	4
MAF217	Real Analysis- II	3	1	0	4
MAF218	Complex Analysis	3	1	0	4
MAF306	Abstract Algebra	3	1	0	4
MAF316	Ring Theory	3	1	0	4
MAF369	Tensor & Differential Geometry	3	1	0	4
	Software	0	0	4	2
	Basket for Minor in Applied Mathematics (min 18 credits to be taken)				
	Name of Courses	L	T	P	C
MAF108	Calculus - I	3	1	0	4
MAF116	Calculus -II	3	1	0	4
MAF117	Ordinary Differential Equations	3	1	0	4
MAF118	Solid Geometry	3	1	0	4
MAF206	Computer Based Numerical Techniques (CBNT)	3	1	2	5
MAF208	Partial Differential Equations	3	1	0	4
MAF307	Integral Transform	3	1	0	4
	Software	0	0	4	2
	Basket for Minor in Statistics (min 18 credits to be taken)				
	Name of Courses	L	T	P	C
SAF106	Statistical Methods I	3	0	2	4
SAF107	Probability and Probability Distributions	3	0	2	4
SAF117	Sampling Distributions	3	0	2	4
SAF307	Linear Statistical Models	3	0	2	4
SAF206	Demography and Vital Statistics	3	0	2	4
SAF217	Statistical Inference	3	1	2	5
SAF306	Multivariate Analysis and Nonparametric Methods	3	0	2	4
SAF316	Time Series Analysis	3	0	2	4
SAF317	Introduction to Stochastic Processes	3	0	2	4
SAF308	Sampling Techniques	3	0	2	4
SAF218	Design of Experiments	3	0	2	4
	Software	0	0	4	2

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FFCBCS Baskets

Discipline Core (DC) (Minimum 74 Credits to be taken)							
Course Category	**Course Code**	**Course Title**	**Prerequisite Courses**	L	T	P	**Credit**
DC	MAF109	Programing in C & Introduction to MS Office	None	0	0	2	1
DC	SAF106	Statistical Methods I	None	3	0	2	4
DC	SAF107	Probability and Probability Distributions	None	3	0	2	4
DC	MAF108	Calculus - I	None	3	1	0	4
DC	SAF116	Statistical Methods II	MAF126	3	0	2	4
DC	SAF117	Sampling Distributions	MAF127	3	0	2	4
DC	MAF117	Ordinary Differential Equations	None	3	1	0	4
DC	MAF207	Real Analysis- I	None	3	1	0	4
DC	SAF206	Demography and Vital Statistics	MAF126	3	0	2	4
DC	MAF209	Linear Programming	None	3	1	0	4
DC	SAF216	Statistical Quality Control	None	3	0	2	4
DC	SAF217	Statistical Inference	MAF137	3	1	2	5
DC	SAF218	Design of Experiments	MAF126	3	0	2	4
DC	SAF306	Multivariate Analysis and Nonparametric Methods	MAF237	3	0	2	4
DC	SAF307	Linear Statistical Models	MAF126, MAF127	3	0	2	4
DC	SAF308	Sampling Techniques	MAF127	3	0	2	4
DC	SAF316	Time Series Analysis	MAF126	3	0	2	4
DC	SAF317	Introduction to Stochastic Processes	MAF127	3	0	2	4
DC	MAF318	Mathematical Modelling	MAF117, MAF206	3	1	0	4

Discipline Electives (DE)(min 8 credits to be taken)						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
DE	SAF346	Financial Mathematics	3	1	0	4
DE	SAF347	Actuarial Statistics	3	0	2	4
DE	SAF348	Biostatistics	3	0	2	4
DE	MAF368	Integral Equations	3	1	0	4
DE	MAF369	Tensor & Differential Geometry	3	1	0	4
DE	MAF376	Introduction to Fuzzy Sets & Fuzzy Logic	3	1	0	4
DE	SAF357	Econometrics	3	0	2	4

Language and Literature (LL) (min 3 credits to be taken)						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
LL	LAF181	Professional Communication	2	0	2	3
LL	LAF182	Indian English Literature	3	0	0	3
LL	LAF183	English Language Teaching	3	0	0	3
LL	LAF184	Corporate Communication and Soft Skills	2	0	2	3

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Humanities & Liberal Arts (HL) (min 6 credits to be taken)						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
HL	LAF281	Introduction to Psychology	3	0	0	3
HL	LAF282	Human Values	3	0	0	3
HL	LAF283	Literature, Language & Society	3	0	0	3
HL	LAF284	Principles of Management	3	0	0	3
HL	LAF286	Youth Psychology	3	0	0	3
HL	LAF287	Sustainable Development	3	0	0	3
HL	LAF381	Positive Psychology & Living	3	0	0	3
HL	LAF382	Engineering Economics	3	0	0	3
HL	LAF383	Introduction to Linguistics	2	0	2	3
HL	LAF385	Health Psychology	3	0	0	3
HL	LAF386	Ecology and Human Development	3	0	0	3

Skill Enhancement Course (SEC) (min 20 credits to be taken)							
Course Category	**Course Code**	**Course Title**	**Prerequisite Courses**	L	T	P	**C**
SEC	MEF104	Workshop Practice	None	0	0	4	2
SEC	MAF256	Aptitude and Skill Enhancement-I	None	0	0	4	2
SEC	MAF346	Technical Writing with LaTeX-I	None	0	0	4	2
SEC	MAF347	Fundamentals of Advanced Mathematics -II	MAF249	3	0	0	3
SEC	MAF348	Aptitude and Skill Enhancement-II	MAF256	3	0	0	3
SEC	MAF349	Aptitude and Skill Enhancement-III	MAF348	3	0	0	3
SEC	MAF249	Fundamentals of Advanced Mathematics -I	None	3	0	0	3
SEC	CS356	Digital Image Processing	None	2	0	2	3
SEC	SAF349	Introduction to SPSS	None	2	0	4	4
SEC	SAF356	Introduction to R Programming	None	2	0	4	4
SEC	MAF246	Introduction to Mathematica	None	2	0	4	4
SEC	MAF248	Introduction to Python	None	2	0	4	4
SEC	ESF502	Solid and Hazardous Waste Management	None	3	0	0	3
SEC	ESF503	Natural Resource Management	None	3	0	0	3
SEC	MAF119	Introduction to MATLAB	None	2	0	4	4

Ability Enhancement Course (AEC)(min 4 credits to be taken)						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
AEC	CHF201	Environmental Science	2	0	0	2
AEC	LAF285	Indian Constitution	2	0	0	2
AEC	MEF483	Entrepreneurship and Start-ups	3	0	0	3

Project (PRJT)						
Course Category	**Course Code**	**Course Title**	L	T	P	**Credit**
PRJT	SAF319	Project	0	0	6	6

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Generic Elective (min 20 credits to be taken)							
Course Category	**Course Code**	**Course Title**	**Prerequisite Courses**	L	T	P	**C**
GE	PYF101	Wave and Optics and Introduction to Quantum Mechanics	None	3	1	2	5
GE	PYF102	Introduction to Mechanics	None	3	1	2	5
GE	PYF103	Electricity and Magnetism	None	3	1	2	5
GE	PYF209	Fundamentals of Thermal Physics	None	3	1	2	5
GE	CHF106	Inorganic Chemistry-I	None	3	1	2	5
GE	CHF107	Physical Chemistry-I	None	3	1	2	5
GE	CHF108	Basic Analytical Chemistry	None	3	1	2	5
GE	CHF116	Organic Chemistry-I	None	3	1	2	5
GE	CHF117	Physical Chemistry-II	CHF107	3	1	2	5
GE	MAF206	Computer Based Numerical Techniques	None	3	1	2	5
GE	CHF206	Inorganic Chemistry-II	CHF106	3	1	2	5
GE	CHF207	Organic Chemistry-II	CHF116	3	1	2	5

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Detailed Syllabus

Program/Branch: B.Sc. (Hons.) – Statistics
Course Description Document

Department offering the course	Mathematics
Course Code	SAF106
Course Title	Statistical Methods I
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of data and different measures. It also includes the bivariate data and index numbers.

Course Objectives

To introduce the basic elements of descriptive statistics including graphics.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.

(09 L)

UNIT II

Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, skewness and kurtosis, Sheppard's corrections. **(09 L)**

UNIT III

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation, rank correlation. Principle of least squares and fitting of polynomials and exponential curves.

(09 L)

UNIT IV

Index Numbers: Definition, construction of index numbers, weighted and unweighted index numbers. Chain index numbers, conversion of fixed based to chain-based index numbers and vice-versa. Consumer price index numbers. **(09 L)**

Text Books:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

Reference Books

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis.
6. Fitting of polynomials, exponential curves.
7. Karl Pearson correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Spearman rank correlation with and without ties.
11. Partial and multiple correlations.
12. Planes of regression and variances of residuals for given simple correlations.
13. Planes of regression and variances of residuals for raw data.
14. Calculate price and quantity index numbers using simple and weighted average of price relatives.
15. To calculate the Chain Base index numbers.
16. To calculate consumer price index number.

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Department offering the course	Mathematics
Course Code	SAF107
Course Title	Probability and Probability Distributions
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of data and different measures. The course includes the concept of random variables and probability functions. It also includes the Bivariate distributions, marginal and conditional densities.

Course Objectives

To introduce the basic concepts of probability theory, random variables and probability distributions.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications. **(09 L)**

UNIT II

Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations. Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations with illustrations. **(09 L)**

UNIT III

Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems along with applications. Conditional expectations. **(09 L)**

UNIT IV

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases. **(09 L)**

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Text Books:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

Reference Books

1. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Fitting of binomial distributions for n and p = q = ½.
2. Fitting of binomial distributions for given n and p.
3. Fitting of binomial distributions after computing mean and variance.
4. Fitting of Poisson distributions for given value of lambda.
5. Fitting of Poisson distributions after computing mean.
6. Fitting of negative binomial.
7. Fitting of suitable distribution.
8. Application problems based on binomial distribution.
9. Application problems based on Poisson distribution.
10. Application problems based on negative binomial distribution.
11. Problems based on area property of normal distribution.
12. To find the ordinate for a given area for normal distribution.
13. Application based problems using normal distribution.
14. Fitting of normal distribution when parameters are given.
15. Fitting of normal distribution when parameters are not given.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF108
3. Course Title	Calculus-I
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Core

Course Summary:

Course Objectives:
To prepare the students with basic concepts of limit, continuity, differentiability, and integration of functions and their applications.
Course Outcome: Students will be able to:

- find derivative and anti-derivative of various functions and use them for further study
- draw graph of various functions in Cartesian and Polar coordinates
- determine area, volume, surface od revolutions using definite integrals
- use the concepts of calculus in higher learning.

Curriculum Content:

UNIT I: Limit and Continuity [8]
Review of functions of single variable: Exponential, Logarithmic, Trigonometric and Hyperbolic functions, Limit, Continuity, Algebra of limits and continuous functions.
UNIT II: Differentiability [10]
Differentiability, Indeterminate forms, L' Hospital rule, Rolle's Theorem, Mean value theorems & their applications, Successive differentiation, Leibnitz theorem, Maclaurin & Taylor series of functions of one variable.
UNIT III: Applications of Derivatives [10]
Review conic sections and their Graphs, Monotonicity, Maxima and Minima, Concavity, Convexity, Point of inflection & Asymptotes, Polar coordinates, Curvature, Envelope of a family of curves, Graphs of functions and curves.
UNIT IV: Integral Calculus [12]
Review of indefinite and definite integrals, Fundamental theorem of integral calculus, Integral as the limit of sum, Area, Volume and surface of revolution, Arc lengths, Double and triple integrals, Change of order of integration, Change of variables, Dirichlet's integral, Application of multiple integrals.
Text Books:

1. G. B. Thomas and R. L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson Education India, 2010

Reference Books:

1. R. K. Jain, & S. R. K. Iyenger,"Advanced Engineering Mathematics", 4thEdition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, "Advanced Engineering Mathematics**"**, 10thEdition, John & Wiley Sons, U.K., 2016.
3. Gorakh Prasad, "Integral Calculus", Pothishala Private Limited, 2015

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF116
Course Title	Statistical Methods II
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	Statistical Methods I
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using regression analysis tools. It provides an overview of estimation of data. The course includes the concept of bivariate and multivariate distributions.

Course Objectives

To introduce the basic concepts related to regression analysis and multivariate data.

Course Outcomes

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

1. Concepts of regression analysis
2. apply statistical tools to the problems related to the multivariate data.
3. Apply the concepts of estimation to different problems.
4. carry out some project related to multivariate data.

Curriculum Content

UNIT I

Regression Analysis: Simple regression analysis, Estimation and hypothesis testing in case of simple and multiple regression models, Concept of model matrix and its use in estimation. Probit and Logit Analyses, Logistic Regression. **(09 L)**

UNIT II

Summarization and analysis of different types of multivariate data. Multiple regression. Partial and multiple correlation. Simulation of probability distributions and stochastic models. Applications of simulation techniques. **(09 L)**

UNIT III

Methods of estimation: method of moments, maximum likelihood estimation. Fitting probability distributions and stochastic models to observed data. Goodness of fit using Pearson's $\chi 2$ and Q-Q plots (applications only). **(09 L)**

UNIT IV

Statistical methods for estimation and hypothesis testing for parameters in bivariate and multivariate normal distributions. Estimation and testing problems in simple and multiple linear regression.

(09 L)

Text Books:

1. Weisberg, S. (2005). Applied Linear Regression (Third edition). Wiley.
2. Wu, C. F. J. And Hamada, M. (2009). Experiments, Analysis, and Parameter Design Optimization (Second edition), John Wiley.
3. Renchner, A. C. And Schaalje, G. B. (2008). Linear Models in Statistics (Second edition), John Wiley and Sons.

Referenecs Books

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Problems based on simple regression analysis.
2. Problems based on logistic regression models.
3. Problems based on multiple regression.
4. Problems based on method of moments.
5. Problems based on maximum likelihood estimation.
6. Goodness of fit using Pearson's $\chi 2$.
7. Estimation and testing problems in simple and multiple linear regression

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF117
Course Title	Sampling Distributions
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about techniques related to sampling distribution. It provides an overview of hypothesis testing.

Course Objectives

To introduce the basic concepts of probability theory, distributions and statistical measures.

Course Outcomes

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

1. Concepts of convergence.
2. Concepts of sampling and testing
3. The application of different tests
4. Carry out some project or research work based on sampling techniques.

Curriculum Content

UNIT I

Limit laws: convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution and their inter relations, Chebyshev's inequality, W.L.L.N., S.L.L.N. and their applications, De-Moivre Laplace theorem, Central Limit Theorem (C.L.T.) for i.i.d. variates, applications of C.L.T. and Liapunov Theorem (without proof).
Order Statistics: Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics, distribution of sample median and sample range. **(09 L)**

UNIT II

Definitions of random sample, parameter and statistic, sampling distribution of a statistic, sampling distribution of sample mean, standard errors of sample mean, sample variance and sample proportion. Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and critical region. Large sample tests, use of CLT for testing single proportion, difference of two proportions, single mean, difference of two means, standard deviation and difference of standard deviations by classical and p-value approaches.

(09 L)

UNIT III

Exact sampling distribution: Definition and derivation of p.d.f. of $\chi 2$ with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean,

variance, m.g.f., cumulant generating function, mode, additive property and limiting form of $\chi 2$ distribution. Tests of significance and confidence intervals based on distribution. **(09 L)**

UNIT IV

Exact sampling distributions: Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments and limiting form of t distribution. Snedecore's F-distribution: Derivation of p.d.f., nature of p.d.f. curve with different degrees of freedom, mean, variance and mode. Distribution of $1/F(n_1,n_2)$. Relationship between t, F and $\chi 2$ distributions. Test of significance and confidence Intervals based on t and F distributions. **(09 L)**

Text Books:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003): *An Outline of Statistical Theory*, Vol. I, 4th Edn. World Press, Kolkata.
2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
3. Hogg, R.V. and Tanis, E.A. (2009): *A Brief Course in Mathematical Statistics*. Pearson Education.

References Books

1. Johnson, R.A. and Bhattacharya, G.K. (2001): *Statistics-Principles and Methods*, 4th Edn. John Wiley and Sons.
2. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): *Introduction to the Theory of Statistics*, 3rd Edn. (Reprint).Tata McGraw-Hill Pub. Co. Ltd.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Testing of significance and confidence intervals for single proportion and difference of two proportions
2. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.
3. Testing of significance and confidence intervals for difference of two standard deviations.
4. Exact Sample Tests based on Chi-Square Distribution.
5. Testing if the population variance has a specific value and its confidence intervals.
6. Testing of goodness of fit.
7. Testing of independence of attributes.
8. Testing based on 2x2 contingency table without and with Yates' corrections.
9. Testing of significance and confidence intervals of an observed sample correlation coefficient.
10. Testing and confidence intervals of equality of two population variances

Private Ltd., 2009.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF117
3. Course Title	Ordinary Differential Equations
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Core

Course Summary:

The course starts with mathematical formulation of real-life problems and covers various forms of differential equations and their solutions.

Course Objective:

This course provides an introduction to the fundamentals of ordinary differential equations and their solutions

Course Outcomes:

After completing this course, students should demonstrate competency in the following skills:

- To understand the order and degree of differential equations and classify them to linear or nonlinear differential equations.
- To determine the solution of differential equation of first order and first degree.
- To understand and identify higher order linear differential equation and determine their solutions by various methods.
- To understand and recognize fundamentals of singular solutions, Clairaut's equations.

Curriculum Content:

UNIT I: Differential Equations of first Order & first Degree

[10]

Formation of differential equations, order and degree of differential equations, complete primitive, methods to solve the differential equations of first order and first degree; separation of variables, homogeneous differential equations, exact differential equations, equations reducible to separation of variables, homogeneous and exact differential equations, linear differential equations, equations reducible to linear differential equation.

Unit- II: Equations of first order but not of first degree & Trajectories

[8]

Equations of first order but not first degree, Various cases & various methods to determine solution, Singular solutions, Clairaut's form, Trajectory, Orthogonal trajectory Self-orthogonal family of curves.

UNIT III: Second and Higher Order ODE

[12]

Solution of homogeneous and non-homogeneous linear ODE with constant coefficients using inverse operator method and method of undetermined coefficients, Euler-Cauchy homogeneous linear differential equations, Simultaneous differential equations, Method of variation of parameters, Solution of second order differential equations by changing dependent and independent variable.

Unit – IV: second order linear differential equations with variable coefficients [10]

Linear differential equations of second order with variable coefficients, following cases: the complete solution in terms of a known integral, finding one integral in C.F. by inspection, reduction to normal form, Change of independent variable, method of variation of parameters, Simultaneous equations of the form $P_1dx + Q_1dy + R_1dz = 0,\ P_2\ dx + Q_2dy + R_2\ dz = 0.$

Text Books:

1. M. D. Raisinghania, "Ordinary and Partial Differential Equations", 19th Edition, S. Chand Publications, 2017.
2. G. F. Simmons and G. Krantz Steven, "Differential Equations", 17th Reprint, McGraw Hill Education (India) Private Ltd., 2016.

Reference Books:

1. M. Tenenbaum, and H. Polard, "Ordinary Differential Equations", Dover Publications, 1985.
2. V.P. Mishra, and J. Sinha, "Elements of Engineering Mathematics", 3rd Edition, S.K. Kataria& Sons, 2013.
3. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, published by John Wiley & Sons, U.K, 2011.
4. B. Rai, D.P. Choudhary and H.I. Freedman, "A Course in Ordinary Differential Equations", 2nd Edition, Narosa Publishing House, 2013.
5. B.S. Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, 2012

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF207
3. Course Title	Real Analysis-I
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Core

Course Summary:
The course starts with introduction of various properties of sets. Also, this course discusses about the basic concepts of sequence and series. Further, course describes convergence of infinite series and radius of convergence of power series.

Course Objective: The objective of this course is to develop a deeper and more rigorous understanding of basic topological properties of the real numbers and sets. Further, students will able to understand the concepts of sequence, convergence of infinite series and term by term differentiation and integration of power series.

Course Outcome:
After completion of this course, students will be able to

- understand and prove a basic set theoretic statement
- define limit and test convergence of a sequence
- · use Cauchy criterion for convergence of sequence
- · test convergence of infinite series
- · find radius of convergence of power series
- · calculate term by term differentiation and integration of power series

Curriculum Content;

UNIT I: Point Set Topology
[11]

Real Numbers, Field of Real Numbers, Ordering properties, Finite, Infinite, Countable, Uncountable and Bounded sets, Intervals, Supremum, Infimum, Completeness of R, Neighborhood, Interior points, Open sets, Limit points, Derived set, closure of a set, Closed sets, Connected sets, Compact sets.

UNIT II: Sequences
[11]

Sequence of real numbers, Convergent and Divergent sequences, Bounded and Monotonic sequence, Limit superior and limit inferior, Cauchy's sequences, Cauchy's principle on convergence of a real sequence.

Unit-III: Series
[9]

Convergence of infinite series of positive terms, Comparison test, Cauchy's Root test, D'Alembert's Ratio, Raabe's test, Logarithm test, Condensation test, Cauchy's Integral tests, Alternating series, Leibnitz test and Conditional convergence.

Unit – IV: Power series **[9]**

Power series (of real variable), Radius and interval of convergence, Term-wise differentiation and integration of power series.

Text Books:

1. S.C. Malik and Savita Arora, "**Mathematical Analysis"**, 5th Edition, New Academic Science Ltd, 2017.

Reference Books:

1. R.G. Bartle and D.R. Sherbert, "Introduction to Real Analysis", 4th Edition, Wiley, 2014.
2. T.M. Apostol, "Mathematical Analysis**",** 2nd Edition, Narosa Publishing House, New Delhi, 2002.
3. Shanti Narayan and M. D. Raisinghania, "Elements of Real Analysis", S. Chand & Co., New Delhi, 2003.
4. H.L. Royden and P.M. Fitzpatrick, "Real Analysis", 4th Edition, Pearson, 2010.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF206
Course Title	Demography and Vital Statistics
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem demography using techniques of statistics. It provides an overview of various terms related to population.

Course Objectives

To introduce the basic concepts of demography.

Course Outcomes

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

1. The basic terminology related to population theory.
2. apply statistical tools to the problems related to the demography.
3. analyse life tables to populations.
4. carry out some project or research work base on demography.

Curriculum Content

UNIT I

Population Theories: Coverage and content errors in demographic data, use of balancing equations and Chandrasekharan-Deming formula to check completeness of registration data. Adjustment of age data, use of Myer and UN indices, Population composition, dependency ratio. **(09 L)**

UNIT II

Introduction and sources of collecting data on vital statistics, errors in census and registration data. Measurement of population, rate and ratio of vital events. Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates. **(09 L)**

UNIT III

Stationary and Stable population, Central Mortality Rates and Force of Mortality. Life(Mortality) Tables: Assumption, description, construction of Life Tables and Uses of Life Tables.

(09 L)

UNIT IV

Abridged Life Tables; Concept and construction of abridged life tables by Reed-Merrell method, Greville's method and King's Method. Measurements of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).

(09 L)

Text Books:

1. Mukhopadhyay P. (1999): Applied Statistics, Books and Allied (P) Ltd.

2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9 th Edition, World Press.
3. Biswas, S. (1988): Stochastic Processes in Demography & Application, Wiley Eastern Ltd.

References Book

1. Croxton, Fredrick E., Cowden, Dudley J. and Klein, S. (1973): Applied General Statistics, 3 rd Edition. Prentice Hall of India Pvt. Ltd.
2. Keyfitz N., Beckman John A.: Demogrphy through Problems S-Verlag New york.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. To calculate CDR and Age Specific death rate for a given set of data
2. To find Standardized death rate by:- (i) Direct method (ii) Indirect method
3. To construct a complete life table
4. To fill in the missing entries in a life table
5. To calculate probabilities of death at pivotal ages and use it construct abridged life table using (i) Reed-Merrell Method, (ii) Greville's Method and (iii) King's Method
6. To calculate CBR, GFR, SFR, TFR for a given set of data
7. To calculate Crude rate of Natural Increase and Pearle's Vital Index for a given set of data
8. Calculate GRR and NRR for a given set of data and compare them

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF209
3. Course Title	Linear Programming
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Core

Course Summary: In this course students will learn the basic of optimization techniques and linear programming problems. The course is designed to give a solid grounding of optimization techniques.

Course Objective: Optimization methods using calculus have several limitations and thus not suitable for many practical applications. Most widely used optimization method is linear programming. The characteristics of linear programming problem (LPP) and also different techniques to solve LPP are introduced.

Course Outcomes: Students will be able to

- formulate the linear programming problem.
- conceptualize the feasible region.
- solve the LPP with two variables using graphical and simplex method.
- formulate the dual problem from primal and their solutions.

Curriculum Content:

Unit-I **[8]**
Introduction, Linear programming problem, Mathematical formulation of LPP, Case studies of LPP, Graphical methods to solve linear programming problems, Standard and matrix forms of linear programming problem, Basic feasible solution, Applications, Advantages, Limitations

Unit –II **[12]**
Convex sets, convex sets, Extreme points, Hyperplanes and Half spaces, Convex cones, polyhedral sets and cones, Fundamental theorem of linear programming, Simplex method. Artificial variables, Big-M method, two phase method.

Unit – III **[10]**
Resolution of degeneracy, Revised simplex method, Duality in linear programming problems, Dual simplex method, Primal-dual method.

Unit- IV **[10]**
Mathematical model of transportation problem, North-West corner method, least cost method, Vogel's approximation method.

Text Book:

1. Hamdy A. Taha, "Operations Research: An Introduction", 9th Edition, Pearson Publications;

2010.
2. J K Sharma, "Operations Research Theory &Applications, Macmillan India Ltd, 2007.
3. Kanti Swarup, P. K. Gupta, Man Mohan, Operations Research, Sultan Chand & Sons Publications, 2019.

Reference Books:

1. P. SankaraIyer, "Operations Research", Tata McGraw Hill, 2008.
2. P. K. Gupta and D. S. Hira, "Operations Research", S. Chand &Co., 2007.

Teaching and Learning Strategy

All materials (Ppts, Tutorials, assignments, , etc.) will be uploaded in Moodle/MS Teams /Google drive. Refer to your course on SAP/MS teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF216
Course Title	Statistical Quality Control
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical quality control tools. It provides an overview of quality control techniques and use of control charts.

Course Objectives

To help students understand the concepts statistical quality control and to develop their ability to apply those concepts to the design and management of quality control processes in industries.

Course Outcomes

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

1. The basic concepts of quality control
2. apply control tools to the problems related to the real-life problems.
3. analyse quality controls of different experiments/events.
4. carry out some project or research work base on quality control tools.

Curriculum Content

UNIT I

Quality: Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration. Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping. **(09 L)**

UNIT II

Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes: np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart, estimation of process capability. **(09L)**

UNIT III

Acceptance sampling plan: Principle of acceptance sampling plans. Single and Double sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables. **(09 L)**

UNIT IV

Introduction to Six-Sigma: Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM). Organizational Structure and Six Sigma training plans- Selection Criteria for Six-Sigma roles and training plans. Voice of customers (VOC): Importance and VOC data collection.

Critical to Quality (CTQ).Introduction to DMAIC using one case study: Define Phase, Measure Phase, Analyse Phase, Improve Phase and Control Phase. **(09 L)**

Text Books

1. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3. Mukhopadhyay, P (2011):Applied Statistics, 2nd edition revised reprint, Books and Allied(P) Ltd.

References Books

1. Montogomery, D. C. and Runger, G.C. (2008): Applied Statistics and Probability for Engineers, 3rd Edition reprint, Wiley India Pvt. Ltd.
2. Ehrlich, B. Harris (2002): Transactional Six Sigma and Lean Servicing, 2nd Edition, St. Lucie Press.
3. Hoyle, David (1995): ISO Quality Systems Handbook, 2nd Edition, Butterworth Heinemann Publication.

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Construction and interpretation of statistical control charts X-bar & R-chart X-bar & s-chart np-chart p-chart c-chart u-chart 2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD, ASN, ATI, AOQ, AOQL curves 3. Calculation of process capability and comparison of 3-sigma control limits with specification limits. 4. Use a case study to apply the concept of six sigma application in DMAIC: practical application.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF217
Course Title	Statistical Inference
Credits (L:T:P:C)	3:1:2:5
Contact Hours (L: T:P)	3:1:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of estimation and methods of estimation. The course also includes the concept of confidence interval for the parameters of various distribution and its applications.

Course Objectives

To introduce the basic concepts of estimation theory. To learn the basic theoretical knowledge about fundamental principles for statistical inference, interval estimators, and hypothesis testing and about the evaluation of these estimators and tests.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Estimation: Concepts of estimation, unbiasedness, sufficiency, consistency and efficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications. Cramer-Rao inequality and MVB estimators (statement and applications). **(09 L)**

UNIT II

Methods of Estimation: Method of moments, method of maximum likelihood estimation, method of minimum Chi-square, basic idea of Bayes estimators. **(09 L)**

UNIT III

Principles of test of significance: Null and alternative hypotheses (simple and composite), Type-I and Type-II errors, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test). Likelihood ratio test, properties of likelihood ratio tests (without proof). **(09 L)**

UNIT IV

Interval estimation - Confidence interval for the parameters of various distributions, Confidence interval for Binomial proportion, Confidence interval for population correlation coefficient for Bivariate Normal

distribution, Pivotal quantity method of constructing confidence interval, Large sample confidence intervals. **(09 L)**

Text Books

1. Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta.
2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2ndEdn. (Reprint) John Wiley and Sons.
3. Miller, I. and Miller, M. (2002) : John E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India.

Reference Books

1. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons.
2. Mood A.M, Graybill F.A. and Boes D.C,: Introduction to the Theory of Statistics, McGraw Hill.
3. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
4. Snedecor G.W and Cochran W.G.(1967) Statistical Methods. lowa State University Press.

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details

List of Practical
1. Unbiased estimators (including unbiased but absurd estimators)
2. Consistent estimators, efficient estimators and relative efficiency of estimators.
3. Cramer-Rao inequality and MVB estimators
4. Sufficient Estimators – Factorization Theorem, Rao-Blackwell theorem, Complete Sufficient estimators
5. Lehman-Scheffe theorem and UMVUE
6. Maximum Likelihood Estimation
7. Asymptotic distribution of maximum likelihood estimators
8. Estimation by the method of moments, minimum Chi-square
9. Type I and Type II errors
10. Most powerful critical region (NP Lemma)
11. Uniformly most powerful critical region
12. Unbiased critical region
13. Power curves
14. Likelihood ratio tests for simple null hypothesis against simple alternative hypothesis
15. Likelihood ratio tests for simple null hypothesis against composite alternative hypothesis

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF218
Course Title	Design of Experiments
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of data and different measures. The course includes the concept of design of experiments, Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD).

Course Objectives

To learn how to plan, design and conduct experiments efficiently and effectively and analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Experimental designs: Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, fertility contour maps, choice of size and shape of plots and blocks. Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, relative efficiency, analysis with missing observations. **(09 L)**

UNIT II

Incomplete Block Designs: Balanced Incomplete Block Design (BIBD) – parameters, relationships among its parameters, incidence matrix and its properties, Symmetric BIBD, Resolvable BIBD, Affine Resolvable BIBD, Intra Block analysis, complimentary BIBD, Residual BIBD, Dual BIBD, Derived BIBD. **(09 L)**

UNIT III

Factorial experiments: advantages, notations and concepts, 2^2, $2^3 \ldots 2^n$ and 3^2 factorial experiments, design and analysis, Total and Partial confounding for 2^n ($n \leq 5$), 3^2 and 3^3. Factorial experiments in a single replicate. **(09 L)**

UNIT IV

Fractional factorial experiments: Construction of one-half and one-quarter fractions of 2^2 ($n \leq 5$) factorial experiments, Alias structure, Resolution of a design. **(09 L)**

Text Books

1. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.
2. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.

Reference Books

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn. World Press, Kolkata.
2. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
5. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Analysis of a CRD
2. Analysis of an RBD
3. Analysis of an LSD
4. Analysis of an RBD with one missing observation
5. Analysis of an LSD with one missing observation
6. Intra Block analysis of a BIBD
7. Analysis of 2^2 and2^3 factorial in CRD and RBD
8. Analysis of 2^2 and2^3 factorial in LSD
9. Analysis of a completely confounded two level factorial design in 2 blocks
10. Analysis of a completely confounded two level factorial design in 4 blocks
11. Analysis of a partially confounded two level factorial design
12. Analysis of a single replicate of a 2^n design
13. Analysis of a fraction of 2^n factorial design

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF306
Course Title	Multivariate Analysis and Nonparametric Methods
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of data and different measures. The course includes the applications of Multivariate Analysis: Discriminant Analysis, Principal Components analysis and Factor Analysis.

Course Objectives

To introduce the basic concepts of probability theory, distributions and statistical measures. Derivation and usage of nonparametric statistical methods in univariate, bivariate, and multivariate data.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Bivariate Normal Distribution (BVN): p.d.f. of BVN, properties of BVN, marginal and conditional p.d.f. of BVN. Multivariate Data: Random Vector: Probability mass/density functions, Distribution function, Mean vector & Dispersion matrix, Marginal & Conditional distributions.

(09 L)

UNIT II

Multivariate Normal distribution and its properties. Sampling distribution for mean vector and variance- covariance matrix. Multiple and partial correlation coefficient and their properties.

(09 L)

UNIT III

Applications of Multivariate Analysis: Discriminant Analysis, Principal Components Analysis and Factor Analysis. **(09 L)**

UNIT IV

Nonparametric Tests: Introduction and Concept, Test for randomness based on total

number of runs, Empirical distribution function, Kolmogrov Smirnov test for one sample, Sign tests- one sample and two samples, Wilcoxon-Mann-Whitney test, Kruskal-Wallis test. **(09 L)**

Text Books

1. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, 3rdEdn., John Wiley
2. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley.
3. Kshirsagar, A.M. (1972) :Multivariate Analysis, 1stEdn. Marcel Dekker.

Reference Books

1. Johnson, R.A. and Wichern, D.W. (2007): Applied Multivariate Analysis, 6thEdn., Pearson & Prentice Hall
2. Mukhopadhyay, P. :Mathematical Statistics.
3. Gibbons, J. D. and Chakraborty, S (2003): Nonparametric Statistical Inference. 4th Edition. Marcel Dekker, CRC.

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Multiple Correlation
2. Partial Correlation
3. Bivariate Normal Distribution,
4. Multivariate Normal Distribution
5. Discriminant Analysis
6. Principal Components Analysis
7. Factor Analysis
8. Test for randomness based on total number of runs,
9. Kolmogrov Smirnov test for one sample.
10. Sign test: one sample, two samples, large samples.
11. Wilcoxon-Mann-Whitney U-test
12. Kruskal-Wallis test

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF307
Course Title	Linear Statistical Models
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical modelling. The course includes the concept of theory of linear estimation, estimability of linear parametric functions, and method of least squares. It also includes the regression analysis, Estimation and hypothesis testing.

Course Objectives

To understand the theory, its use in the analysis of real data, analysis of real data and interpretation of the results. Students acquire the knowledge for the independent work in the field of statistical modelling.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Gauss-Markov set-up: Theory of linear estimation, Estimability of linear parametric functions, Method of least squares, Gauss-Markov theorem, Estimation of error variance.

(09 L)

UNIT II

Regression analysis: Simple regression analysis, Estimation and hypothesis testing in case of simple and multiple regression models, Concept of model matrix and its use in estimation.

(09 L)

UNIT III

Analysis of variance: Definitions of fixed, random and mixed effect models, analysis of variance and covariance in one-way classified data for fixed effect models, analysis of variance and covariance in two-way classified data with one observation per cell for fixed effect models. **(09 L)**

UNIT IV

Model checking: Prediction from a fitted model, Violation of usual assumptions concerning normality, Homoscedasticity and collinearity, Diagnostics using quantile-quantile plots.

(09 L)

Text Books

1. Weisberg, S. (2005). Applied Linear Regression (Third edition). Wiley.
2. Wu, C. F. J. And Hamada, M. (2009). Experiments, Analysis, and Parameter Design Optimization (Second edition), John Wiley.

Reference Books

1. Renchner, A. C. And Schaalje, G. B. (2008). Linear Models in Statistics (Second edition), John Wiley and Sons.

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Estimability when X is a full rank matrix and not a full rank matrix 2. Distribution of Quadratic forms 3. Simple Linear Regression 4. Multiple Regression 5. Tests for Linear Hypothesis 6. Bias in regression estimates 7. Lack of fit 8. Orthogonal Polynomials 9. Analysis of Variance of a one-way classified data 10. Analysis of Variance of a two-way classified data with one observation per cell 11. Analysis of Covariance of a one-way classified data 12. Analysis of Covariance of a two-way classified data

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

a	Mathematics
Course Code	SAF308
Course Title	Sampling Techniques
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using sampling tools. . The course includes the concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. It also includes the systematic Sampling Technique, estimates of population mean and Ratio and regression methods of estimation.

Course Objectives

To understand the principles of sampling as a means of making inferences about a population. The objective of the course is to understand the difference between randomization theory and model based analysis,

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of their variances and sample size determination. **(09 L)**

UNIT II

Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision, post stratification and its performance. **(09 L)**

UNIT III

Systematic Sampling: Technique, estimates of population mean and total,

variances of these estimates (N=nxk). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections. **(09 L)**

UNIT IV

Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression method of estimation and their comparison with SRS. Cluster sampling (equal clusters only) estimation of population mean and its variance, comparison (with and without randomly formed clusters). Relative efficiency of cluster sampling with SRS in terms of intra class correlation. Concept of sub sampling. **(09 L)**

Text Books

1. Cochran W.G. (1984):Sampling Techniques(3rd Ed.), Wiley Eastern.
2. Sukhatme,P.V., Sukhatme,B.V. Sukhatme,S. Asok,C.(1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics

Reference Books

1. Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.
2. Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House.
3. Goon A.M., Gupta M.K. and Dasgupta B. (2001): Fundamentals of Statistics (Vol.2), World Press

Teaching and Learning Strategy

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. To select a SRS with and without replacement. 2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS. 3. For SRSWOR, estimate mean, standard error, the sample size 4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods Compare the efficiencies of above two methods relative to SRS 5. Estimation of gain in precision in stratified sampling. 6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend. 7. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS. 8. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF316
Course Title	Time Series Analysis
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using Time Series Analysis. The course includes the introduction to times series data, application of time series from various fields and Components of a times series. It also includes the component method, Forecasting: Exponential smoothing methods and short-term forecasting methods.

Course Objectives

To Learn the basic analysis of time series data; learn basic concepts in time series regression; learn auto-regressive and model averaging models; learn seasonal Component cont: Ratio to Moving Averages and Link Relative method, and analysis of time series data.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. enlarge their minds regarding the occurrence of events
2. apply statistical tools to the problems related to the real life problems
3. analyse data pertaining to different experiments/events
4. carry out some project or research work base on analysis of the data

Curriculum Content

UNIT I

Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves. **(09 L)**

UNIT II

Trend Cont.: Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend. **(09 L)**

UNIT III

Seasonal Component cont: Ratio to Moving Averages and Link Relative method, Deseasonalization. Cyclic Component: Harmonic Analysis. Some Special Processes: Moving-average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR (1) and AR (2) – Yule-Walker equations. **(09 L)**

UNIT IV

Random Component: Variate component method. Forecasting: Exponential smoothing

methods, Short term forecasting methods: Brown's discounted regression, Box-Jenkins method and Bayesian forecasting. Stationary Time series: Weak stationarity, autocorrelation function and correlogram of moving average. **(09 L)**

Text Books

1. Kendall M.G. (1976): Time Series, Charles Griffin.
2. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall.

Reference Books

1. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied

Teaching and Learning Strategy

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

List of Practical
1. Fitting and plotting of modified exponential curve
2. Fitting and plotting of Gompertz curve
3. Fitting and plotting of logistic curve
4. Fitting of trend by Moving Average Method
5. Measurement of Seasonal indices Ratio-to-Trend method
6. Measurement of Seasonal indices Ratio-to-Moving Average method
7. Measurement of seasonal indices Link Relative method
8. Calculation of variance of random component by variate difference method
9. Forecasting by exponential smoothing
10. Forecasting by short term forecasting methods.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF317
Course Title	Introduction to Stochastic Processes
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Core

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of the random processes.

Course Objectives

To introduce the basic concepts of stochastic processes and queuing systems.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. Enlarge their minds regarding the probabilistic functions.
2. To understand the Markov process and applications.
3. To understand the Poisson process and applications.
4. To understand the queuing system and applications in real life problems.

Curriculum Content

UNIT I
Probability Distributions: Generating functions, Bivariate probability generating function. Stochastic Process: Introduction, Stationary Process.

UNIT II
Markov Chains: Definition of Markov Chain, transition probability matrix, order of Markov chain, Markov chain as graphs, higher transition probabilities. Generalization of independent Bernoulli trials, classification of states and chains, stability of Markov system, graph theoretic approach.

UNIT III
Poisson Process: postulates of Poisson process, properties of Poisson process, inter-arrival time, pure birth process, Yule Furry process, birth and death process, pure death process.

UNIT IV
Queuing System: General concept, steady state distribution, queuing model, M/M/1 with finite and infinite system capacity, waiting time distribution (without proof). Gambler's Ruin Problem: Classical ruin problem, expected duration of the game.

Text Books:
1. Medhi, J. (2009): Stochastic Processes, New Age International Publishers.
2. Bhat,B.R.(2000): Stochastic Models: Analysis and Applications, New Age International Publishers.

3. Taha, H. (1995): Operations Research: An Introduction, Prentice- Hall India.

Reference Books:

1. Basu, A.K. (2005): Introduction to Stochastic Processes, Narosa Publishing.
2. Feller, William (1968): Introduction to probability Theory and Its Applications, Vol I, 3rd Edition, Wiley International.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Calculation of transition probability matrix 2. Identification of characteristics of reducible and irreducible chains. 3. Identification of types of classes 4. Identification of ergodic transition probability matrix 5. Stationarity of Markov chain and graphical representation of Markov chain 6. Computation of probabilities in case of generalizations of independent Bernoulli trials 7. Calculation of probabilities for given birth and death rates and vice versa 8. Calculation of probabilities for Birth and Death Process

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Discipline Electives (min 8 credits to be taken)

1. Department offering the course	Mathematics
2. Course Code	SAF346
3. Course Title	Financial Mathematics
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Electives

Course Summary:

Course Objectives:
The students will learn about functions, limit, continuity and differentiability of functions and their applications. Definite and indefinite integrals with applications.

Course Outcome:

Student will be able to:

- Understand the concept of limit, continuity and differentiability.
- Learn the use of differential calculus in business mathematics.
- Sketch the graph and its applications in economics.
- Learn the use of integral calculus in business mathematics.

Curriculum Content:

Unit I: Functions, Limit, Continuity
[7]
Review of number system, Definition of function, Examples, limits at a point, limit theorems, infinite, limits/limits at infinity, continuity of a function at point.

Unit II: Differentiation, Tangent, Normal, Velocity, Acceleration
[10]
Differentiation: the derivative and tangent, line concepts, differentiation rules, interpretation of the derivative in economics/business, the marginal concept, Differentiation of logarithm, exponential and trigonometric functions, Chain rule, implicit differentiation, Leibnitz rule for derivative, Taylor's series for one variable, Application problems (elasticity of demand, logarithmic differentiation, Newton's method).

Unit III: Extrema of functions and applications
[10]
Applications of derivatives and curve sketching: monotonicity, extrema, extrema on a closed interval, applications in economics, concavity, derivative tests, asymptotes, curve sketching.

Unit IV: Integration **[12]**
Integration: the indefinite integral, integration, with initial conditions, applications in economics, elementary techniques of integration, substitution, manipulations, integration by parts, applications in economics, Definite integral, fundamental theorem of calculus, area beneath and

between curves, Applications in economics (Consumers and producers), Monte-Carlo integration and Simulation.

Text Books:

1. AK Gupta & T. Varga , "Introduction to Actuarial Mathematics" , Kluwer Academic Publishers, London .
2. R. Sharma, "Mathematics", Dhanpat Rai Publications (P) Ltd.

Reference Book:
1. J.K. Sharma , "Business Mathematics", J.K. International Publishing House pvt. Ltd. New Delhi, 3rd edition 2016.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF347
Course Title	Actuarial Statistics
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Elective

Course Summary

This course will introduce students about problem solving techniques using statistical tools. The course includes the concept of statistical concepts related to insurance and risk analysis.

Course Objectives

To introduce the basic concepts of Statistics and Insurance, Survival Distribution and Life Tables.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. To enlarge their minds regarding statistical tools and applications in the field of insurance.
2. To apply statistical tools to the problems related to Principles of Premium Calculation.
3. To understand Survival Distribution and Life Tables.
4. To understand the Life Insurance and Life annuities.

Curriculum Content

UNIT I

Introductory Statistics and Insurance Applications: Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

UNIT II

Principles of Premium Calculation: Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

UNIT III

Survival Distribution and Life Tables: Uncertainty of age at death, survival function, time until-death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics, assumptions for fractional age, some analytical laws of mortality.

UNIT IV

Life Insurance: Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships. Life annuities: continuous life annuities,

discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

Text Books:

1. Dickson, C. M. D. (2005): Insurance Risk And Ruin (International Series On Actuarial Science), Cambridge University Press.

Reference Books:

1. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A. And Nesbitt, C. J. (1997): Actuarial Mathematics, Society Of Actuaries, Itasca, Illinois, U.S.A.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Risk computation for different utility models
2. Discrete and continuous risk calculations
3. Calculation of aggregate claims for collective risks
4. Calculation of aggregate claim for individual risks
5. Computing Ruin probabilities and aggregate losses
6. Annuity and present value of contract
7. Computing premium for different insurance schemes
8. Practical based on life models and tables

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF348
Course Title	Biostatistics
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Elective

Course Summary

This course will introduce students about problem solving techniques using statistical tools. It provides an overview of statistical techniques in the field of Bio-sciences.

Course Objectives

To introduce the basic concepts of probability theory, distributions and statistical measures.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. To understand the survival analysis and censoring schemes.
2. To assess the validity and reliability of diagnostic and screening test.
3. To understand the issues in epidemiology.
4. To analyse data pertaining to genetics and clinical trials.

Curriculum Content

Unit I

Survival Analysis: Functions of survival times, survival distributions and their applications exponential, gamma, Weibull, Rayleigh, lognormal, death density function for a distribution having bath-tub shaped hazard function. Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples. Estimation of mean survival time and variance of the estimator for Type I and Type II censored data with numerical examples. Non-parametric methods: Actuarial and Kaplan-Meier methods for estimating survival function and variance of the Estimator.

Unt II

Competing Risk Theory: Indices for measurement of probability of death under competing risks and their inter-relations. Estimation of probabilities of death using maximum likelihood principle and modified minimum Chi-square methods. Theory of independent and dependent risks. Bivariate normal dependent risk model.

Unit III

Stochastic Epidemic Models: Simple epidemic models, general epidemic model definition and concept (without derivation). Duration of an epidemic.

Unit IV

Statistical Genetics: Introduction, concepts-Genotype, Phenotype, Dominance, Recessive ness, Linkage and Recombination, Coupling and Repulsion. Mendelian laws of Heredity, Random mating, Gametic Array. relation between genotypic array and gametic array under random mating. Distribution of genotypes under random mating. Clinical Trials: Planning and design of clinical trials, Phase I, II and III trials. Single Blinding.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Text Books:

1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3rd Edition, John Wiley and Sons.
2. Biswas, S. (2007): Applied Stochastic Processes: A Biostatistical and Population Oriented Approach, Reprinted 2ndCentral Edition, New Central Book Agency.

Reference Books:

1. Kleinbaum, D.G. (1996): Survival Analysis, Springer
2. Chiang, C.L. (1968): Introduction to Stochastic Processes in Bio Statistics, John Wiley and Sons.

3. Indrayan, A. (2008): Medical Biostatistics, 2nd Edition Chapman and Hall/CRC.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. To estimate survival function 2. To determine death density function and hazard function 3. To identify type of censoring and to estimate survival time for type I censored data 4. To identify type of censoring and to estimate survival time for type II censored data 5. To identify type of censoring and to estimate survival time for progressively type I censored data 6. Estimation of mean survival time and variance of the estimator for type I censored data 7. Estimation of mean survival time and variance of the estimator for type II censored data 8. Estimation of mean survival time and variance of the estimator for progressively type I censored data 9. To estimate the survival function and variance of the estimator using Non-parametric methods with Actuarial methods 10. To estimate the survival function and variance of the estimator using Non-parametric methods with Kaplan-Meier method 11. To estimate Crude probability of death 12. To estimate Net-type I probability of death 13. To estimate Net-type II probability of death 14. To estimate partially crude probability of death 15. To estimate gene frequencies

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF368
3. Course Title	Integral Equations
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Electives

Course Summary:

Course Objective: To learn the techniques for solutions of certain integral equations and their applications. Conversion of boundary value problems into integral equations using Green's function.

Course Outcome: Students will be able to

- convert boundary value problems into integral equations using Green's function.
- solve different types of integral equations and their applications to various real life problems.
- solve Volterra integral equation of the second kind by successive approximations.
- convert a boundary Value Problem to Fredholm integral equation.

Curriculum Content:

Unit-I **[9]**

Definition of integral equation and their classification, Solution of an integral equation, Differentiation of a function under integral sign, Conversion of an ordinary differential equation into integral equation, Eigenvalues and Eigen functions.

Unit-II **[11]**

Iterated kernel, Resolvent kernel, Solution of Fredholm integral equation of second kind by successive approximation, Solution of Volterra integral equation of second kind by successive approximation, Iterative method, and Neumann series.

Unit-III **[10]**

Green's function and its application in Initial and Boundary Value Problems to integral equations, Conversion of IVP/BVP into integral equations.

Unit-IV **[10]**

Solution of integral equations using integral transform, Singular integral equation, Applications of integral equations to differential equations and Boundary Value Problem.

Text Books:

1. M. D. Raisinghania, "Integral equations and boundary value problems"6th revised Edition, S. Chand Publications. 2013

2. Shanti Swaroop, "Integral Equations"**,** 22ndEdition, Krishna Prakashan, 2014.

Reference Books:

1. R. P. Kanwal, "Linear Integral Equations: Theory and Techniques", 2ndEdition, Birkhäuser, 2013.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF369
3. Course Title	Tensors and Differential Geometry
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Electives

Course Summary: This course is an introduction to the modern differential geometry: tensors, differential forms, smooth manifolds and vector bundles. The geometries lying above these structures are involved in several applications through mathematical analysis. The course provides basic skills to recognize geometric phenomena in mathematical analysis and applications.

Course Objective: To introduce space curves and their intrinsic properties of a surface. Further the no intrinsic properties of surface Tensor law of transformation and the differential geometry of surfaces are explored

Course outcomes: This course will enable the students to:

- explain the basic concepts of tensors.
- understand role of tensors in differential geometry.
- learn various properties of curves including Frenet–Serret formulae and their applications.
- know the Interpretation of the curvature tensor, Geodesic curvature, Gauss and Weingarten formulae
- apply problem-solving with differential geometry to diverse situations in physics, engineering and in other mathematical contexts.

Course Pre/Co requisite: Multivariable Calculus, Linear Algebra

Curriculum Content:

Unit-I **[9]**

Curves in space, space curves, arc lengths, tangent plane lines, osculating plane, normal plane, unit vectors t, n, b, Serret- fernet formula, curvature and torsion of curves helix, osculating circle and osculation sphere.

Unit-II **[10]**

Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines, Mainardi Codazzi Equations, Weingarten Equations.

Unit-III **[11]**

Envelopes and Developable surfaces, characteristics envelop, edge of regression, developable surface, envelops of a plane, Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature

Unit-IV **[10]**

Contra variant & Covariant Vectors & Tensors, Contraction, Tensor algebra, Associated Vectors and Tensors. Christoffel Symbols, Tensor law of transformation, Covariant derivative of Tensors. Riemann Christoffel Tensor.

Text Books:

1. Christian Bär, Elementary Differential Geometry, Cambridge University Press, 2010.

2. "Differential Geometry" by A. R. Vasistha and J. N. Sharma, Kedarnath Ramnath.

3. "Tensor Calculus" by G. C. Sharma and S.K. Singh Laxmi Narayan Publisher Agra.

4. "Differential Geometry" by P. P. Gupta and G. S. Malik, Pragati Prakashan.

Reference Books:

1. "Differential Geometry" by A.B. Chandra Moule and J. B. Chauhan, Siksha Sahitya Prakashan.
2. "Differential Geometry" by S. C. Mittal and D. C. Agarwal, Krishna Pracashan.
4. "Differential Geometry" by T. J. Willmore Oxford University Press, New Delhi.
5. A. Thorpe, Elementary Topics in Differential Geometry, Springer, India, 2004.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF376
3. Course Title	Introduction to Fuzzy Sets and Fuzzy Logic
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Discipline Electives

Course Summary: In this course students will learn the fundamentals of fuzzy sets, which will give them to deal with uncertainty and randomness using fuzzy sets. The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications.

Course Objective: To introduce the fundamentals of fuzzy sets, to discuss theoretical differences between fuzzy sets and classical sets. The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get a foundation of these concepts through this course.

Course Pre/Co- requisite (if any): Basic knowledge about set theory and its operations.

Course Outcome: Students will be able to:

- interpret fuzzy set theory and uncertainty concepts.
- identify the similarities and differences between probability theory and fuzzy set theory and their application conditions.
- apply fuzzy set theory in modeling and analyzing uncertainty in a decision problem.
- apply fuzzy control by examining simple control problem examples.

Curriculum Content:

Unit- I **[12]**

Background of Fuzzy set theory, Uncertainty and Imprecision, Statistics and Random Processes, Fuzzy sets – Basic definitions, level sets, convex fuzzy sets, Basic operations on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic products bounded sum and difference, Extension principle and application, Zadeh extension principle, image and inverse image of fuzzy sets.

Unit- II **[10]**

Fuzzy numbers, Elements of fuzzy arithmetic, Fuzzy relations on fuzzy sets, The union and intersection of fuzzy relation, Composition of fuzzy relations, Min-max composition and its properties, Fuzzy equivalence relation.

Unit- III **[9]**

Fuzzy decision making, Fuzzy linear programming problem, Symmetric fuzzy linear programming problem, Fuzzy linear programming with crisp objective function, Fuzzy graph.

Unit- IV **[9]**

Fuzzy logic: An overview of classic logic, its connectives, Tautologies, Contradiction fuzzy logic, Fuzzy quantities, Logical connectives for fuzzy logic, Applications to control theory.

Text Books:

1. Didier Dubois, Henri M. Prade, "Fuzzy Sets and Systems: Theory and Applications", Academic Press, 1994.
2. H. J. Zimmermann, Fuzzy set theory and its applications, Allied publishers Ltd., New Delhi, 2001.

Reference Books:

1. G. J. Klir & B. Yuan, "Fuzzy sets and Fuzzy logic; Theory and Applications", Prentice Hall of India 1995.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India Pvt. Ltd., 2009.
3. Kwang H. Lee, "First Course on Fuzzy Theory and Applications", Springer-Verlag Berlin Heidelberg 2005

Teaching and Learning Strategy

All materials (Ppts, Tutorials, assignments, , etc.) will be uploaded in Moodle/MS Teams /Google drive. Refer to your course on SAP/MS teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF357
Course Title	Econometrics
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L: T:P)	3:0:2
Prerequisites (if any)	
Course Basket	Discipline Elective

Course Summary

This course provides an overview of statistical tools in the field of economics.

Course Objectives

To introduce the basic concepts and econometric models.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. To understand linear econometric models.
2. To apply statistical tools to the problems related to the multicollinearity.
3. To understand the different estimators.
4. To carry out some practical base on econometrics.

Curriculum Content

UNIT I

Introduction: Objective behind building econometric models, nature of econometrics, role of econometrics. General linear econometric model (GLM), Estimation, Disturbance Term.

UNIT II

Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions for multicollinearity, specification error.

UNIT III

Generalized least squares estimation, Aitken estimators. Autocorrelation: concept, consequences of autocorrelated disturbances, detection and solution of autocorrelation.

UNIT IV

Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Autoregressive and Lag models, Dummy variables.

Text Books:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw Hill Companies.

2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.

Reference Books:

1. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited,

2. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wile

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments, tutorials etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

List of Practical
1. Problems based on estimation of General linear model 2. Testing of parameters of General linear model 3. Forecasting of General linear model 4. Problems concerning specification errors 5. Problems related to consequences of Multicollinearity 6. Diagnostics of Multicollinearity 7. Problems related to consequences of Autocorrelation (AR(I)) 8. Diagnostics of Autocorrelation 9. Estimation of problems of General linear model under Autocorrelation 10. Problems related to consequences Heteroscedasticity 11. Diagnostics of Heteroscedasticity 12. Estimation of problems of General linear model under Heteroscedastic distance terms 13. Problems related to General linear model under (Aitken Estimation) 14. Problems on Autoregressive and Lag models.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Generic Electives (min 20 credits to be taken):

1. Department offering the course	**Physics**
2. Course Code	**PYF101**
3. Course Title	**Wave and Optics & Introduction to Quantum Mechanics**
4. Credits (L:T:P:C)	**3:1:2:5**
5. Contact Hours (L:T:P)	**3:1:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Generic Electives**

COURSE OBJECTIVE: The objective of this course is to develop a fundamental basis of waves, optical phenomenon, concepts of quantum mechanics and semiconductor physics which the engineering students can apply to their respective area of specialization.

COURSE OUTCOME:

At the end of the course, the student will be able to:

CO1. To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature.

CO2.To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail.

CO3. To be able to make approximate judgments about optical and other wave phenomena when necessary.

CO4. To acquire skills allowing the student to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report.

CO5. To have basic knowledge of Quantum Mechanics and Semiconductors

Curriculum Content

Unit-I **6Hrs**

Mechanical and electrical simple harmonic oscillators (characteristics and energy), damped harmonic oscillator, forced mechanical and electrical oscillators, impedance.

Unit-II **8Hrs**

Transverse wave on a string, the wave equation on a string, harmonic waves, reflection and transmission of waves at a boundary, standing waves and their eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves (Newton formula and Laplace correction).

Unit-III **10Hrs**

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, fringes with white light, interference in parallel thin films, Newton's rings, Fraunhofer diffraction from a single slit & N- slits, Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Unit-IV **6Hrs**

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, components of LASER and pumping methods (in brief), different types of lasers: gas lasers (He-Ne), solid-state laser (ruby)

Unit-V **10Hrs**

Wave nature of particles, Phase velocity, wave-packet and group velocity, Uncertainty principle and its applications, time-dependent and time-independent Schrodinger equation, physical significance of wave function., Solution of stationary-state Schrodinger equation for one dimensional problem–particle in a box, potential barrier.

TEXT BOOKS:

1. N. K Bajaj, Physics of Waves and Oscillations, Tata McGraw-Hill, 2008
2. A. Ghatak, Optics, McGraw Hill Education, 2017.
3. D. J. Griffiths, Quantum mechanics, Pearson Education, 2015.

REFERENCE BOOKS:

1. H. J. Pain, The physics of vibrations and waves, Wiley, 2008
2. E. Hecht, Optics, Pearson Education, 2008

SR. NO.	LIST OF EXPERIMENTS
1	(a) To determine wavelength of sodium light using Newton's Rings. (b) To determine the refractive index of a liquid using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	(a) To determine wavelength of prominent lines of mercury using plane diffraction grating. (b) To determine the dispersive power of a plane transmission diffraction grating.
4	To determine the specific rotation of cane sugar solution using bi-quartz polarimeter
5	To study the diffraction pattern of Single slit and hence determine the slit width.
6	(a) To verify cosine square law (Malus Law) for plane polarized light. (b) To study the nature of polarization using a quarter wave plate.
7	To study the variation of refractive index of the material of the prism with

	wavelength and to verify Cauchy's dispersion formula
8	(a) To study photoelectric effect and determine the value of Planck's constant. (b) To verify inverse square law using photocell.
9	To determine the frequency of AC mains using sonometer.
10	To determine the frequency of AC mains or of an electric vibrator by Melde's experiment
11	To measure the numerical aperture (NA) of an optical fiber.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Physics**
2. Course Code	**PYF102**
3. Course Title	**Introduction to Mechanics**
4. Credits (L:T:P:C)	**3:1:2:5**
5. Contact Hours (L:T:P)	**3:1:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Generic Electives**

COURSE OBJECTIVE: Mechanics lies at the foundation of physics and along with an appreciation of the molecular structure of matter exposes the student to the phenomenology of physics.

COURSE OUTCOME:

At the end of the course, the student can:

CO1. To know Newton's laws of motion, potentials, conservation of energy, momentum and angular momentum, and be able to apply them to projectiles, circular motion, and gravity

CO2. Demonstrate an understanding of intermediate mechanics topics such as co-ordinate transformations, oscillatory motion, gravitation etc.

CO3. Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.

CO4. Understand the concept of non-inertial frames of reference, coriolis and centripetal accelerations and their applications.

CO5. Understand the concept of elastic constants and demonstrate bending of beams.

Curriculum Content

Unit-I **8Hrs**

Transformation of scalars and vectors under Rotation transformation; Newton's laws and its completeness in describing particle motion, Cylindrical and spherical coordinates

Mechanics of a system of particles, conservation of laws of linear momentum, angular momentum and mechanical energy, centre of mass and equation of motion, Constraints and degrees of freedom.

Unit-II **8Hrs**

Potential energy function; F = - Grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum and areal velocity; Elliptical, parabolic and hyperbolic orbits.

Unit-III **6Hrs**

Non-inertial frames of reference; Rotating frames of reference, Coriolis force; Applications: Weather systems, projectile motion.

Unit-IV **8Hrs**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance, Kater's Pendulum and bar pendulum.

Unit-V **8Hrs**

Rotation of rigid body, Moment of Inertia, Torque, angular momentum, kinetic energy of rotation, Theorems of perpendicular and parallel axis, Moment of Inertia of rectangular rod, spherical and cylindrical bodies. Acceleration of a body moving on horizontal and inclined plane. Moment of inertia of Fly Wheel.

Unit-VI **8Hrs**

Elastic constants- Introduction and relationship between elastic constants, Cantilever, Beam, bending of beam, Twisting of a cylindrical body.

TEXT BOOKS:

1. D.S. Mathur, Mechanics, S. Chand & Co., 2012.
2. D.Kleppner & R.Kolenkow , Introduction to Mechanics, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. G.R. Fowles and G.L. Cassiday, Analytical Mechanics, Cengage Learning India Pvt. Ltd., 2006.
2. R. Resnick, Introduction to Special Relativity, John Wiley and Sons, 2007.
3. J.L. Synge & B.A. Griffiths, Principles of Mechanics, Andesite Press, 2015.

SR. NO.	LIST OF EXPERIMENTS
1	To measure internal diameter, external diameter and depth of a vessel using vernier calipers
2	To measure density of a wire using screw gauge.
3	To determine the Moment of Inertia of a Flywheel
4	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method)
5	To determine the Modulus of Rigidity of a Wire by Maxwell's needle
6	To determine the elastic Constants of a wire by Searle's method
7	To determine the value of g using Bar Pendulum
8	To measure the Young's Modulus using Bending of Beam
9	To determine the value of g using Kater's Pendulum
10	To determine the moment of inertia of a body using Torsion pendulum

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Physics**
2. Course Code	**PYF103**
3. Course Title	**Electricity and Magnetism**
4. Credits (L:T:P:C)	**3:1:2:5**
5. Contact Hours (L:T:P)	**3:1:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Generic Electives**

COURSE OBJECTIVE:

To teach students the effects of electric charges at rest and in motion. Both positive and negative charges produce force field which is called "electric field". Moving charges produce current, which gives rise to another force field called "magnetic field". The electromagnetic theory studies the behavior of the electric and magnetic fields.

COURSE OUTCOME:

Having successfully completed this course, the student will be able to demonstrate knowledge and understanding of:

CO1. The use of Coulomb's law and Gauss' law for the electrostatic force
CO2. The relationship between electrostatic field and electrostatic potential
CO3. The use of the Lorentz force law for the magnetic force
CO4. The use of Ampere's law to calculate magnetic fields
CO5. The use of Faraday's law in induction problems
CO6. The basic laws that underlie the properties of electric circuit elements

Unit-I **9Hrs**

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Gauss law and its applications, Laplace's and Poisson's equations; Practical examples like Faraday's cage and coffee-ring effect; energy of a charge distribution and its expression in terms of electric field.

Unit-II **7Hrs**

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; gauss law in dielectrics; Polarization vector, solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field. Energy in dielectrics system

Unit-III **9Hrs**

Electric current and current density, magnetic force, continuity equation, Bio-Savart law and its applications (straight wire and solenoid), Divergence and curl of static magnetic field; Ampere circuital law and its applications(wire, solenoid & toroid), current loop as magnetic dipole and dipole moment, Para, dia and ferro magnetic materials (properties only).

Unit-IV **6Hrs**

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Unit-V **9Hrs**

Concept of displace current, Modifying equation for the curl of magnetic field to satisfy continuity equation; and magnetic field arising from time-dependent electric field; Maxwell's equation in integral and differential form in vacuum and non-conducting medium; transverse nature of EM wave, Wave equation in free space, Wave propagation in conducting medium and non-conducting medium & skin depth, Flow of energy and Poynting vector.

Text Books:

1. David Griffiths, Introduction to Electrodynamics, PHI Learning, 2012.

Reference Books:

1. Halliday and Resnick, Physics, Wiley, 2013.
2. W. Saslow, Electricity, Magnetism and Light,Academic Press, 2002.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Physics
2. Course Code	PYF209
3. Course Title	Fundamentals of Thermal Physics
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

COURSE SUMMARY:

This course covers temperature, heat exchange, heat capacity, phases of matter, ideal gas law, kinetic theory of gases, zeroth, first, second and third law of thermodynamics, entropy and their applications.

COURSE OBJECTIVE:

The objective of this course is to develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics and to use this knowledge to explore various applications. Many of these applications will relate to topics in materials science and the physics of condensed matter.

Course Pre/Co- requisite (if any) : no restricted pre-requisite

COURSE OUTCOME

Having successfully completed this course, the student will be able to:

1. State the Zeroth, First, Second and Third Laws of thermodynamics, if appropriate in different but equivalent forms and demonstrate their equivalence
2. Understand all the concepts needed to state the laws of thermodynamics, such as 'thermodynamic equilibrium', 'exact' and 'inexact' differentials and 'reversible' and 'irreversible' processes
3. Use the laws of thermodynamics (particularly the first and second laws) to solve a variety of problems, such as the expansion of gases and the efficiency of heat engines
4. Understand the meaning and significance of state variables in general, and of the variables P; V; T;U; S in particular, especially in the context of a simple fluid, and to manipulate these variables to solve a variety of thermodynamic problems
5. Understand the efficiency and properties of thermodynamic cycles for heat engines, refrigerators and heat pumps.
6. Define the enthalpy H, Helmholtz function F and the Gibbs function G and state their roles in determining equilibrium under different constraints

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

CURRICULUM CONTENT

Unit 1: Introduction to Thermodynamics 10Hrs

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient.

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

Unit 2: Entropy 6Hrs

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

Unit 3: Thermodynamic Potentials 5Hrs

Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations

Unit-4: Maxwell's Thermodynamic Relations 4Hrs

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) Tds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Unit- 5:Kinetic Theory of Gases 14Hrs

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. JouleThomson Effect for Real and Van der Waal Gases. Temperature of Inversion. JouleThomson Cooling

Text books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, McGraw-Hill, 1981.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill, 1993

Reference books:

1. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, Indian Press, 1958
2. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, Springer, 2009.
3. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger, Narosa, 1988.
4. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed, Oxford University Press., 2012

SR. NO.	LIST OF EXPERIMENTS
1	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2	To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3	To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method
4	To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5	To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.
6	To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
7	To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
8	To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
9	Determine a high resistance by leakage method using Ballistic Galvanometer.

Teaching and Learning Strategy:

All materials (Course material, assignments, tutorials) will be uploaded in Moodle/MS Teams. Refer to your course on SAP/MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF106
3. Course Title	Inorganic Chemistry-I
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

Course Outline:

The course briefly covers the wave mechanics of H-atom and shrodinger´s wave equation for atomic orbitals interpretations in the first unit. In the second unit the periodic properties of elements are described with reference to characteristic physical parameters of atoms and molecules. In the third, fourth and fifth units are explained the basis of formation, geometry and properties of covalent bonds, Ionic and metallic bonds and interpretation of their salient features.

COURSE OBJECTIVE:

The objective of this course is to develop basics concepts of Inorganic Chemistry and enhance the understanding of the properties of inorganic compounds in their ionic and covalent bondings.

Course Pre/Co- requisite (if any) :The student must have basic knowledge of H-atom spectrum, energy calculations, preliminary knowledge of the configurations of atomic orbitals and the laws governing the electrons fillings criteria.

CURRICULUM CONTENT

Unit 1: Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's uncertainty principle and its significance, Schrödinger's wave equation, significance of ψ and $\psi 2$. Quantum numbers and their significance, Normal and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams.Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Unit 2: Periodicity of Elements:

s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s&p- block. Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.Atomic radii (van der Waals) Ionic and crystal radii. Covalent radii (octahedral and tetrahedral) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. Electron gain enthalpy, trends of electron gain enthalpy. Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of

electronegativity with bond order, partial charge, hybridization, group electronegativity.Sanderson's electron density ratio.

Unit 3 : Ionic Bonding

Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals.Born-Landé equation with derivation and importance of Kapustinskii

expression for lattice energy.Madelung constant, Born-Haber cycle and its application, Solvation energy.

Unit 4 : Covalent Bonding

Covalent bond: Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule,

Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H2O, NH3, PCl3, PCl5, SF6, ClF3, I3-, BrF2+, PCl6-, ICl2-, ICl4- and SO42-. Multiple bonding (ζ and π bond approach) and bond lengths.Covalent character in ionic compounds, polarizing power and polarizability .Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Unit 5 : Metallic Bond

Metallic Bond: Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.(iv) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Hydrogen bonding (theories of hydrogen bonding, valence bond treatment).Effects of weak chemical forces, melting and boiling points, solubility, energetics of dissolution process.

Course outcome:

At the end of the course, the student will be able to:

1. Explain the atomic structure based on quantum mechanics and explain periodic properties of the atoms viz. atomic radii, ionization energy and their interpretations.

2. Explain the structure and bonding in molecules and ions and predict the structure and geometry of molecules on the basis of VBT and VSEPR theory.

3. Explain electronegativity and dipole moment and its vector in determining ionic characters in covalent compounds.

3. Explain the band structure of solids and determine the electrical properties, semiconductivity and packing orders of crystals with defects.

4. Explain the relationships between weak forces and physical properties of solid compounds

TEXT BOOKS

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education 2010

2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.

3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970

4. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.

5. Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

SR. NO.	EXPERIMENT NAME
1	Acid-Base Titrations: Principles of acid-base titrations to be discussed. (i) Estimation of sodium carbonate using standardized HCl. (ii) Estimation of carbonate and hydroxide present together in mixture. (iii) Estimation of carbonate and bicarbonate present together in mixture. (iv) Estimation of free alkali present in different soaps/detergents
2	Oxidation-Reduction Titrimetry: Principles of oxidation-reduction titration (electrode potentials) to be discussed. (i) Estimation of Fe(II) and oxalic acid using standardized KMnO solution (ii) Estimation of oxalic acid and sodium oxalate in a given mixture (iii) Estimation of Fe(II) with $K_2Cr_2O_7$

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF107
3. Course Title	Physical Chemistry-I
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

Course Outline:

The course covers the gaseous states kinetics and P-V-R relations in the first unit. The second unit is renders details of the types of crystalline packing and symmetry for prototype crystalline solids. The third, fourth and fifth unit covers the thermodynamics of gaseous expansions and compressions and changes in intrinsic parameters, like, enthalpy, internal energy during gaseous phase reactions.

COURSE OBJECTIVE:

The objectives of this course involve learning of the basics concepts of thermodynamics and to be able to identify and describe energy exchange processes of reactions.

Course Pre/Co- requisite (if any): The student must have basic knowledge of gaseous laws and equations regarding Pressure-Volume-Temperature dependency of gaseous molecules. Students should also have prior understanding of crystalline nature of well-known salts (NaCl) to be further explained and basis of homogenous solutions and colloidal suspensions.

Curriculum Content:

Unit I: Gaseous state:

Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure.

Unit 2: Solid State:

Definition of space lattice, unit cell, Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices (iii) Law of symmetry, Symmetry elements in crystals. X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method).

UNIT 3: Chemical Thermodynamics:

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

UNIT 4: Thermochemistry, Second and Third law of thermodynamics:

Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's

equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of Thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

UNIT 5: Free Energy functions and Systems of Variable Composition:

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Learning outcome:-

At the end of the course, the student will able to:

1. Explain the kinetic of gaseous diffusion and viscosity based on various parameters; understanding of gaseous mixture separation based on partial pressures.
2. Explain the crystal structures and symmetry elements present in various crystal based on the understanding of X-ray diffraction technique of Crystal lattices.
3. Formulate various derivations expressing the intrinsic and extrinsic parameters of reaction thermodynamics and Free energy-enthalpy correlations and their implications in the reaction monitoring.
4. Predict the Thermo chemistry of various types of reactions based on Enthalpy expressions.

TEXT BOOKS

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).
2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).
3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF108
3. Course Title	Basic Analytical Chemistry
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

Course Outline:

The course briefly covers the quantitative aspects of statistics for data interpretations for accuracy and distributions and then the next unit covers the instrumentation and basics methods utilized in UV-VIS and IR spectroscopy. An introductory third and fourth unist would cover the instrumentation, principles and data interpretations for thermogravimetric analysis and electro-analytical titration methods. Finally, the unit-5 touches upon the basic principles and methods for different chromatographic techniques

COURSE OBJECTIVE:

The objectives of this course is to teach basics Analytical techniques with instrumentation working and principles methods of data acquisitions for major instruments like; UV-VIS, IR spectroscopic methods, TGA based sample analysis and electro-analytical titration methods. The course intends to impart basic knowledge of the principles and methods for different chromatographic techniques and separation criteria for advanced chromatographic instruments. The course introduces the basic learning for calculating data sampling and distribution analysis.

Course Pre/Co- requisite (if any) :The student must have the basic knowledge of electromagnetic radiations and quantitative aspects of quantized electronic and molecular bands and Hydrogen-atom spectrum. Students also should have studied the statistical means and standard deviation calculations.

Detailed Syllabus

Unit I: Qualitative and Quantitative aspects of analysis:

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q, and T test, rejection of data, and confidence intervals

Unit 2: Optical methods of analysis:

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principle of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enoltautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator& detector) for single and double beam instrument; sampling techniques.

Unit 3 : Thermal method of analysis:

Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.

Unit 4: Electro analytical methods:

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence point. Techniques used for the determination of pKa values.

Unit 5: Separation Techniques:

Solvent extraction: Classification and principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.

Technique of extraction: batch, continuous and counter current extractions.

Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.Chromatography: Classification and principle and efficiency of the technique. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

Learning outcome:-

At the end of the course, the student will be able to:

1. Perform data sampling, identification of patterns through estimation of analytical errors and precision, statistical test of data and confidence intervals.

2. Explain the principles of the origin of spectroscopy, selection rules in UV-Vis and IR-spectrometry, instrumentation and various domains of applications.

3. Interpret the IR spectra in the determination of functional group changes during reactions and UV-Vis spectroscopy in the quantitative estimation of metal-ligands stoichiometry in the solutions and basis of bioanalytical methods.

4. Develop insight of the practical methods for performing thermogravimetric analysis, potentiometric and conductometric titrations and their graph analysis.

5. Gain practical understanding of solvent extraction; implications in metallic and organic compound extractions. Students will develop a basic knowledge of various chromatographic techniques and corresponding stationary phases and mobile phases.

TEXT BOOKS

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by GH Jeffery and others) 5th Ed. The English Language Book Society of Longman

2. Willard, Hobert H. et. al: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

3. Christian, Gary D; Analytical Chemistry, 6th Ed. New York- John Willy, 2004.

4. Khopkar, S.M. Basic Concepts of Analytical Chemistry New Age, International Publisher, 2009.

SR.NO.	EXPERIMENT NAME
1	Paper chromatographic separation of Fe3+, Al3+, and Cr3+

2 Separate and identify the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography.

3 Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

4 Determine the pH of given aerated drinks fruit juices, shampoos and soaps.

5 Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

6 Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF116
3. Course Title	Organic Chemistry-I
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

COURSE OUTLINE:

This course would be a pre-requisite for the advanced level course at the M. Sc. Level. The course begins with a review of Maxwell equations. The course covers reflection, refraction and polarization of electromagnetic waves ate different media, optical fibres and wave guides.

COURSE OBJECTIVE:

The objective of this course is to learn the Principles of Thermodynamics and their implications in the understanding of thermochemistry of reactions; course enables the students to learn the thermodynamics of solutions and coligative phases.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of electrostatics and magnetostatics.

DETAILED SYLLABUS

Unit I: Basics of Organic Chemistry 9Hrs

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit 2: Stereochemistry of Organic compounds: 8Hrs

Newman projection, Sawhorse, Fischer projection and Flying-Wedge formulae, Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogeniccentre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogeniccentres, diastereomers, meso compounds, resolution of racemic mixtures; relative and absolute configurations – D&L and R&S systems of nomenclature, sequence rules; geometrical isomerism – cis-trans isomerism, E&Z system of nomenclature of alkenes

Unit 3: Chemistry of Aliphatic Hydrocarbons: 9 Hrs

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz- Fittig Reactions, Free

radical substitutions: Halogenation - relative reactivity and selectivity. Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions.Saytzeff and Hofmann eliminations.Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration. oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti hydroxylation (oxidation). 1, 2- and 1, 4- addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylicbromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes. Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Unit 4: Aromatic Hydrocarbons 7Hrs

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes, Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene;

Unit 5: Alkyl and Aryl Halides 6Hrs

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams;Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions;The addition-elimination and the elimination-addition mechanisms of nucleophilc aromatic substitution reactions; Relative reactivities of alkyl halides vsallyl, vingl and aryl halides, Synthesis and uses of DDT and BHC.

Learning Outcome:-

At the end of the course, the student can :

1. Identify the name of the functional groups and different class of organic compounds
2. Develop an insight of organic reactions classes and their mechanism
3. Draw various models of chiral compounds, basis of chiralty and determination of absolute configurations
4. Understand the physico-chemical properties and forces in the organic molecules which govern their reactivities.

5. Understand the basis of aromaticity of organic compounds, and differences in the reactivity of aromatic vs aliphatic and alicyclic compounds.

SR. NO.	EXPERIMENT NAME
1	**Purification of organic solids by** i) Sublimation (Naphthalene, camphor etc.) ii) Hot water (Benzoic acid, acetanilide etc.) Checking purity of organic solids by melting point/mixed melting point.
2	**Identification of Organic Compounds** The preliminary examination of physical and chemical characteristics (physical state, colour, odor and ignition tests), elemental analysis (nitrogen, sulphur, chlorine, bromine, iodine), solubility tests including acid-base reactions. Functional group tests of following classes of compounds – phenols, carboxylic acids – carbonyl compounds – ketones, aldehydes – carbohydrates – aromatic amines – amides, ureas and anilides – aromatic hydrocarbons and their halo- derivatives
3	**Preparations** i) Acetylation of salicylic acid, aniline ii) Benzoylation of salicylic acid, aniline iii) Preparation of iodoform from ethanol and acetone iv) Preparation of 4-nitroacetanilide from acetanilide v) Preparation of 4-bromoacetanilide from acetanilide

TEXT BOOKS

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

2. Finar, I. L. Organic Chemistry (Volume 1), 6th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education) (2002).

REFERENCE BOOKS

1. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of NaturalProducts), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
3. Organic Chemistry, Vol. I, II & III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF117
3. Course Title	Physical Chemistry-II
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

COURSE OUTLINE:

The course covers the basic concepts related to types of bonding and properties of liquids in unit one. The second unit covers the equilibrium chemistry of solution phase reactions and calculations of quantitative determination of concentration changes with reaction progression. The third unit covers the colligative properties of real solutions. Colloidal state is been discussed in unit four while in unit five ionic equilibrium is discussed in detail.

COURSE OBJECTIVE:

The objective of this course is to acquaint the student with the basic phenomenon/concepts of equation of state and properties of liquid. In this module students will learnt about chemical equilibrium, its types and the factors affecting the state of equilibrium. In this the lesson you will learn about the equilibria involving ionic species.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have gained ample understanding of the course Physical Chemistry-I taught at semester-I and cleared the paper.

Learning Outcome:-

At the end of the course, the student will able to:

1. Understand different concepts related to type of bonding and properties of liquid.
2. Derive Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient.
3. Understand the basic concepts associated with LeChatelier's Principle.
4. Know about basic concepts of acids and basis and also about salt hydrolysis.

Detailed Syllabus

Unit I: Liquid State

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapor pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Unit 2: Chemical Equilibrium

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature,

pressure and concentration (LeChatelier Principle, Quantitatively)). Free energy of mixing and spontaneity of equilibrium between ideal gases and a pure condensed phase.

Unit 3: Solutions and Colligative Properties

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal dissociated and associated solutes in solution.

Unit 4: Colloidal State:

Definition of colloids, classification of colloids; Solids in liquids (sols): properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number. Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier, Liquids in solids (gels) : classification, preparation and properties, inhibition, general application of colloids, colloidal electrolytes.

Unit 5: Ionic Equilibrium

Strong, moderate weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants mono- di-and triprotic acids (exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its application; buffer capacity, buffer range, buffer action and applications buffers in analytical chemistry and biochemical processes in the human body.

TEXT BOOKS

1. Khosla, B. D.; Garg, V. C. &Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

2. Athawale, V. D. &Mathur, P. Experimental Physical Chemistry New Age International: New Delhi (2001).

REFERENCE BOOKS

1. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry 8th Ed., Oxford University Press (2006).

2. Ball, D. W. Physical Chemistry Thomson Press, India (2007).

3. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

4. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

SR.NO.	EXPERIMENT NAME
1	Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $MnCl_2.4H_2O$/$SrBr_2.2H_2O$).

2 To study the effect of a solute (e.g. NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g. phenol-water system) and to determine the concentration of that solute in the given phenol-water system.

3 To construct the phase diagram of two component (e.g. diphenylamine – benzophenone) system by cooling curve method.

4 **Surface tension measurements** (use of organic solvents excluded). (a)Determine the surface tension by (i) drop number (ii) drop weight method.
(b)Study the variation of surface tension of detergent solutions with concentration

5 **Viscosity measurement using Ostwald's viscometer:** Study the effect of variation of viscosity of an aqueous solution with the concentration of solute.

6 **pH measurements**
(a)Measurement of pH of different solutions using pH-meter. (b)Preparation of buffer solutions Sodium acetate-acetic acid Ammonium chloride-ammonium hydroxide

7 **pH metric titrations of**
(i)strong acid and strong base (ii)weak acid and strong base

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF206
3. Course Title	Inorganic Chemistry-II
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

COURSE OUTLINE:

This course covers chemistry of s- and p-block elements with extensive understanding. This course also covers chemistry of Boranes, Silanes, oxo and peroxo acids, interhalogen compounds along with the reactivity of noble gases, theories of acids and bases and also covers the brief understanding of inorganic Polymers.

COURSE OBJECTIVE:

This is an advance course in chemistry which provides extensive understanding of the chemical properties of s- and p-block elements and comprehension of their structure-reactivity in terms of acid-base nature; Course build up an insight to understand the complex nature of higher order boranes and interhalogen compounds and their reactions.

COURSE PRE/CO- REQUISITE (IF ANY) :

The student must have basic knowledge of electrostatics and magnetostatics.

DETAILED SYLLABUS

Unit I: Chemistry of s and p block elements: 9 Hrs

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behavior of first member of each group. Allotropy and catenation, Complex formation tendency of s- and p-block elements. Hydrides and their classification: ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Unit II: Chemistry of Boranes, Silanes,oxo and peroxo acids and interhalogen compounds 10 Hrs

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses:Boric acid and borates, boron nitrides, borohydrides (diborane), silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur; Interhalogen compounds, polyhalide ions, pseudohalogens.

Unit III: Noble gases: 6 Hrs

Occurrence & uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2 and XeF_4, XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds (VSEPR theory).

Unit V: Acids and Bases: 7 Hrs

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of

acid-base reactions, leveling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.

Unit IV: Inorganic Polymers: **7 Hrs**

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes.Borazines, silicates and phosphazenes, and polysulphates.

Learning Outcome:-

At the end of the course, the student will be able to:

1. Explain the concepts of Acid-Base reactivity and theorize the nature of super acids and bases
2. Gain an insight into the reactivity of various p-block compounds, their oxo- and peroxo-acids forming ability and reactions.
3. Explain the hybridization and geometry of compounds of Nobel gases and their applications
4. Classify and understand the complex structures of various boranes, silanes and Interhalogen compounds and also their implications for modern-day catalysts design and applications in medical sciences.
5. Gain an understanding of the various inorganic polymers, their chemical properties and applications in modern days.

TEXT BOOKS

1. N.N. Greenwood, and Earnshaw, Chemistry of the Elements, ButterworthHeinemann. 1997.
2. J. D. Lee, Concise Inorganic Chemistry, ELBS (1991).
3. Canham, G.R. and Overton, T., Descriptive Inorganic Chemistry, Freeman & Co.2006
4. F. A. Cotton andG. Wilkinson; Advanced Inorganic Chemistry, Wiley, VCH, 1999.

REFERENCE BOOKS

1. T. H. Dunning and D. E. Woon; p-Block elements-Inorganic chemistry, Magnum Publishing, 2016
2. W. N. Lipscomb; Boron Hydrides, Dover Publications.inc, 2012

SR.NO.	EXPERIMENT NAME
1	**(a) Iodo / Iodimetric Titrations** (i) Estimation of Cu (II) and $K_2Cr_2O_7$ Using sodium thiosulphate solution (Iodimetrically). (ii) Estimation of (i) arsenite and (ii) antimony in tartar-emeticiodimetrically (iii) Estimation of available chlorine in bleaching powder iodometrically.
2	Inorganic preparations of Cuprous Chloride, Cu_2Cl_2
3	Inorganic Preparation of Manganese (III) phosphate, $MnPO_4.H_2O$
4	Inorganic Preparation of Aluminium Potassium sulphate $K_2Al(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.
5	Inorganic Preparation of salicyldehyde and ethylenediamineligands based Cu-schiff base complexes.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Chemistry
2. Course Code	CHF207
3. Course Title	Organic Chemistry-II
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

COURSE OUTLINE:

This course covers reactivity, preparation and important reactions of halogenated compounds. Course also covers preparation properties and reactivity of alcohols, Phenols, Ethers and epoxide, carbonyl, carboxylic acid and sulphur containing compounds.

COURSE OBJECTIVE:

The objective of this course is to learn basics concepts of reaction mechanism and electronic flow present in the molecules which help to drive arrow pushing mechanism. This course recalls the fundamental principles of organic chemistry that include chemical bonding, nomenclature, structural isomerism, stereochemistry, chemical reactions and mechanism.

COURSE PRE/CO- REQUISITE (IF ANY): no restricted pre-requisite

DETAILED SYLLABUS

Unit I: Chemistry of Halogenated hydrocarbons 8 Hrs

Alkyl halides: Methods of preparation, nucleophilic substitution reactions-S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvents etc; nucleophilic substitution vs. elimination.

Aryl halides: Preparation, including preparation from diazoniumsalts.Nucleophilic aromatic substitution; S_NAr andBenzyne mechanism.

Relative reactivity of Alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

Organometallic compounds of Mg and Li metals and use in synthesis of organic compounds.

Unit II: Alcohols, Phenols, Ethers and epoxide 9Hrs

Alcohols:preparation,properties and relative reactivity of 1^o, 2^o, 3^oalcohols,Bouvaelt-Blanc Reduction; Preparation and properties of glycols; Oxidation by periodic acid and tetraacetate, Pinacol- Pinacolone rearrangement;
Phenols: Preparation and properties; Acidity of substituted phenols; Ring substitution reactions, Reimer-Tiemann and Kolbe's-Schmidt Reactions, Fries and Claisen rearrangements.

Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Unit III: Carbonyl Compounds 8 Hrs

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldolcondensation,Claisen- Schmidt condensation, Perkin and Cannizzaro reactions; Benzoin condensation, Beckmann and Benzil-Benzilic acid rearrangements and Wittig reactions.Oxidation (BaeyerVilliger) and reduction reactions (Clemmensen,Wolff-Kishnerandborohydrides).Addition reactions of α, β-unsaturated carbonyl compounds: Michael additions. Active methylene compounds-Keto-enol,tautomerism.

Unit IV:Carboxylic Acids and their Derivatives **8 Hrs**

Preparation, physical properties and reactions of monocarboxylic acids, typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids, viz; succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids.Preparation and reactions of acid chlorides, anhydrides, esters and amides; Mechanism of acidic and alkaline hydrolysis of esters.Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement

Unit V: Sulphur containing compounds **6 Hrs**

Preparation and reactions of thiols, thioethers and sulphonic acids;
Thiophene: reactions and properties.

Learning Outcome

Having successfully completed this course, the student will be able to:

1. Predict the reactivity of an organic compound from its structure.
2. Develop basic skills for the multi-step synthesis of organic compounds.
3. Justify a reasonable mechanism for a chemical reaction.
4. Identify name the functional groups and different class of organic compounds
5. Predict electronic flow and arrow pushing mechanism in a chemical reaction.

Text book [TB]:

1. Organic Chemistry, Morrison, R. T. & Boyd, R. N., Pearson Education, 7 Ed., (2010)
2. Organic Chemistry (Volume 1), Finar, I. L., Pearson Education 6 Ed., (2002)
3. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure

Reference books [RB]:

1. J. Cleyden and S. Warren, Organic Chemistry, Oxford University Press; Second edition (2012)
2. F.A. Carey & R. Sundberg, Advanced Organic Chemistry-(Part-A & B), Springer; 5th edition
3. R. B. Grossmann, The Art of Writing Reasonable Organic Reaction Mechanisms, Springer;

SR.NO.	LIST OF EXPERIMENTS
1	Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.

2	Organic preparations: Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidine and o-, m-, p-anisidine)
3	Acetylation of Salicylic acid by any one method: a. Using conventional method b. Using green approach
4	Benzolyation of one of the following amines (aniline,β-naphthol, resorcinol, p-cresol) by Schotten-Baumann reaction.
5	Nitration of acetanilide/nitrobenzene by conventional method.
6	Preparation of Warfarin
7	Semicarbazone of any one of the following compounds: acetone, ethyl methyl Ketone, cyclohexanone, benzaldehyde.
8	Nitration of salicylic acid by green approach (using ceric ammonium nitrate.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF206
3. Course Title	Computer Based Numerical Techniques
4. Credits (L:T:P:C)	3:1:2:5
5. Contact Hours (L:T:P)	3:1:2
6. Prerequisites (if any)	None
7. Course Basket	Generic Elective

Course Objective: To enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain experience in the implementation of numerical methods using a computer.

Unit I: Solution of system of linear equations: **[7]**

Direct methods: Matrix inverse method, Gauss elimination, Gauss-Jordan method and LU decomposition method, Iterative methods: Jacobi's method, Gauss-Seidal method

Unit II: Solution of Algebraic and Transcendental equations: **[9]**

Approximation and Errors, Initial approximation of the roots, Bisection method, Method of false position, secant method, iteration method, Newton-Raphson method and its convergence.

Unit III: Finite differences and interpolation: **[12]**

Finite difference operators, their properties and their interrelations, finite difference tables, Newton's forward and Newton's backward interpolation formula, various central difference formulae including Stirling's formula, Bessel's formula. Divided differences: Operators and difference table, Newton's divided difference formula, Lagrange's interpolation formula.

Unit IV: Numerical differentiation and integration: **[12]**

Differentiation using Newton's forward and backward interpolation formula, Newton-Cotes quadrature formula - derivations & comparison of Trapezoidal rule, Simpsons 1/3 and 3/8 rules. Numerical solution of first order differential equations: Euler's method, modified Euler's method, Runge-Kutta second order and fourth order methods.

Text Books:

- B. S. Grewal, **Numerical Methods in Engineering and Science,** (9^{th} Edition), Khanna Publishers, New Delhi, India, 2010.

Reference Books:

- S.S. Sastry, **Introductory Methods of Numerical Analysis,** 4^{th} edition, PHI learning Pvt. Ltd, 2005.
- Curtis F. Gerald and Patrick O. Wheatley**, Applied Numerical Analysis,** 7^{th} Edition, Pearson Education Lt, 2009.
- M.K Jain, S.R.K Iyengar and R.K Jain, **Numerical Methods for Scientific and Engineering computation, 4^{th}**Edition, New age International Publishers, 2003.

List of Practical:

(1) Bisection Method.

(2) Regula Falsi method.

(3) Newton Raphson method.

(4) Gauss Elimination method.

(5) Gauss - Jacobi Method.

(6) Gauss - Seidal Method.

(7) Newton's Forward Interpolation Formula.

(8) Newton's Backward Interpolation Formula.

(9) Trapezoidal rule.

(10) Simpson's $\frac{1}{3}rd$ rule.

(11) Simpson's $\frac{3}{8}rd$ rule.

(12) Euler's method.

(13) Fourth order Runge - Kutta methods.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Language and Literature:

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF181**
3. Course Title	**Professional Communication**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Language and Literature**

1. Course Summary

This course is to enhance the Communication Skills of the students. It also focuses on Basic facets of communication. It introduces the students to LSRW and Non-verbal Language and how to master these aspects to be an effective communicator.

2. Course Objectives

The course aims at developing the LSRW skills of students for effective communication. Also, to equip them for a business environment. It also focusses at preparing the students understand and present themselves effectively.

3. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. Communicate smoothly
2. Greater self-confidence and knowledge of life skills helps them to develop healthier interpersonal relationships.
3. Present themselves effectively
4. Prepares the students to face future challenges and excel in their personal and professional lives.

4. Curriculum Content

Unit 1: Communication

Communication: Meaning, Types of Communication: General & Technical Communication Knowledge and adoption of Non Verbal cues of communication: Kinesics, Proxemics, Chronemics, Oculesics, Haptics, Paralinguistics, Barriers to Communication, Overcoming strategies.

Unit 2: Listening & Speaking Skills

Listening Comprehension: identifying General & Specific information, Note taking and drawing inferences

Introduction to Phonetics: Articulation of consonants and vowel sounds.

Unit 3: Reading Skills & Technical Writing Skills

Reading Strategies and Vocabulary Building Reading Comprehension, Paragraph development, Intra office Correspondence: Notice, Agenda, Minutes and Memorandum Technical Proposal & Report

Unit 4: Communication at Work

Business Letter Writing, Job Application Letter & Resume, Interview Skills, Impression Management, SWOT Analysis (Identifying Strength & Weakness), EQ and Its Dimensions

Textbook(s)

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Raman, Meenakshi and Sangeeta Sharma, Technical Communication: Principles and Practice, 2nd Edition. New Delhi: Oxford University Press. 2011.

Reference Books

8. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
9. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
10. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
11. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications,
12. Hyderabad.2010.
13. Tyagi, Kavita& Padma Misra. Basic Technical Communication, PHI, New Delhi. 2011.
14. Ghosh, B. N. Managing Soft skills for Personality development,Laxmi Publications Ltd., New Delhi, 2013.
15. Elizabeth B. Hurlock. Personality Development , TMH Publication,2010

5. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Assignments, Class Tests etc. will be done. Various teaching methods like Discussion Method, Case Study Method and Lecture Method will be adopted.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF182**
3. Course Title	**Indian English Literature**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Language and Literature**

1. Course Summary

- Indian English Literature is an honest enterprise to demonstrate the ever rare gems of Indian Writing in English. From being a singular and exceptional, rather gradual native flare – up of geniuses, Indian Writing has turned out to be a new form of Indian culture and voice in which India converses regularly. This course will introduce various authors and will help to understand the role of literature in reflecting the social context and the shaping of a young nation.

2. Course Objectives

- The course will enable the students to understand the level of Indian English Literature.
- It will also enable the students to understand different genres such as prose, poetry, and fiction in Indian Writers in English.

3. Course Outcomes

On successful completion of the course, students will be able to achieve the following:
Course Outcome:

- The students will develop an insight into Indian literature.
- The students will learn to appreciate different genres of literature of Indian Literature in English.
- The students will understand the role of literature in reflecting the social context and the shaping of a young nation.
- The students will demonstrate knowledge and comprehension of major texts and traditions of language and literature written in English as well as their social, cultural, theoretical, and historical contexts.

4. Curriculum Content

Unit 1
Prose
APJ Abdul Kalam: Unity of Minds
Swami Vivekananda: The Cosmos-Macrocosm
Mahatma Gandhi: Hind Swaraj, What is Civilization? (Chapter XIII) Education (Chapter XVIII)

Unit II
Poetry

Toru Dutt: Our Casuarina Tree
Rabindranath Tagore: Geetanjali – Where the mind is without fear

Sri Arbindo:	Stone Goddess
Sarojani Naidu:	Life
Nissim Ezekiel:	The Night of Scorpion
Kamla Das:	An Introduction

Unit III
Short Stories

R.N.Tagore:	Kabuliwala
Mulk Raj Anand:	Duty
R.K. Narayan:	An Astrologer's Day
NayantaraSehgal:	Martand

Unit IV
Novel

Ruskin Bond: Flights of Pigeons

Textbook(s).

1. Kumar, Shiv K. (ed),Contemporary Indian Short Stories in English, 2007 SahityaAkademi.
2. Anand, Mulk Raj; SarosCowasjee (ed.);Selected Short StoriesPenguin Books, 2006
3. Bond, Ruskin. Flights of Pigeons, Penguin Books, 2003

Reference Books

1. Tagore, Rabindra. *Nationalism*. Delhi: Rupa Publications, 1992.Print.
2. Chinhade, Sirish. *Five Indian English Poets*. New Delhi: Atlantic Publishers and Distributors, 1996.Print.
3. Naik, M.K. *A History of Indian English Literature*. New Delhi: SahityaAkademi, 2004.Print.
4. Agrawal, K.A. Ed. *Indian Writing In English: A Critical Study*. Atlantic Publishers &Dist, 2003.Print.

5. **Teaching and Learning Strategy**
   All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF183**
3. Course Title	**English Language Teaching (ELT)**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Language and Literature**

8. Course Summary

This course will offer a historical perspective to the teaching of English as a second language. It will trace the changes in language teaching methods throughout history depending on changes in the kind of proficiency learners need. It includes the different approaches used over the years and their application in teaching English as a second language in the classroom. It also traces the status of English language and the 'World English' and how it affects the teaching of English.

9. Course Objectives

To introduce students to the nature of English language learning and its theoretical implications. The main objective of the course is to enable students to evaluate a variety of language learning methods and approaches. It also aims to empower students to understand ELT in their contexts of language learning.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. Students will learn about communicative approaches to English language teaching.
2. Be able to understand the theories and methodologies of ELT
3. Be able to explore core components of communicative language teaching
4. Students will learn to apply ELT theories

11. Curriculum Content

Unit 1
Historical Perspective , ELT and its beginnings: development of reading approach, oral method and audio-lingual method

Unit 2
Communicative Language Teaching (CLT): the concept of 'communicative competence; ESL in India: a historical trajectory

Unit 3
Halliday's notion of 'transitivity' and 'meta-functions'
Corpus Linguistics ELT: corpus studies and how it can be used for language teaching

Unit 4
'World English' and ELT, Model of the 'Concentric Circles' and its impact on ELT

Textbook(s)

1. Maybin, Janet and Swann, Joan. (2009). The Routledge Companion to English Language Studies. London: Routledge, Print

Reference Books

1. Richards, J. & T.S. Rogers. (1986). Approaches and Methods in Language Teaching. Cambridge: Cambridge University Press, Print.
2. Ur, Penny. (1996). A Course in Language Teaching: Practice and Theory. Cambridge: Cambridge University Press, Print.

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF184**
3. Course Title	**Corporate Communication and Soft Skills**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Language and Literature**

COURSE SUMMARY

This course is to enhance the soft skills of the students. It also focuses on business communication. It will help the students to develop professional skills and how to be effective communicator at work place.

COURSE OBJECTIVES

To introduce to students to the business & corporate environment and its expectations. To help students to identify and sharpen their personal and professional skills. To ensure employability of students through a perfect blend of hard & soft skills.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:. Students identify their goals and through enhanced soft skills work towards achieving them.

1. Greater self-confidence and knowledge of life skills helps them to develop healthier interpersonal relationships.
2. Prepares the students to face future challenges and excel in their personal and professional lives.

Curriculum Content

Unit 1

Business Communication **8hrs**

Importance & Features of Business Communication, Flow of Communication: Channels &Networks
Business Presentation
Business Etiquette, Telephonic Etiquette
Interview Skills, Impression Management

Unit 2 **8hrs**

Business Letter Writing
Job Application Letter & Resume
Compunication: E mails & E- Tools

Unit 3

Personal Skills for Corporate Communication **8hrs**

SWOT Analysis: Self-Assessment, Identifying Strength & Weakness
Self-Awareness, Self-Disclosure & Self-Management (Stress, Anger)
Goal Setting: Personal & Professional Goals, SMART-ER Goals
Human Perception: Understanding People, Perceptions, Attitudes
Personality (Personality Test)

Unit 4 **8hrs**

Professional Skills for Corporate Communication

Decision Making: Techniques, Six Thinking Hats
Creative Thinking, Lateral Thinking
Team Building & Leadership Skills
Time Management: Planning Organizing, Time Wasters
Conflict Resolution Skills
Negotiation Skills

Lab 1 Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 2 Telephone Etiquette: Making an appointment, answering calls (Role Play)
Lab 3 Business Presentations (PPT Presentation)
Lab 4 Business Presentations (PPT Presentation)
Lab 5 Interview Skills: Mock Interview
Lab 6 Interview Skills: Mock Interview
Lab 7 Panel Discussion
Lab 8 Panel Discussion
Lab 9 Conflict & Negotiation (Situational Role Play)
Lab 10 Conflict & Negotiation (Situational Role Play)
Lab 11 Evaluation
Lab 12 Evaluation

TEXT BOOKS

1. Rizvi, Ashraf. Effective Technical Communication, McGraw Hill, New Delhi. 2005.
2. Gulati, Sarvesh. Corporate Soft skills, Rupa & Company, 2006

REFERENCE BOOKS

1. Steven R. Covey. The Seven Habits of Highly Effective People, Simon and Schuster, London, 2007.
2. Robbins, Stephen. Management, Pearson Prentice Hall. 2009
3. Carnegie, Dale. How to win Friends and influence People, Simon and Schuster, London, 2009.
4. Dr. Alex. Soft Skills: Know Yourself & Know the World, S. Chand Publications, 2001.
5. Gopalswamy, Ramesh. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson, New Delhi, 2008.
6. Ghosh, B. N. Managing Soft skills for Personality development, Laxmi Publications Ltd., New Delhi, 2013.
7. Elizabeth B. Hurlock. Personality Development, TMH Publication, 2010.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Humanities and Liberal Arts (Minimum 6 credits to be taken)

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF281**
3. Course Title	**Introduction to Psychology**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Humanities & Liberal Arts**

COURSE SUMMARY

This course will highlight the most interesting scientific findings and insights of psychology, discussing the implications of those for our understanding of the human mind and human behaviour. We will explore some of the cognitive abilities including memory, learning, attention, perception and consciousness. We will examine the trajectory of growth of psychological perspectives. By the end of this course you will have gained a fascinating understanding and appreciation of who you are and how you work and relate with others. And I can guarantee you that you'll learn things that you'll be telling your friends and family about, things that will fundamentally change the way you think of yourself and others.

COURSE OBJECTIVES

The purpose of this course provides coverage for the broad range of COURSE OUTCOMEs that may be taught in introductory psychology courses. With the goal of supporting faculty in the selection of content for their courses, we have organized this course around the 5 pillars, or domains, of psychology as recently recommended by the American Psychological Association: biological pillar, cognitive pillar, developmental pillar, and social and personality pillar, mental and physical health pillar.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Identify the various approaches, fields, and subfields of psychology along with their major concepts and important figures
2. Describe the strengths and weaknesses of descriptive, experimental, and correlational research
3. Explain how nature, nurture, and epigenetics influence personality and behaviour
4. Explain the physical, cognitive, and emotional development that occurs from infancy through childhood
5. Recognize aspects of social psychology, including the fundamental attribution error, biases, social roles, and social norms, in your daily life.

CURRICULUM CONTENT

Unit 1 Introduction

Definition, Scope, Perspectives: biological, psychoanalytic, behavioural, cognitive, humanistic, Methods: experiment, case study

Unit 2 Cognitive Processes

Perception: Meaning, laws of perceptual organization, identifying perceptual errors; Techniques for improving our behaviors: Classical conditioning, Reinforcement theory & Modeling; Creative Thinking & Problem-Solving

Unit 3 Motivation and Emotion

Motivation: definition, self-motivation through goal setting, self-regulation, motivating employees, improving confidence; Emotion: definition, types, emotion and health, assessing emotional intelligence, body language

Unit-4 Human abilities

Self & Personality: definition, approaches for assessment, exploration through JOHARI Window; Understanding intelligence; Stress: meaning & coping; Conflict: definition & resolution;

TEXT BOOKS

1. Baron, R.A. and Misra, G., Psychology (Indian Subcontinent Edition). Person Education Ltd. (2014)
2. Chadha, N.K. & Seth, S., The Psychological Realm: An Introduction. Pinnacle Learning, New Delhi. (2014)

REFERENCE BOOKS

1. Ciccarelli, S.K. & Meyer, G.E., Psychology (South Asian Edition). New Delhi: Tata Mc Graw Hill. (2008).
2. Glassman, W.F., Approaches to Psychology (3rd Ed.) Buckingham: Open University Press. (2000).
3. Passer, M.W., Smith, R.E., Holt, N. and Bremmer, A., Psychology: The Science of Mind and Behaviour, McGraw-Hill Education, UK. (2008).

Teaching and Learning Strategy

All materials (PPTs, Assignments, Seminars, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF282**
3	**Course Title**	**Human Values**
4	**Credits (L:T:P:C)**	**3:0:0:3**
5	**Contact Hours (L:T:P)**	**3:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

COURSE SUMMARY

This course will introduce students to the nature of the individual and the relationship between the self and the community. It includes Principles of Interdependence between individuals and society and role of material values in promoting human well-being. It also includes psychological and spiritual values through topics like Humanistic Psychology, religion, concept of Dharma and Spirituality morality, Professional values and developing an open and balanced mind.

COURSE OBJECTIVES

To inculcate the skills of ethical decision making and then to apply these skills to the real and current challenges of the Engineering profession. The main objective of the course is to enable the students to understand the need and importance of value-education and education for Human Rights. It also aims to develop their inter personal and leadership skills and empower them to develop into evolved human beings.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Students will become more sensitive to their surroundings including both people and nature, with commitment towards what they believe in (human values).
2. Be able to understand how universal values can be uncovered by different means, including scientific investigation, historical research, or public debate and deliberation (what some philosophers call a dialectic method).
3. They will become more aware of their self and their relationships and have better reflective and discerning ability.
4. Be able to understand and discuss the idea of moral relativism and the challenges it poses to universal values.

CURRICULUM CONTENT

Unit 1 INTRODUCTION

Nature of Value-Crisis in the contemporary Indian society, Meaning, Nature & Types of Values; Sources of Value Formation, Foundational Human Values – Integrity, Freedom, Creativity, Morals, Love and Wisdom, Case Studies Case Studies on the above aspects

Unit 2 SOCIETAL VALUES & MATERIAL VALUES

Definition of Society, Units of Society, and Social Consciousness. Concepts & Principles of Interdependence, Conceptualizing 'Good Society' and 'Social Goods' and Corporate Social Responsibility, Role of Material Values in promoting Human Well-being. Role of Science and Technology; Problems of Material Development, Case Studies Case Studies on the above aspects

Unit 3 PSYCHOLOGICAL & SPIRITUAL VALUES

Humanistic Psychology; Concept of Intelligence, Emotional Intelligence & Mental health; Cognitive Dissonance & Ego Defense, Maslow's Hierarchy of Human Need; Characteristics of 'Self-Actualizing' persons; Understanding Common Religion & Concept of Dharma and Spirituality; Case Studies Case Studies on the above aspects

Unit 4 PSYCHOLOGICAL & SPIRITUAL VALUES

Bases for moral Judgments: Customary Morality, Religious Morality, Reflective Morality. Concept of Professional values: Competence , Confidence , Devotion to Duty, Efficiency , Accountability , Respect for learning / Learned , Willingness to Learn, Open and Balanced mind; Team spirit ; Willingness for Discussion, Aims, Effort , Avoidance of Procrastination and Slothfulness, Alertness, IEEE; Case Studies Case Studies on the above aspects

Textbook(s)

1. Human Values - Prof. A.N. Tripathi New Age International, 2009

Reference Books

1. Human Values and Professional Ethics - Jayshree, Suresh and B.S. Raghwan , S. Chand Publication, 2011-12

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF283**
3	**Course Title**	**Literature, Language & Society**
4	**Credits (L:T:P:C)**	**3:0:0:3**
5	**Contact Hours (L:T:P)**	**3:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

COURSE SUMMARY

This course will introduce students about the literature, language & society. It also includes the overview of aspects of literature and language with its impact on the society. The course explores the dimensions of literature, its nature and its functions with its approaches to the study of society. It explores the role of language and literature in the society. The course will through study of text, also analyse the practical aspect of it.

COURSE OBJECTIVES

The main objective of the course is to focus is on the interaction between literature & Society, and Literature and visual culture. This course is also about how Literature reacts to major changes in society. This course offers the students to experience different dimension of literature and language.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Students will read critically from a variety of genres, specifically poetry, drama, non-fiction, and fiction.
2. Students will read literature more carefully and meaningfully, practicing close-reading skills.
3. Students will understand the relation between historical and cultural contexts.
4. The students will develop a critical understanding of how literature can both uphold and resist existing structures of power.

CURRICULUM CONTENT

Unit 1:

Nature and Functions of Literature, Literature and Society with special reference to Indian Literature and Indian Society, Literary Forms, Poetry, Drama, Fiction, Essay, Autobiography

Unit 2:

Approaches to the Study of Literature, Reader response to the study of Literature, Interpretation, Appreciation, Evaluation, Special problems in understanding Modern Literature.

Unit 3:

Social dimension of language. problems of multilingual communities, dominance and conflict, shift and attrition, language and the state, language and nation, Indian multilingualism, language variation, language and identity, linguistic prejudice and inequality, standardization, linguistic determinism, critical discourse analysis, and methodological issues.

Unit 4:

Jerome K Jerome: Three Men on a Bummel (selection), Martin Amis: Last Days of Muhammad Atta, Li Ho: A Girl Comb her hair, R.K. Narayan: Malgudi Days (selection)

Textbook(s)

1. Jerome K Jerome: Three Men on a Bummel (selection), Arrow smith Publications.

2. R.K. Narayan: Malgudi Days (selection), I*ndian Thought Publications.*

Reference Books

1. Martin Montgomery, An Introduction to Language and Society (Studies in Culture and Communication) Routledge; 2 edition (December 22, 1995).
2. Robe Pope, *An Introduction to Language Literature and Culture*. Routledge, 2005.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF284**
3	**Course Title**	**Principles of Management**
4	**Credits (L:T:P:C)**	**3:0:0:3**
5	**Contact Hours (L:T:P)**	**3:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

COURSE SUMMARY

This course will introduce students about the basic Principles needed for management. It also includes case studies where a student can get idea about the actual working of the management field. Topics include Overview of Management, Management Information, and Planning Approach to Organizational Analysis, Motivation and Productivity.

COURSE OBJECTIVES

The objective of this course is to familiarize B.Tech. Students with the roles, responsibilities, and skills required of modern managers. This course will be present the concepts of management as it applies to current thinking in the workplace.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. To present the topics in management, management theories, while at the same time focusing on practical applications in the real world especially for engineers.
2. Evaluate the global context for taking managerial actions of planning, organizing and controlling.
3. Assess global situation, including opportunities and threats that will impact management of an organization.
4. Integrate management principles into management practices.

Curriculum Content

Unit 1 Overview of management

Definition-Management-Role of managers-Organization and the internal and environmental factors –Trends and Challenges of Management in India.
Directing – delegation –span of control– communication, Controlling

Unit 2 Management Information

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management

Unit 3 Planning Approach to Organizational Analysis

Design of organization structure; job design and enrichment; job evaluation and merit rating

Unit 4 Motivation and Productivity

Theories of motivation, Leadership styles and Managerial grid. Co-ordination, monitoring and control in organizations. Techniques of control; Few Cases on current management issues in India

TEXT BOOKS:

1. Schermerhorn, Management and Organisational Behaviour essentials, Wiley India
2. Koontz: Essentials of Management, PHI Learning.
3. Hirschey: Managerial Economics, Cengage Learning.
4. A V Rau: Management Science, BSP, Hyderabad
5. Mote, l Paul and Gupta: Managerial Economics Concepts & Cases, TMH, New Delhi.

6. Stephan R Robbins Fundamental of Management, Pearson

REFERENCE BOOKS

1. Koontz, H., and Weihrich, H., Essentials of Management: An International Perspective, 8th ed., McGraw Hill, 2009.
2. Hicks, Management: Concepts and Applications, Cengage Learning, 2007.
3. Mahadevan, B., Operations Management, Theory and Practice, Pearson Education Asia, 2009
4. Kotler, P., Keller, K.L, Koshy, A., and Jha, M., Marketing Management, 13th ed., 2009.
5. Khan, M.Y., and Jain, P.K., Financial Management, Tata-Mcgraw Hill, 2008.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF286**
3. Course Title	**Youth Psychology**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Humanities & Liberal Arts**

8. Course Summary

This course will introduce students about the youth, identity and development related issues. The course explores the risk factors of a youth such as education. It explores the development of youth in the society. The course will through study of text, also analyse the practical aspect of it.

9. Course Objectives

To help students understand the notion of youth, youth across cultures, the factors influencing youth identity and sensitivity to issues concerning the youth of today.

10 Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. Students will get to know about concepts of youth, youth identity.
2. Students will learn about the process of youth development and relationship.
3. Students will learn to how a youth could develop on his own.
4. Students will learn about relevance of positive virtues during young age.

8. Curriculum Content

Unit 1: Introduction

Defining youth; Youth across cultures**;** Formulation of youth identity**;** Concerns of youth in Indian context.

Unit 2: Youth development and Relationships

Relationship with family members and friends**;** Romantic relationships**;** Youth culture: Influence of globalization, identity crisis

Unit 3: Today's Youth: Issues and challenges

Youth and risk behaviours; Employment and education

Unit 4: Developing Youth

Positive youth development**;** Building resources: Hope, Optimism and Resilience

Textbook(s)

1. Robbins, S. P. & Judge, T.A. (2008).Essentials of Organizational Behavior.9th Edition. New Delhi: Prentice Hall of India.
2. Adler, N.J. (1997). Global leaders: Women of influence. In G. N. Powell (Ed.), Handbook of Gender and Work, (239-261). Thousand Oaks, CA, US: Sage Publications, Inc.

Reference Books

1. Adler, N.J. (1997). Global Leaders: A Dialogue with future history. Journal of International Management, 2, 21-33.
2. Chadha, N.K. (2007). Organizational Behavior (1st Edition). Galgotia Publishers: New Delhi.
3. Greenberg, J. & Baron, R.A. (2007). Behaviour in Organizations (9th Ed.). India: Dorling

Kindersley
4. Griffin, R.W. & Moorhead, G. (2009). Organizational Behavior: Managing People & Organizations (11th Edition). Biztantra publishers

1 Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on the online platform. Refer to your course for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF287**
3. Course Title	**Sustainable Development**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Humanities & Liberal Arts**

8. Course Summary

This course will introduce students about the basic Principles needed for management. It also includes case studies where a student can get idea about the actual working of the management field. Topics include Overview of Management, Management Information, and Planning Approach to Organizational Analysis, Motivation and Productivity.

9. Course Objectives

To provide the overview of sustainable and its needs to the students.
To provide the importance and components of sustainable development to the students.
To provide the association of social and economic development to the students

10. Course Outcomes

Students will get the importance of natural resource in economic development.
Students also would be able to sophisticated concept of sustainable development.
Students would be able to contribute significant efforts towards sustainable development.

11. Curriculum Content

Unit 1: Overview of Sustainable Development

History and emergence of the concept of Sustainable Development, Components of SD i.e., Economic, Social, Human, Institutional, Technological and Environmental development; Definitions, Sustainability in Ecosystem Services; natural resource degradation, greenhouse gases, factors affecting SD (i.e., Industrialization, urbanization, population growth, globalization, etc.).

Unit 2: Polices on Sustainable Development at international level

Government Policies for SD in India; Socio-economic policies for sustainable development in India, Sustainable development through trade, Carrying Capacity, global policies for sustainable development.

Unit 3: Sustainable Development and International Contribution

SDGs and MDGs, Complexity of growth and equity, International Summits, Conventions, Agreements, Initiations of international organizations like WHO, UNDP, WTO, FAO and World Bank towards sustainable development.

Unit 4: Measurement of Sustainable Development

Role of developed and developing countries in the sustainable development, Demographic dynamics and sustainability, integrated approach for resource protection and management; Index based estimation of SD i.e., Environmentally Sustainable Development Index and sustainable development, and another index.

TEXT BOOKS:

1. The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.

REFERENCE BOOKS

1. The Sustainability Revolution: Portrait of a Paradigm Shift by Edwards, Andres R., New Society Publishers, 2005.
2. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.

12. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online portal.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF381**
3	**Course Title**	**Positive Psychology and Living**
4	**Credits (L:T:P:C)**	**3:0:0:3**
5	**Contact Hours (L:T:P)**	**3:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

COURSE SUMMARY

This course provides an introduction to the science related to happiness, well-being, flourishing and the positive aspects of human experience. This course discusses research findings in the field of positive psychology. It also features practical applications of this science that you can put to use immediately to help you live a full and meaningful life.

COURSE OBJECTIVES

The purpose of this course is to provide increase awareness for relevance of positive emotions at workplace. Students will gain psychological skills to maximize happiness and virtues like compassion, love and wisdom through experiential, workshop based and interactive activities along with assigned lectures and reading. Students will have an opportunity to explore the concepts (e.g., biological, psychological, social, emotional), the research behind the concepts, and evidence-based experiential activities that enhance well-being. Students will engage in a detailed analysis and evidence-based positivity change process utilizing validated questionnaires and positive psychology and well-being enhancing interventions.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Students learn about modern psychological knowledge of happiness.
2. Students acquire skills to cultivate positive emotions.
3. Measure and build individual, workplace and educational flourishing; plan, implement and assess positive psychology.
4. Students will gain an understanding of what contributes to well-being and how to build the enabling conditions of a life worth living.

CURRICULUM CONTENT

Unit 1: What is positive psychology?

Introducing Positive Psychology: Definition, goals, assumptions, key concepts and relationships with health psychology, developmental psychology, social psychology and psychology of religion, Meaning and measure of Happiness: Hedonic and Eudemonic perspective, Yogic notion of bliss

Unit 2: Positive Emotions, Cognitive states and Well-being

What are positive emotions? The broaden and build theory, relevance of positive emotional states for physical, social & psychological resources, Positive emotions and well-being: Happiness and positive behavior, positive emotions and success, resilience, Self-efficacy, Optimism, Hope, Wisdom, Mindfulness and flourishing

Unit 3: How to enhance well-being?

Use of postures, breathing practices, Sounds, dietary consumption

Unit 4: Positive Psychology at work place

Maximizing achievement, conflict resolution, gratitude, positive leadership

Textbook(s)

Snyder (2011). Positive Psychology: The Scientific and Practical Explorations of Human Strengths. New Delhi: Sage.

Reference Books

1. Carr, A. (2004). Positive Psychology: The science of happiness and human strength.UK: Routledge.
2. Peterson, C. (2006). A Primer in Positive Psychology. New York: Oxford University Press.
3. Seligman, M.E.P. (2002). Authentic Happiness: Using the New Positive Psychology to Realize YourPotential for Lasting Fulfillment. New York: Free Press/Simon and Schuster.
4. Snyder, C.R., & Lopez,S.J.(2007). Positive psychology: The scientific and practical explorations of human strengths. Thousand Oaks, CA: Sage.
5. Snyder, C. R., & Lopez, S. (Eds.). (2002). Handbook of positive psychology. New York: Oxford University Press.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF382**
3	**Course Title**	**Engineering Economics**
4	**Credits (L:T:P:C)**	**3:0:0:3**
5	**Contact Hours (L:T:P)**	**3:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

COURSE SUMMARY

The course is devoted to teach basic concept of economics to the student of engineering. This includes basic concept of demand and supply of goods and services. Break-even point and evaluation is also included in this subject. Project evaluation and depreciation of physical assets are also key contribution in this subject. Finally, few concepts of banking system, inflation and business cycle are also the vital topics in this subject.

COURSE OBJECTIVES

To provide the basic overview of economics in engineering perspectives.
To increase the understanding of students to solve the engineering problems through economic theories.
To increase the understanding of students to use economics theories in project investment of industries

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Students will be able to apply economic principles and calculations to solve engineering projects.
2. To students will be efficient to get the idea of production activities and its applications in industries.
3. Students will be competent to estimate the present and future value of money on their various investment plans.
4. Develop the ability to account for time value of money using engineering economy factors and formulas, as well as the implications and importance of considering taxes, depreciation, and inflation.

CURRICULUM CONTENT

Unit 1 General Overview of Economics

Nature and Scope of Economics in engineering perspective; **Theory of Demand Analysis:** Meaning and Types, Law of demand, Exceptions to the Law of Demand, Elasticity of Demand; **Theory of Supply Analysis:** Law of Supply and Elasticity of Supply; Mathematical Explanation on cost, revenue and profit function

Unit 2 Production Function and Its Applications

Production Function: Short-run and long-run Production Function; **Mathematical Explanation:** Laws of Returns to Scale & Law of Diminishing Returns Scale; **Concept of Cost and Its Types:** Total cost, fixed cost, variable cost, average variable cost, average fixed cost, marginal cost, explicit and implicit cost; **Break-Even-Analysis:** Importance and graphical presentation, mathematical problems

Unit 3 Time Value of Money and Project Evaluation

Time Value of Money: Simple and Compound, Uniform Series Compound Interest Formula, Present Worth Analysis, Future Worth Analysis, Future Value through Annuity, Rate of Return Analysis, Cash flow diagrams; **Depreciation**: Introduction, Straight Line and Declining Balance Method of Depreciation; **Project Evaluation Techniques:** Present Worth Method, Future Worth Method, Annual Worth Method; Benefit Cost Analysis: Conventional and Modified B/C Ratio with PW method

Unit 4 Banking and Finance

Banking Sector: Functions of the Commercial Bank and Central Bank, Financial Institutions; **Financial Market:** Money Market and Capital Market; **Monetary and Fiscal Policy:** Objectives, Instruments, Tools in Indian Economy; **Inflation:**Causes, Effects and Methods to Control it, Measurement of Inflation- Consumer Price Index and Whole Price Index; Deflation and Stagflation; **Business Cycles:** Various phases, Control and Measurement, Impact on business cycles on economic activities

TEXT BOOKS TEXT BOOKS

1. Pravin Kumar (2015). Fundamental of Engineering Economics. Raj Kamal Press, New Delhi.

2. Riggs J.L., Dedworth, Bedworth D.B., and Randhawa, S.U. (1996). Engineering Economics. McGraw Hill International, New Delhi

3. Panneer Selvam R. (2001). Engineering Economics. Prentice Hall of India Ltd, New Delhi.

REFERENCE BOOK

1. L.M. Bhole (2007). Financial Institutions and Markets. Tata McGraw Hill, New Delhi.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF383**
3. Course Title	**Introduction to Linguistics**
4. Credits (L:T:P:C)	**2:0:2:3**
5. Contact Hours (L:T:P)	**2:0:2**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Humanities & Liberal Arts**

COURSE SUMMARY

The student will be able to comprehend foundational linguistic concepts and their relation with the human mind. They will understand how research in linguistics can be used to address real world problems.

COURSE OBJECTIVES

To introduce the basic concepts in areas of linguistics, syntax, morphology, phonetics, and phonology and the interaction between them.
To provide an understanding of the main communicative functions of language, and the formal ways to achieve them.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. The student will be able to apply the basic concepts of linguistics, syntax, morphology, phonetics, and phonology
2. The student will be able to appreciate the use of basic concept of linguistics.

CURRICULUM CONTENT

Unit 1: (10)

Linguistics and its Scope, Branches of Linguistics, Some basic concepts in Linguistics, Language and Communication

UNIT 2 (16)

Language Structure Sassure's concept of Linguistic sign, Langue and Parole; Syntagmatic and Paradigmatic relations, Synchronic and Diachronic studies; Chomsky – Competence and Performance; Language Variation and Language Change

UNIT 3 (15)

Phonetics and Phonology; Phoneme, Allophone, Human Speech Mechanism,
Vowels and Consonants in English Syllable structure, Phonemic Transcription, Supra-segmental features, Neutralization of MTI

UNIT 4 (11)

Morphology and Syntax; Morpheme, Word Formation Processes in English, Roots, prefix & suffix

Text book [TB]:

1. Halliday, Michael A.K.; Jonathan Webster (2006). On Language and Linguistics. Continuum International Publishing Group. p. vii. ISBN 978-0-8264-8824-4.
2. Rens Bod (2014). A New History of the Humanities: The Search for Principles and Patterns from Antiquity to the Present. Oxford University Press. ISBN 978-0-19-966521.

Reference books [RB]:

1. Delany, Sheila. The Naked Text: Chaucer's Legend of Good Women. Berkeley: University of California Press, 1994.

2. Mc Alpine, Monica. The Genre of Troilus and Criseyde. Ithaca: Cornell University Press, 1978.
3. Brooks, Cleanth. The Language of Paradox: 'The Canonization' John Donne: A Collection of Critical Essays. Ed. Helen Gardner. Englewood Cliffs, N. J.: Prentice Hall, 1962.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Humanities & Liberal Arts**
2	**Course Code**	**LAF385**
3	**Course Title**	**Health Psychology**
4	**Credits (L:T:P:C)**	**3:1:0:4**
5	**Contact Hours (L:T:P)**	**3:1:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Humanities & Liberal Arts**

8.Course Summary

The present investigates the relationship of social, biological, behavioral and cognition variables to health. It includes those dimensions of the social that influence health and illness result including interactions among family members and healthcare consumers and providers.

9.Course Objective

1. Demonstrate understanding of the biological, behavioral, cognitive and social determinants of health, and risk factors for health- compromising behaviours and strategies for their modification, across the lifespan.

2. Demonstrate advanced knowledge of individual, group and community-based approaches to the prevention and management of major identifiable health conditions (both acute and chronic).

3. Demonstrate the capacity to critically evaluate research in health psychology and use this knowledge to explain mind-body interaction to health-care consumers and professionals.
4. Apply the knowledge of health psychology in different domains of life

10. Curriculum Content

Unit-I: Introduction
Health Psychology: Concept, Assumptions, Models (Biomedical and Biopsychosocial)

Unit -II: Stress and Coping
Nature and sources of stress; Effects of stress on physical and mental health; Coping and stress management

Unit-III Health Promotion and Illness Prevention: Health and Behavior; Changing health habits; Cognitive behavioral approaches to health behavior change.

UNIT IV: Human strengths and life enhancement
Classification of human strengths and virtues; cultivating inner strengths: Hope and optimism; gainful Employment and Me/We Balance, Well-being and enhancement

Textbook(s)

Ogden, J. (2012). Health Psychology. McCrawhill Foundation

Taylor, S.E., (2009). Health Psychology (9th Ed). New Delhi: Tata McGraw-Hill Publishing Company Ltd.

Reference Books

Ayers, S., Baum, A., McManus, C., Newman, S., Wallston, K., Weinman, J., &West,R. (2007). Cambridg

Brannon, L., McNeese, J. F., & Updegraff, J. A. (2014).Health Psychology an introduction to behavior and health (8th Ed). Delhi: Cengage Learning

Straub, R.O. (2014). Health Psychology a Bio Psychosocial Approach (4th Ed). Worth Publishers A Macmillan Higher Education Company

Teaching and Learning Strategy
All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF386**
3. Course Title	**Ecology and Human Development**
4. Credits (L:T:P:C)	**3:0:0:3**
5. Contact Hours (L:T:P)	**3:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Humanities & Liberal Arts**

8. Course Summary

This course introduces students to environment concerns. Students are expected to learn about environment, factors affecting it, environmental ethics and its protection through lectures, presentations, documentaries and field visits.

9. Course Objectives

To increase the understanding of students on ecological and its role in human livelihoods.
To demonstrate understanding of some issue of ecological development.
To provide basic information related to human utilization of resources and how human activities impact the environment.

10. Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. Students will be able to identify key issues and concepts relevant to the understanding of how human behaviour develops over the life cycle and be able to explain them to a layperson.

2. Students will be able to generate a hypothesis using a conceptual model relevant to a developmental question and identify an appropriate test of that hypothesis.

3. Students will be able to see how research findings can be applied in real-life settings.

11. Curriculum Content

Unit 1: Major Components of Ecological System; Various Ecosystem Services; Measurement of Nature; Methods to Measure the Ecosystem Services; Ecosystem Services in Developed and Developing Economies.

Unit 2: Rural Development and Ecosystem Services, Regional Diversity in Ecosystem Services, Economic Valuation of Various Ecosystem Services; Ecosystem Services of Rivers, Forestry, Soil, Air, Plants.

Unit 3: Management Policies of Ecosystem Services; Sustainability of Ecosystem Services; Inter-linkages between Economic Development and Ecosystem Services; Human Well-being and Ecosystem Services; Sustainability in Ecosystem Services.

Unit 4: Government Policies and Ecosystem Services in India; Different Mathematical and Econometric Models for Ecosystem Services; Simulation Techniques for Ecosystem Services.

12. TEXT BOOKS

1. Millennium Ecosystem Assessment (MEA) (2005). Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.
2. Verma M. and Kumar CVRSV (2006). Natural Resource Accounting of Land and Forestry Sector (Excluding Mining) for the States of Madhya Pradesh and Himachal Pradesh. Indian Institute of Forest Management Bhopal, Bhopal (M.P.)

13. REFERENCE BOOKS

3. (2013). Human Activity and the Environment: Measuring Ecosystem goods and Services in Canada.

4. Negi G.C.S. and Dhyani PP. (2012). Glimpses of Forestry Research in the Indian Himalayan Region: Special Issue on International Year of Forests-2011. ENVIS Centre on Himalayan Ecology, G.B. Pant Institute of Himalayan Environment & Development, Kosi-Katarmal, Almora- 263643, India.

5. (2004) Valuing Ecosystem Services: Towards Better Environmental Decision-Making. National Research Council of the National Academies Press, Washington, D.C.

14. Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded on online platform.

Skill Enhancement Courses (Minimum 18 credits to be taken):

a.	Department offering the course	Mathematics
b.	Course Code	MAF109
c.	Course Title	Introduction to C Programming & MS Office
d.	Credits (L:T:P:C)	2:0:2:3
e.	Contact Hours (L:T:P)	2:0:2
f.	Prerequisites (if any)	None
g.	Course Basket	Skill Enhancement

Course Outline:
This course includes basic topics of C programing and MS word, excel and power point.

Objectives:
To introduce basic knowledge about C programing, to introduce basic and intermediate knowledge about MS Office which includes word, excel and power point.

Course Pre/Co- requisite (if any) : no restricted pre-requisite.

Unit I

Overview of C, Constant, variables, data, types and size, variable declaration, operators and expressions,
type conversion, conditional expression, special operators, precedence rules. Decision making, looping and control structures. Data input/output. Input/output: Unformatted & formatted I/O function in C, Input
functions viz. scanf(), getch(), getche(), getchar(), gets(), output functions viz. printf(),putch(), putchar(),puts().

Unit II

Arrays and String: defining and processing an array, one dimensional arrays, multidimensional arrays, passing arrays to functions, Handling of character strings. Pointers: Declaration, operations on pointers, array of pointers, pointers to arrays. Structure and Unions: Defining and processing a structure, user defined data types, structure and Pointers, nested structure, self-referential structures, and unions.

Unit III

Installation of MS Office, Introduction of **MS Word**, Creating a New Document, Formatting Text, Bulleted Lists, Line and Paragraph Spacing, Modifying Page Layout, Working with Headers and Footers, Tables, Hyperlinks and Printing.

Introduction of **Power point**, Presentation Basics, Themes and Background Styles, Animating Text and Objects, Using Transitions, Slide Show Options, Inserting Pictures, Clip Art and video.

Unit IV

Introduction of **MS Excel**, Starting a Workbook, working with Columns, Rows & Cells, Working with Functions, Formatting Tables, Aligning Text, Freezing Worksheet Panes, Working with Graphs and Charts, Working with Data analysis using Data analysis tool pak.

Learning Outcome: Students will be able to

1. Use C programing to write a program
2. Use MS word for report writing.

3. Use MS excel for data analysis and representation of data in tabular form.
4. Use powerpoint for presenting in a nice way.

Text Books:

1. E Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill, 4th Edition, 2008.
2. Jeri R. Hanly& Elliot P, Problem Solving and Program Design in C, , Pearson, 7thEdition, 2013.
3. Joan Lambert and Curtis Frye, "Microsoft Office 2016 Step by Step". 1st edition. Microsoft Press 2015.

Reference Books:

1. Dennis Ritchie,**The C programming Language.**, Pearson, 6th Edition, 2015.
2. Melton Beth, Mark Dodge, Echo Swinford and Andrew Couch. "Microsoft Office Professional 2013 Step by Step": Micr Offi Prof 2013 Step _p1. Pearson Education, 2013.

List of practicals:

1. Program to find area and circumference of circle.
2. Program to find the simple interest.
3. Program to convert temperature from degree centigrade to Fahrenheit.
4. Program to calculate sum of 5 subjects & find percentage.
5. Program to find whether given no is even or odd.
6. Program to find whether given no is a prime no or not.
7. Program to display sum of series 1+1/2+1/3+…….+1/n.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF119
3. Course Title	Introduction to MATLAB
4. Credits (L:T:P:C)	2:0:2:3
5. Contact Hours (L:T:P)	2:0:2
6. Prerequisites (if any)	None
7. Course Basket	Skill Enhancement

Course Summary:

Course Objective:

The objective of this course is to introduce the students with basics of MATLAB, curve plotting and use of basic commands to solve various algebraic and differential equations through MATLAB.

Course Outcomes:

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

- Understand the basics functions of MATLAB.
- Plot the 2D, 3D figures.
- Use basic commands of MATLAB.
- Solve various differential equations using MATLAB.

Curriculum Content:

Unit I

Introduction to MATLAB: vector and matrix generation, subscripting and the colon notation, matrix and array operations and their manipulations, introduction to some inbuilt functions related to array operations. m-files: scripts and functions, editing, saving m-files, and interaction between them.

Unit II

Two & three-dimensional graphics: basic plots, change in axes and annotation in a figure, multiple plots in a figure, saving and printing figures, mesh plots, surface plots and their variants.

Unit III

Relational and logical operators: flow control using various statements and loops including If-End statement, If-Else-End statement, nested If-Else-End statement, For-End and While-End loops with Break commands.

Unit IV

Introduction to builtin functions: related to matrix inversion, eigenvalues, eigenvectors, condition number; for data representation: bar charts, histograms, pie chart, stem plots etc; for solving various type of differential equations; for specialized plotting e.g., contour plots, sphere, and animations.

Text Books

1. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers by Rudra Pratap, Oxford University Press.

Reference Books

1. Applied Numerical Methods with Matlab for Engineers and Scientists by Steven Chapra, McGraw Hill.

2. MATLAB: An introduction with applications: Amos Gilat, 5th Edition, Wiley India.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF246
3. Course Title	Introduction to Mathematica
4. Credits (L:T:P:C)	0:0:4:2
5. Contact Hours (L:T:P)	0:0:4
6. Prerequisites (if any)	None
7. Course Basket	Skill Enhancement

Course Summary:
The course starts with the basics of mathematical operations through Mathematica and covers the solution of algebraic equations and differential equations and their curve plotting.

Course Objectives: The objective of this course is to calculate basic mathematical operations, curve plotting, contour plot, calculate maxima and minima, solution of algebraic equations and solution of differential equations through Mathematica.

Course Outcomes

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

1. Translate mathematical methods with help of Mathematica.
2. Understand the concepts of applied mathematics by hands on.
3. Use Mathematica software to solve mathematical problems.

Course Pre/Co- requisite (if any) : no restricted pre-requisite.

Contents to be covered

1. Brief Introduction of Mathematica and Key features.
2. Introduction mathematical tools and drawing.
3. Program for Arithmetic operations on functions and equations, Factorizing and Expanding Expressions, Substituting Values, Solving Equations.
4. Writing program for Matrix operations, and Trigonometric functions.
5. Calculate the maxima and minima of one variable.
6. Writing program for Plotting and Graphics.
7. saving and printing figures and multiple plots in a figure.
8. Solution of algebraic and differential equations and their solution curves.
9. Surface plot and contour plot.
10. Writing research article on Mathematica and its conversion into LaTeX.

Text Books:

1. Cliff Hastings, Kelvin Mischo, Michael Morrison, "Hands-on Start to Wolfram Mathematica and Programming with the Wolfram Language", 2nd Ed. , Wolfram Media, Inc., 2016.
2. Stephen Wolfram, "An elementary introduction to Wolfram Language", 2nd Ed. , Amazon, 2017.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF248
3. Course Title	Introduction to Python
4. Credits (L:T:P:C)	3:1:0:4
5. Contact Hours (L:T:P)	3:1:0
6. Prerequisites (if any)	None
7. Course Basket	Skill Enhancement

Course Summary:

Python is a language with a simple syntax, and a powerful set of libraries. It is easy for beginners to learn, it is widely used in many scientific areas for data exploration. This course is an introduction to the Python programming language for students without prior programming experience. We cover data types, control flow. The examples and problems used in this course are drawn from various topics of mathematics.

Course Objectives: The objectives of this course are:

- to provide skills for writing PYTHON programs.
- to create simple programming scripts and functions.
- to solve basic and advanced numerical and symbolic mathematics problems.
- to visualize and present data.

Course Pre/Co- requisite (if any) : no restricted pre-requisite.

Course Outcomes

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

1. Translate mathematical methods to PYTHON code.
2. Break a complex task up into smaller, simpler tasks.
3. Use python software to solve mathematical problems.

Curriculum Content:

1. Brief Introduction, Installation of PYTHON, Use of PYTHON, Key features.
2. Introduction to PYTHON Software and different editors.
3. Data files and Data types: Character and string, Arrays and vectors, Column vectors, Row vectors.
4. Program for Arithmetic operations on functions and equations, Factorizing and Expanding Expressions, Substituting Values, Solving Equations.
5. Writing program for Matrix operations, and Trigonometric functions.
6. Writing program for Plotting and Graphics.
7. Writing programs to solve mathematical problems by user defined functions.
8. Programs for Symbolic Math.
9. Introduction to Scientific Python and Numpy.

Text Books:

1. Amit Saha. Doing Math with Python. William Pollock (2015).
2. Tim Hall and J-P Stacey. Python 3 for Absolute Beginners. (2009).

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF249
3. Course Title	Fundamentals of Advanced Mathematics-I
4. Credits (L:T:P:C)	3:0:0:3
5. Contact Hours (L:T:P)	3:0:0
6. Prerequisites (if any)	None
7. Course Basket	Skill Enhancement

Course Summary:
The course covers the fundamentals of calculus and vector calculus.

Course Objective:
The course is designed to enrich the students with advance concepts of applied mathematics which will help them in higher education in Mathematics.

Course Outcomes:
After successful completion of this course students are able to:

- Understand the concepts of function of one and more variables their limit, continuity and differentiability.
- Learn advance concepts of integral calculus.
- Simplify the complex problems of vector calculus.
- Determine the solution of differential equations.

Curriculum Content:

Unit I: Differential Calculus [10]
Function of one variable: Limit, continuity, intermediate value property, differentiation, Rolle's Theorem, mean value theorem, L'Hospital rule, Taylor's theorem, maxima, and minima.
Function of several variables: Limit, continuity, partial derivatives, differentiability, maxima, and minima.

Unit II: Integral Calculus [12]
Integration as the inverse process of differentiation, definite integrals, and their properties, fundamental theorem of calculus. Double and triple integrals, change of order of integration, calculating surface areas and volumes using double integrals, calculating volumes using triple integrals.

Unit III: Vector Calculus [8]
Scalar and vector fields, gradient, divergence, curl, line integrals, surface integrals, Green's, Stoke's, and Gauss theorems.

Unit IV: Differential Equations [10]
Ordinary differential equations of the first order of the form y'=f(x,y), Bernoulli's equation, exact differential equations, integrating factor, orthogonal trajectories, homogeneous differential equations, variable separable equations, linear differential equations of second order with constant coefficients, Method of variation of parameters, Cauchy-Euler equation.

Text Books:

4. R. K. Jain, & S. R. K. Iyenger,"Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, India, 2014.

5. M. Tenenbaum, and H. Polard, "Ordinary Differential Equations", Dover Publications, 1985.

Reference Books:

1. G. B. Thomas and R. L. Finney, "Calculus and Analytic Geometry", 9th Edition, Pearson Education India, 2010
2. B. Rai, D.P. Choudhary and H.I. Freedman, "A Course in Ordinary Differential Equations", 2nd Edition, Narosa Publishing House, 2013.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

2	**Department offering the course**	**Mathematics and Career Development Centre**
3	**Course Code**	MAF256
4	**Course Title**	**Aptitude and Skill Enhancement- I**
5	**Credits (L:T:P:C)**	**2:0:0:2**
6	**Contact Hours (L:T:P)**	**2:0:0**
7	**Prerequisites (if any)**	**NIL**
8	**Course Basket**	**Skill Enhancement**

COURSE SUMMARY

This module is focused on providing students hands-on practice on aptitude problems and prepare a stronger fundamental base for Aptitude and Soft Skills capabilities.

COURSE OBJECTIVES

Prepare a ground for the students to be ready in Quantitative, Logical Aptitude and Verbal Aptitude

Prepare them for becoming confident and corporate-culture fit as present-day workplace requires professionals who are not only well qualified and competent but also possess Soft Skills like interpersonal skills and good presentation skills.

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Develop Leadership & Team Building Skills.

2. Receive hands-on guidance to develop an effective CV.

3. The students would be able to understand the basic trends of questions asked in the aptitude part of placements.

Curriculum Content

UNIT 1: APTITUDE (Quantitative and Logical)

Progression, logarithm, Quadratic Equations (concept of determinant, real, non-real, rational and conjugate roots); Mensuration

Input Output – Sequential output tracing of logical operations applied on machine input, Ranking and Order- Test - Ordering of measurable attributes like height / weight / performances, etc. Eligibility test, Logical sequences and series, Completion of incomplete pattern, Odd figures

UNIT 2: VERBAL APTITUDE

Tenses and Grammar drills.

Creative Writing: Essay, Report Writing, Article, Letters, E-mail: difference between formal and informal tone, appropriate use of transition words, creating a signature, understanding different situations and the responses they require (situation- based writing), Proper use of connectors.

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UNIT 3: LEADERSHIP & TEAM BUILDING SKILLS

Importance, How to develop Leadership Skills? Best Leadership & Team Building Examples. Suggested Activities & Exercises: (i) Leadership Pizza, (ii) Minefield, (iii) Leaders You Admire.

UNIT 4: PRESENTATION SKILLS

Principles of Effective Presentations, Do's and Don'ts of Formal Presentations, How to prepare for a formal presentation, Presentation Exercises a) Welcome speech, c) Farewell Speech, d) Vote of thanks etc.

Suggested Activities & Games: (i) Stand Up for Fillers, (ii) Mimes, (iii) Short Speech Challenge.

Textbook(s)

1. Quantitative Aptitude: How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition-2018.
2. Logical Reasoning: A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018

Reference Books

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House, 1st edition-2016.

2. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications; 4th edition-2015.
   Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing; 3rd edition - 2009.

3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.

4. Soft Skills: Talk like Ted – Carmine Gallo, St. Martin's Press.
   Soft Skills: No Excuses – Dr Wayne Dyer, Hay House Inc.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle / Google drive. Refer to your course on SAP for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF346
3. Course Title	Technical Writing with LaTeX
4. Credits (L:T:P:C)	0:0:4:2
2. Contact Hours (L:T:P)	0:0:4
3. Prerequisites (if any)	None
4. Course Basket	Skill Enhancement

Course Summary:
Course Objectives: The objectives of this lab are to

- instal and basic handling of the software.
- teach the basics of LaTeX.
- introduce advanced techniques for writing mathematics.
- introduce advanced techniques for editing and formatting documents, preparing large documents such as
- use of LaTeX in daily academic and official work.

Course Pre/Co- requisite (if any) : no restricted pre-requisite
Course Outcomes

After successful completion of the workshop, participants will be able to :

1. execute typesetting of journal articles, technical reports, thesis, books, and slide presentations.
2. control over large documents containing sectioning, cross-references, tables and figures.
3. typesetting of complex mathematical formulae.
4. advanced typesetting of mathematics with AMS-LaTeX.
5. automatic generation of table of contents, bibliographies and indexes.

Curriculum Content:

1. Installation of LaTex and editors.
2. Introduction of LaTex and different editors.
3. Basic and advanced document typesetting.
4. Mathematical equation typing and editing.
5. Inclusion of figures and tables.
6. Preparation of bibliography.
7. Typesetting of Journal articles, Technical reports, Thesis, Books.
8. Slide preparation using Beamer.

Text Books:

1. Laslie Lamport, LaTeX: A Document Preparation System (2nd Edition), 1994

Reference Books:

1. George Gratzer, Practical LaTeX, Springer, 2014.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	Mathematics
2. Course Code	MAF347
3. Course Title	Fundamentals of Advanced Mathematics-II
4. Credits (L:T:P:C)	3:0:0:3
5. Contact Hours (L:T:P)	3:0:0
6. Prerequisites (if any)	None
7. Course Basket	Skill Enhancement

Course Summary:

The course starts with introduction of elementary concepts of sets and their properties and covers the convergence of sequence and series, concepts of group theory and problems in linear algebra.

Course Objective:

The course is designed to enrich the students with advance concepts of pure mathematics which will help them in higher education in Mathematics.

Course Outcomes:

After successful completion of this course students are able to:

- Understand the fundamentals of sets and their properties.
- Perform tests to examine the convergence of sequence and series.
- Understand the basics of group theory.
- Handle the use of linear algebra.

Curriculum Content:

Unit I: Real Analysis [8]

Interior points, limit points, open sets, closed sets, bounded sets, connected sets, compact sets, completeness of R. Power series (of real variable), Taylor's series, radius and interval of convergence, term-wise differentiation, and integration of power series.

Unit II: Sequences and Series of Real Numbers [8]

Sequence of real numbers, the convergence of sequences, bounded and monotone sequences, convergence criteria for sequences of real numbers, Cauchy sequences, subsequences, Bolzano-Weierstrass theorem. Series of real numbers, absolute convergence, tests of convergence for series of positive terms – comparison test, ratio test, root test; Leibniz test for convergence of alternating series.

Unit III: Group Theory [12]

Groups, subgroups, Abelian groups, non-Abelian groups, cyclic groups, permutation groups, normal subgroups, Lagrange's Theorem for finite groups, group homomorphism, and basic concepts of quotient groups.

Unit IV: Linear Algebra [12]

Finite dimensional vector spaces, linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem. Rank and inverse of a matrix, determinant, solutions of systems of linear equations, consistency conditions, eigenvalues, and eigenvectors for matrices, Cayley-Hamilton theorem.

Text Books:

5. S.C. Malik and Savita Arora, "**Mathematical Analysis"**, 5th Edition, New Academic Science Ltd, 2017.
6. Sen, Ghosh, Mukhopadhyay & Maity , "Topics in Abstract algebra", Fourth edition, University Press.
7. W. Cheney, D. Kincaid, " Linear Algebra: Theory and applications", 2nd Edition, Jones and Bartlett learning, 2012.

Reference Books:

1. R.G. Bartle and D.R. Sherbert, "Introduction to Real Analysis", 4th Edition, Wiley, 2014.
2. Joseph Gallian, "Contemporary Abstract Algebra", Eighth edition, Cengage Leraning.
3. V. Krishnamurthy, V. P.Mainra, J.L. Arora, "An introduction to linear Algebra", East-West Press Pvt. Ltd., 1976.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Mathematics and Career Development Centre**
2	**Course Code**	MAF348
3	**Course Title**	**Aptitude and Skill Enhancement- II**
4	**Credits (L:T:P:C)**	**2:0:0:2**
5	**Contact Hours (L:T:P)**	**2:0:0**
6	**Prerequisites (if any)**	**None**
7	**Course Basket**	**Skill Enhancement**

COURSE SUMMARY

The first step of an intensive two step placement training module equips the students to successfully handle the placement program of any on-campus/off-campus company. It not only provides career guidance about the selection process but also helps students in profile building and enhancing their employability skills.

COURSE OBJECTIVES

Interpret the questions of aptitude building objectively and prepare for various competitive examinations

Understand the optimized approach of dealing with placement questions

Learn ways of representing themselves effectively in formal settings

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. By the end of this semester, students will be able to perceive and analyse the requirements of placement trends as detailed information about the selection process would be provided by career guidance.
2. They will be more confident and will be able to develop a professional profile, both online and offline.

CURRICULUM CONTENT

UNIT 1 - QUANTITATIVE APTITUDE

Number System

Types of numbers; Factors; Divisibility test; Place and face Value; Base system; Remainder theorem; digits at the unit places and finding last two digits in a given expression; Calculating number of zeroes, Finding maximum power of any prime number or any composite number in any factorial, HCF and LCM.

Fractions–Types of fractions; Conversion of terminating and non-terminating types of decimal into fraction; Subtraction, addition and multiplication of terminating and non-terminating decimals.

Percentage

Basic concepts; Conversion from fraction to percentage; Application of percentage in – Expenditure, Cost, Consumption problems; Population increase or decrease problems; Production, Manpower and Working hour problems; successive increment or decrement; Comparison of salary or numbers; Percentage change in area or volume, etc.

Ratio and Proportion
Ratio, Proportion and Variation: Ratio- Introduction; Types of ratios; Comparison of Ratios; Concept of duplicate, triplicate, sub-duplicate and sub-triplicate ratios.
Proportion and variation – Concept of direct, inverse, continuous and mean proportions.

Profit and Loss
Introduction; Concept of single, double and triple discount and marked price.
Simple / Compound Interest
Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.

UNIT 2- VERBAL APTITUDE

Subject-Verb agreement & Gerunds, Active and Passive voice

Question Types
Introduction to Question types-I: Fill in the blanks, One word Substitution, Spellings, understanding the right word choice, concept of para jumbles and para completion, reading comprehension, verbal analogies, odd man out, phrases and idioms.
Introduction to Question types-II: Error identification, Homophones, Usage of the various figures of speech, commonly confused words and phrases, techniques for tackling synonyms and antonyms.

Reading Comprehensions
Reading Comprehension: Basics of Comprehensions, different tones of comprehensions, cracking question types like contextual vocabulary, fill in the blanks, true/false questions, reference to context, summary and title of the passage, paraphrasing the text.

UNIT 3- LOGICAL REASONING

Coding Decoding and Sequences
Coding Decoding, Crypt arithmetic, Sequence and Series - Finding the missing term/wrong term in the logical sequence of letter/number/word/alphanumeric, Continuous pattern series.

Verbal Analogies and Odd man out
Verbal Analogy based on various parameters - Antonym / synonym relationship, Quantity and unit, Individual and Group, Product and Raw material, cause and Effect etc.
Odd man out based on several kind of relationship – Relationship based on meaning, functional relationship, even- odd or prime-composite, divisibility rule, etc.

Blood Relation and Direction Sense
Blood Relation- Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

Seating Arrangements
Seating Arrangements – Linear / Circular / Distribution / comparison/ Floor and box arrangement /Quant based arrangements/ etc.

Critical Reasoning
Statement and assumptions, course of action, statement and conclusion, probably true/false.

UNIT 4- NON VERBAL COMMUNICATION
Types of Non Verbal Communication, Body Language-Exercises and Activities, Error Analysis & Feedback Sharing.

Suggested Activities & Exercises: (i) Communication Origami, (ii) Power of body language, (iii) Draw it.

UNIT 4: EMPLOYABILITY SKILLS & CV WRITING
What Skills Do Employers Expect From Graduates? CV vs. Resume, CV writing Do's & Don'ts, Tips with Best Examples/ Samples, Feedback Sharing & Error Analysis.
Suggested Activities & Exercises: (i) Relevant Videos on 'Employability', (ii) Group Discussions on Newspaper Articles, (iii) Sample correction, (iv) writing exercise.

Textbooks

1. Quantitative Aptitude : How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning **:** A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude : English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills- The Power of Now- Eckhart Tolle, Yogi Impressions Books Pvt. Ltd.-2010.

Reference Books

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications-2018.
   Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House, 1st edition-2016.
2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha; Pearson India; 5th edition-2016.
   Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND,Wiley -2016.
3. Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.
4. Soft Skills- The Greatness Guide – Robin Sharma, Jaico Publishing House- 2006.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle/Google drive. Refer to your course on SAP for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1	**Department offering the course**	**Mathematics and Career Development Centre**
2	**Course Code**	MAF349
3	**Course Title**	**Aptitude and Skill Enhancement- III**
4	**Credits (L:T:P:C)**	**2:0:0:2**
5	**Contact Hours (L:T:P)**	**2:0:0**
6	**Prerequisites (if any)**	**NIL**
7	**Course Basket**	**Skill Enhancement**

COURSE SUMMARY

Aptitude and Skill Enhancement-III is the final step of the program and the module is designed to enhance the analytical and interpersonal skills of students to make them ready to face various placements, interviews. It will also help them learn various personality development techniques by enhancing their GD and PI skills. Mock Placement Drive will test and improve students by Feedback Sharing & Error Correction.

COURSE OBJECTIVES

Align themselves with the placement requirements and their needs
Learn analytical and employability skills
Prepare students for job placements so that they could clear the selection process successfully and give them strategies and skills to crack GD as well as PI to get selected with decent job offers

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Be prepared for the upcoming placements and they will also be ready for other competitive exams.
2. Improve their GD and PI Skills and be able to have firsthand experience of a Placement drive and gain sufficient confidence to perform well.

CURRICULUM CONTENT

UNIT 1: QUANTITATIVE APTITUDE

Time Speed Distance
Introduction & types; Speed, Distance and Time: Average Velocity; Race tracks - Straight and Circular; Trains; Boats and Streams

Time and Work & Partnership
Basic concepts (relationship between men, days and work); Understanding group efficiency; Alternate work; Negative work; Wages; Pipes and Cisterns. Concept of partnership.

Permutation and Combination
Basic Principles of Counting (Addition and Multiplication); Arrangements, circular permutation, selection, grouping and distribution.

Probability
Introduction, various types of events; Classical definition of probability; Random and Discrete variables; Bayes' Theorem and question types.
Data Interpretation
Introduction; Different ways of representing data- Narration based, pictorial, pie chart, Bar graph, line charts; various questions based upon them.

UNIT 2: VERBAL APTITUDE

Cloze test
Intricacies of cloze test, correct use of specific adjectives, concept of sentence improvement, writing concept, auxiliaries and modals.
Words
Concept of consistency, precision, concision in terms of reading and writing, advance word choice with respect to placement papers, SAP (Subject-Audience-Purpose) approach.
Clauses
Subordinate Clauses- The noun clause, the adjective clause, the adverb clause, Analysis of simple and complex sentences, prepositional phrases, transformation of sentences.
Vocabulary
Revisiting vocabulary- high, medium and low frequency words, organization of ideas an thoughts in order to understand the text- The Pyramid Principle.
Questions
Various test taking skills in accordance with the placement papers.

UNIT 3: LOGICAL REASONING
Deductive Logic
Premises and conclusion structure, Quality of deductive argument, Syllogism, Conditional Arguments- If..then, only if..then, If and only if , Either or.

Puzzles
Grouping and selection, Binary logic- truth teller-lie teller, Team formation and miscellaneous puzzles.

Set Theory and Critical Reasoning
Union and Intersection of sets, Use of venn diagrams in problem solving with two, three, four set, concept of maxima-minima through Venn diagram.

Critical reasoning: Statement and Inferences, cause and Effects, Statement and Arguments- Strengthen or Weaken the argument, Statement Assertion and Reason.

Data Sufficiency
Data Sufficiency based on logical reasoning field like Coding-Decoding / Puzzle Test / Blood Relations / Mathematical calculations / clock / calendar / etc.

UNIT 4: SOFT SKILLS
Group Discussion
Importance, Do's & Don'ts, Personality Traits, Tips and Strategies, Types of Group Discussions. Suggested Exercises, Games & Activities: Mock Group Discussions (on basic topics), with feedback sharing and error analysis.

Personal Interview

Importance, Do's & Don'ts, Personality Interview, Tips and Strategies, Etiquette Rules.
Suggested Exercises, Games & Activities: Mock Personal Interviews (contd.) with feedback sharing and error analysis.

Textbooks

1. Quantitative Aptitude**:** How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill, 8th edition, 2018.
2. Logical Reasoning: A Modern Approach to Logical Reasoning-R.S. Aggarwal, S Chand Publishing; 2nd Colour edition-2018.
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication-2018.
4. Soft Skills: Group Discussion on Current Topics by P. N. Joshi; Upkar Prakashan-2010.

Reference Book(s)

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal, S. Chand Publications-2017.
   Quantitative Aptitude: Quantitative Aptitude-Saurabh Rawat & Anushree Sah Rawat Savera Publishing House, 1st edition-2016.

2. Logical Reasoning: Logical Reasoning and Data Interpretation for the CAT - Nishit K Sinha, Pearson India; 5th edition-2016.
   Logical Reasoning: Wiley's Verbal Ability and Reasoning - P A ANAND, Wiley-2016.

3. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
   Verbal Aptitude: Fun with grammar- Suzanne W. Woodward Pearson Education ESL-1996.

4. Soft Skills: A Complete Kit for Group Discussion by S. Hundiwala; Arihant publications; edition-2018.
   Soft Skills: Basic Interviewing Skills by Raymond L. Gorden, Waveland Press, Inc.; 1 edition-1998.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle/Google drive.. Refer to your course on SAP for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF349
Course Title	Introduction to SPSS
Credits (L:T:P:C)	2:0:4:4
Contact Hours (L: T:P)	2:0:4
Prerequisites (if any)	
Course Basket	Skill Enhancement Course (SEC)

Course Summary

This course will review and expand upon core topics in statistics and probability, particularly by initiating the beneficiaries of the course to the software packages SPSS for statistical computing.

Course Objectives

To introduce the basic concepts of probability theory, distributions and statistical measures.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. To understand the data file handling and variable transformations.
2. To apply statistical tools to the problems related to data handling and diagrammatic representations.
3. To analyse data with descriptive statistics pertaining to different experiments.
4. To perform analysis based on testing of hypothesis.

Curriculum Content

Lab based on Unit I to IV

Unit I
Data handling: open SPSS data file – save – import from other data source – data entry – labelling for dummy numbers - recode in to same variable – recode in to different variable – transpose of data – insert variables and cases – merge variables and cases.

Unit II
Data handling: Split – select cases – compute total scores – table looks – Changing column - font style and sizes Diagrammatic representation: Simple Bar diagram – Multiple bar diagram – Sub-divided Bar diagram - Percentage diagram - Pie Diagram – Frequency Table – Histogram – Scatter diagram – Box plot.

Unit III
Descriptive Statistics - Mean, Median, Mode, SD- Skewness- Kurtosis. Correlation – Karl Pearson's and Spearman's Rank Correlation, Regression analysis: Simple and Multiple Regression Analysis [Enter and stepwise methods].

Unit IV
Testing of Hypothesis: Parametric – One sample – Two sample Independent t – test – Paired t – test. Non – parametric: One sample KS test- Mann-Whitney U test – Wilcoxon Signed Rank test - Kruskal Wallis test – Friedman test- Chi- square test. Analysis of variance: One way and Two way ANOVA.

Text Books:

1. Jeremy J. Foster (2001). Data analysis using SPSS for windows. New edition. Versions 8-10. Sage publications. London.
2. Michael S. Louis – Beck (1995). Data analysis an introduction, Series: quantitative applications in the social sciences. Sage. Publications. London.

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Department offering the course	Mathematics
Course Code	SAF356
Course Title	Introduction to R Programming
Credits (L:T:P:C)	2:0:4:4
Contact Hours (L: T:P)	2:0:4
Prerequisites (if any)	
Course Basket	Skill Enhancement Course (SEC)

Course Summary

This course will review and expand upon core topics in probability and statistics through the study and practice of data analysis and graphical interpretation using `R'.

Course Objectives

To introduce the basic concepts of R programming for statistical data analysis.

Course Outcomes

On successful completion of the course, students will be able to achieve the following:

1. To plot various graphical representations based on data.
2. To apply statistical tools for descriptive statistics and bivariate data.
3. To generate the random numbers and fitting of distributions.
4. To carry out some project or research work based on data analysis and testing.

Curriculum Content

Lab based on Unit I to IV

UNIT I

Learn how to load data, plot a graph viz. histograms (equal class intervals and unequal class intervals), box plot, stem-leaf, frequency polygon, pie chart, ogives with graphical summaries of data.

UNIT II

Generate automated reports giving detailed descriptive statistics, correlation and lines of regression.

UNIT III

Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application Problems based on fitting of suitable distribution, Normal probability plot.

UNIT IV

Simple analysis and create and manage statistical analysis projects, import data, code editing, Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals.

Text Books:

1. Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.

2. Braun W J, Murdoch D J (2007): A First Course in Statistical Programming with R. Cambridge University Press. New York

TEACHING AND LEARNING STRATEGY

All materials (ppts, assignments etc.) will be uploaded in MS Teams. Refer to your course in MS Teams for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

Ability Enhancement (min. 12 credits to be taken):

1. Department offering the course	Chemistry
2. Course Code	CHF201
3. Course Title	Environmental Science
4. Credits (L:T:P:C)	2:0:0:2
5. Contact Hours (L:T:P)	2:0:0
6. Prerequisites (if any)	None
7. Course Basket	Ability Enhancement

COURSE OBJECTIVE

To impart basic knowledge about the environment and its allied problems and to develop an attitude of concern for the environment. Further the course structure will create the awareness about environmental problems among students and motivate the students to participate in environment protection and environment improvement programs. The course aims to develop skills to help the concerned individuals in identifying and solving environmental problems.

COURSE OUTCOME:

1. At the end of the course, the student will be able to:
2. Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
3. Able to identify the structure and functioning of natural ecosystems.
4. Establish man-wildlife harmonious relationship.
5. Adapt to 3R (Reuse, Recovery, Recycle). Identify the causes and control measures related to Pollutions.
6. Illustrate and analyze various Case Studies related to Environmental issues and Env. Legislation.

CURRICULUM CONTENT

Unit 1: Basics of Environment and Natural Resources: **04** L

Definition and Concept of Environment, Multidisciplinary nature of environmental studies. Scope and importance of environmental studies, Need for public awareness, Environmental concerns and people. Introduction and classification of natural resources. Energy Resources, Water Resources, Land Resources, Forest Resources, Food Resources, Mineral Resources, Case studies related to over exploitation of resources and their impacts. Role of an individual in conservation of natural resources, Sustainable lifestyles.

Unit 2: Ecosystems: **04** L

Definition and concept of ecology, Structure and Function of an Ecosystem, Energy Flow in Ecosystems, Biogeochemical cycles (Nitrogen, Carbon, Phosphorus, Oxygen, Hydrological). Species interactions in ecosystems. Ecological succession and ecological pyramids. Characteristic features of grassland, pond, desert and forest ecosystems. Ecosystem services and conservation.

Unit 3: Biodiversity and its conservation: **04** L

Introduction and types of biodiversity. Bio-geographic classification of India, Value and significance of biodiversity, Biodiversity at global, national and local levels, India: A mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity: Poaching and man-wildlife

conflicts, IUCN Red Data Book and endangered & endemic species of India. Biodiversity conservation strategies, Institutes and organizations.

Unit-4 Environmental Pollutions: **05** L

Introduction and Definition. Causes, consequences and control measures of: Air pollution, Water pollution, Noise pollution, Nuclear pollution, Soil pollution, Thermal and Marine pollution. Solid waste management, Bio-medical waste management. Disasters and its mitigation strategies, Global warming, Climate change, Acid rain, Ozone depletion and Smog. Pollution case studies. Role of an individual in pollution prevention.

Unit-5 Social Issues and Environment: **04** L

Sustainable Development: Concept and importance, Environmental Impact Assessment (EIA), GIS, Remote sensing. Water conservation and rain water harvesting. Resettlement and rehabilitation problems, Environmental audit, eco-labeling and eco-friendly business. Environmental Legislation in India, Population explosion and its impact on environment and human health, Value Education and environmental ethics.

Field work: **03** L

- Visit to a local area to document environmental asset: river/forest/grassland/hill/mountain
- Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- Study of common flora and fauna.
- Study of a common ecosystem-pond, river, hill slopes, etc.

Text book [TB]:

1. BharuchaErach, 2004. Textbook for Environmental Studies, University Grants Commission, New Delhi.
2. Kaushik A & Kaushik C P. 2007. Perspectives in Environmental Studies, New Age International Publ.
3. S. Deswal & A. Deswal 2015. A Basic Course in Environmental Studies. Dhanpat Rai & Co.

REFERENCES

1. Miller T.G. Jr. 2002. Environmental Science, Wadsworth Publishing Co. (TB).
2. De A.K.,1996. Environmental Chemistry, Wiley Eastern Ltd.
3. Sharma, P.D. 2005. Ecology and environment, Rastogi Publication.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	**LAF285**
3. Course Title	**Indian Constitution**
4. Credits (L:T:P:C)	**2:0:0:2**
5. Contact Hours (L:T:P)	**2:0:0**
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Ability Enhancement**

COURSE SUMMARY:

The Constitution of India is the supreme law of India. The document lays down the framework demarcating fundamental political code, structure, procedures, powers, and duties of government institutions and sets out fundamental rights, directive principles, and the duties of citizens. The course will provide knowledge of their constitutional rights to the students and also familiarize the students with the features of the Indian Constitution.

COURSE OBJECTIVE:

To familiarize the students with the features of the Indian Constitution

To provide a knowledge of their constitutional rights

COURSE OUTCOMES

On successful completion of the course, students will be able to achieve the following:

1. Enable the students to protect their rights
2. The students will be engaged in the political system of India

CURRICULUM CONTENT

Unit 1: Introduction

Constitution- meaning of the term, basic features Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy, debates on Fundamental Rights and Directive

Unit 2: Union Government and its Administration

Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha Institutional Functioning: Prime Minister, Parliament and Judiciary, Power Structure in India: Caste, class and patriarchy

Unit 3: State Government and its Administration

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.

Unit-4 Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected, Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit 5: Election Commission

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

TEXT BOOKS

1. Abbas, H., Kumar, R. & Alam, M. A. (2011) Indian Government and Politics. New Delhi: Pearson, 2011.
2. Chandhoke, N. & Priyadarshi, P. (eds.) (2009) Contemporary India: Economy, Society, Politics. New Delhi: Pearson.

REFERENCE BOOKS

1. Chakravarty, B. & Pandey, K. P. (2006) Indian Government and Politics. New Delhi: Sage.
2. Chandra, B., Mukherjee, A. & Mukherjee, M. (2010) India After Independence. New Delhi: Penguin.
3. Singh, M.P. & Saxena, R. (2008) Indian Politics: Contemporary Issues and Concerns. New Delhi: PHI Learning.
4. Vanaik, A. & Bhargava, R. (eds.) (2010) Understanding Contemporary India: Critical Perspectives. New Delhi: Orient Blackswan.

Teaching and Learning Strategy

All materials (ppts, assignments, labs, etc.) will be uploaded in Moodle. Refer to your course in Moodle for details.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

1. Department offering the course	**Humanities & Liberal Arts**
2. Course Code	
3. Course Title	**Yoga**
4. Credits (L:T:P:C)	
5. Contact Hours (L:T:P)	
6. Prerequisites (if any)	**NIL**
7. Course Basket	**Ability Enhancement**

Course Objective:

1. To impart understanding and awareness for Yogic practices
2. To promote holistic health
3. To develop cultural sensitivity

Course Outcome: After completing this course, the students would be better able to:

1. Demonstrate understanding of yogic philosophy and process
2. Improved health in physical, social and psychological domains
3. Be culturally sensitized

Have scientific understanding of yogic effects and techniques

Curriculum Content:

UNIT 1: Introduction

Meaning & Forms: Definition of Yoga in different texts, Karm Yoga, Gyan Yoga, Bhakti Yoga & Raj Yoga; Science of Yoga: Yogic process & Mechanisms

UNIT 2: Biological Bases of Yoga

Human anatomy, Yoga & Digestion, Yoga for Neural disorders, Yoga for muscular system, Yoga for circulation and hormonal system

UNIT 3: Asana

Meaning & Types of Asanas**:** Sookshm Vyayam, Surya Namaskar, back bending postures, Sitting postures, Standing postures, forward moving postures & side bending postures

UNIT 4: Pranayam

Definition of Pranayam, Types: Anulom Vilom, Kapalbhati, Ujjayii, Sheetli, Sheetkari and their precautions

Text book [TB]:

1. Desikachar, T.K.V. (1999). The heart of Yoga: developing a personal practice. Rochester, VT: Inner Traditions International.

Reference books [RB]:

1. रामदेव, स्वामी (२०१२) योगसाधना व चिकित्सा रहस्य. हरिद्वार: दिव्य प्रकाशन.
2. बालकृष्ण, आचार्य (२०१२). विज्ञान की कसौटी पर योग. हरिद्वार: दिव्य प्रकाशन.
3. रामदेव स्वामी (२०१४). दैनंदिन योगाभ्यास क्रम. हरिद्वार: दिव्य प्रकाशन.
4. आचार्य, श्री राम शर्मा (2008). पंच प्राण, पंच देव. मथुरा:युग निर्माण योजना.
5. आचार्य, श्री राम शर्मा (2008). इंद्रिय संयम. मथुरा:युग निर्माण योजना.
6. आचार्य, श्री राम शर्मा (2008). जीवन जीने की कला. मथुरा:युग निर्माण योजना.
7. आचार्य, श्री राम शर्मा. (2008). समय का सदुपयोग. मथुरा:युग निर्माण योजना.
8. आचार्य,पंडित श्री राम शर्मा. (2008) यम, नियम, आसन और प्राणायाम मथुरा: अखंड ज्योति संस्थान।
9. आचार्य,पंडित श्री राम शर्मा. (2008). प्रत्याहार, धारणा, ध्यान और समाधि. मथुरा: अखंड ज्योति संस्थान।
10. राम, स्वामी. (2016). हिमालय के संतों के संग निवास. रामपुर: हिमालय इंस्टीटूट.

Course Structure & Syllabus of B.Sc. (Hons.) – Statistics
Applicable for Batch: 2021-24

.1. Department offering the course	Humanities & Liberal Arts
.2. Course Code	
3. Course Title	Basics of NSS Studies
4. Credits (L:T:P:C)	
5. Contact Hours (L:T:P)	
6. Prerequisites (if any)	NIL
7. Course Basket	Ability Enhancement

Course Objective

- To enrich the student's personality and deepen his understanding of the social environment in which he lives.
- To develop an awareness of his responsibility to society/community.
- To promote a concern for the well-being of the community
- To undertake and participate in the activities designed to tackle social problem and to promote welfare
- To understand the role of youth in nation building.
- To bring the values of life and social responsibilities among youth citizens.

Unit I: Introduction and Basic Concepts of NSS

History and Philosophy & Definition of NSS, Aims & Objectives of NSS, Emblem, Flag, Motto, Song, Badge, NSS day etc, Organizational structure (from national to regional level), Roles and responsibilities of various NSS functionaries

Unit II : NSS Programmes and Activities

Concept of regular activities (one day camp), special seven-day conduction camping, day and night camps and relevance of celebration of important days recognized by united nations, Centre, State Govt. & University, Basis of adoption of village/slums, methodology of conduction survey, Financial pattern of the scheme, Coordination with different agencies, Maintenance of the diary

Unit III: Community Mobilization

Functioning of community stakeholders, Designing the message in the context of the problem and the culture of the community, Identifying methods of mobilization, Youth-Adult partnership, Concept of Community development

Unit IV: Volunteerism and Shramdan

Indian tradition of volunteerism, Value system of volunteerism, Motivation and constraints of volunteerism, Shramdan as a part of volunteerism, Role of NSS volunteers in Swatch Bharat Abhiyan, Role of NSS volunteers in Digital India, Role of Youth in Peace-building and conflict resolution, Role of youth in Nation-Building

Unit V: Planning and Training programmes and other activities

Orientation for selected NSS volunteers and other YLTC programmes, Training/Orientation for NSS programme officers, NSS regular and special camping programmes (pattern of Financial Expenditure), Youth development programmes at the National level, State level and voluntary sector, Youth development programme at University level, college level and voluntary Sector (NGO).

Project Work/Practical: The Project should be related from the above topics.

Evaluation Pattern: Written exam of 75 marks and project evaluation of 25 marks.

Reference Books:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. National Service Scheme in India: A case study of Karnataka, M.B. dishad, Trust Publications, 2001
3. http://nss.gov.in