DIT UNIVERSITY
Dehradun

Detailed Course Structure & Syllabus

of

B.Sc. (Statistics) Honours/Honours with Research

(4 Year Program with Minor)

Approved by the Academic Council at its 22nd meeting held on 06.03.2023

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.

In accordance with the NEP 2020, the UGC has formulated a new student-centric "Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. Further, it also recommends that the undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a UG certificate after completing 1 year in a discipline or field including vocational and professional areas, or a UG diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

Advantages of CCFUP
- 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.
- CCFUP allows students to obtain 4 year Honors degree with Minor in a discipline of their interest by choosing courses offered by other departments, from various baskets of inter-disciplinary, intra-disciplinary, skill oriented, ability enhancing, and from other disciplines.

Features unique to DIT University CCFUP structure:

1. A minimum of 120 credits has to be earned by a student to be eligible for a 3 year Under Graduate degree in Sciences and a minimum of 160 credits for a 4-year Undergraduate Degree (Honors) OR (Honors in Research). Each department will decide their total credits for each program, and it can vary across disciplines.

2. Courses are categorized into 8 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. To provide sufficient flexibility and room during the program for additional *Internships, Project, Vocational Studies,* 8-week summer semesters (Summer 1, Summer 2, and Summer 3) may have to run. Summer semesters are critical for implementing a fully flexible system. Each department will decide *a priori* which courses to offer in the summer semester and get them finalized at the Academic Advisory Committee meeting.

5. 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, Design Oriented Project, Computer Oriented Project, Projects of Organizational Aspects, Research Projects, or Entrepreneurship and Start Up Projects.

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

7. 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 center 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.

8. 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.

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

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Baskets of CCFUP

8 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:

S.No.	Basket	Details
1	Major (Core)	In-depth study of a particular subject or discipline
2	Minor	Different interdisciplinary minors After securing the specified credits in minor, student is eligible for a degree in major discipline with minor in the chosen interdisciplinary course
3	Inter-disciplinary	Natural and Physical Sciences: Chemistry, Physics, Biophysics, Astronomy and Astrophysics, Earth and Environmental Science etc. Mathematics, Statistics, and Computer Applications: Python, data analysis software, etc. Library, information, and media science: journalism, mass media, and communication Commerce and Management: Business Management, accountancy, finance. Humanities and Social Sciences: Economics, History, Linguistics, Psychology, sustainable development etc.
4	Ability enhancement courses (AEC)	Modern Indian language and English language focused on language and communication skills
5	Skill enhancement courses (SEC)	Courses on Hands on training, soft skills, institutes may design their own courses also
6	Value added courses common for all UG	Understanding India Environmental Science, Digital and technological solutions: AI, 3D machining, big data, machine learning etc. Health and Wellness, Yoga, sports and fitness
7	Summer Internship	From any firm, industry, training lab, organization, own institution also (Students who exit after 2 semesters must undergo a 4 credit work based learning/internship to get UG certificate) Community engagement/service Field based learning/minor project
8	Research Project/Dissertation	Students for 4 year degree (Honours with Research) to take up research project under guidance of faculty member

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Structure of the B.Sc. (Statistics) Program

S.No.	Basket	Minimum credit requirement			Credit per Course	Total Courses		
		3 year UG	4 year UG (Honours)	4 year UG (Honours with Research)		3 year UG	4 year UG (Honours)	4 year UG (Honours with Research)
1	Major (Core)	61	89	77	4-5	13	19	17
2	Minor	28	36	36	4-5	7	9	9
3	Inter-disciplinary	12	12	12	3-5	3	3	3
4	Ability enhancement courses (AEC)	9	9	9	3	3	3	3
5	Skill enhancement courses (SEC)	9	9	9	3	3	3	3
6	Value added courses common for all UG	6	6	6	2	3	3	3
7	Summer Internship	2-4	2-4	2-4	2	-	-	-
8	Research Project/Dissertation	-	-	12	12	-	-	1
	Total	**125**	**161**	**161**		**32**	**40**	**39**

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Course Baskets: B.Sc. (Statistics)

For B.Sc. (Statistics) with Minor in other Discipline				
Discipline Courses (61 credits for 3 year UG, 89 credits for 4 year UG)				
S.No.	**Name of Courses**	**L**	**T**	**P**	**C**
1	Descriptive Statistics	3	1	2	5
2	Probability and Probability Distributions	3	1	2	5
3	Statistical Inference- I	3	1	2	5
4	Sampling Distributions	3	1	0	4
5	Data Analysis Using MS. Excel	2	0	4	4
6	Statistical Inference- II	3	1	2	5
7	Nonparametric Methods	3	1	2	5
8	Design of Experiments	3	1	2	5
9	Sampling Techniques	3	1	2	5
10	Statistical Quality Control	3	1	2	5
11	Demography and Vital Statistics	3	1	0	4
12	Time Series Analysis	3	1	2	5
13	Introduction to R Programming	2	0	4	4
14	Multivariate Analysis	3	1	2	5
15	Linear Statistical Models	3	1	2	5
16	Introduction to SPSS	2	0	4	4
17	Economic and Official Statistics	3	1	0	4
18	Linear Programming	3	1	0	4
19	Introduction to Stochastic Processes	3	1	0	4

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Inter-disciplinary Courses (12 credits)					
Course Code	Name of Courses	L	T	P	C
	Calculus-I	3	1	0	4
	Waves and Optics	3	1	2	5
	Introduction to Python	2	0	2	3

Ability Enhancement Courses (8 credits)					
	Name of Courses	L	T	P	C
LAF181	Professional Communication	2	0	2	3
LAF282	Human Values	3	0	0	3
LAF184	Corporate Communication and Soft Skills	2	0	2	3
Skill Enhancement Courses (9 credits)					
	Name of Courses	L	T	P	C
MAF346	Technical Writing with LATEX-I	2	0	2	3
MAF119	Introduction to MATLAB	2	0	2	3
MAF256	Aptitude and Skill Enhancement-I	3	0	0	3
MAF348	Aptitude and Skill Enhancement-II	3	0	0	3
Common Value Added Courses (8 credits)					
	Name of Courses	L	T	P	C
CHF201	Environmental Science	2	0	0	2
LAF285	Indian Constitution	2	0	0	2
	Yoga	0	0	4	2
	Physical Education	0	0	4	2
Project (12 credits)					
SAF***	Research Project	0	0	24	12

Discipline Course (Semester-I)

Department offering the course	Mathematics
Course Code	SAFN106
Course Title	Descriptive Statistics
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 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 lab work base on analysis of the data.

Curriculum Content

UNIT I: Introduction

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: Statistical Measures

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, correlation, rank correlation. Principle of least squares, two regression lines 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)**

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. Spearman rank correlation with and without ties.
10. Lines of regression, angle between lines and estimated values of variables.
11. Calculate price and quantity index numbers using simple and weighted average of price relatives.
12. 12.To calculate the Chain Base index numbers.
13. 13.To calculate consumer price index number.

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.

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Department offering the course	Mathematics
Course Code	MAF108
Course Title	Calculus-I
Credits (L:T:P:C)	3:1:0:4
Contact Hours (L:T:P)	3:1:0
Prerequisites (if any)	None
Course Basket	Inter-disciplinary

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, Beta and Gamma function, 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", 4th Edition, Narosa Publishing House, New Delhi, India, 2014.
2. E. Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John & Wiley Sons, U.K., 2016.
3. Gorakh Prasad, "Integral Calculus", Pothishala Private Limited, 2015

Ability enhancement courses (AEC) Courses (Semester-I)

Subject Code	HLAN146	Subject Title	Professional Communication						
LTP	2 0 2	Credit	3	Subject Category	AEC I	Year	I	Semester	I

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.

Course Objective

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

UNIT I
Communication (7)

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

UNIT II:
Listening & Speaking Skills (4)

Listening Comprehension: Identifying General and Specific information, Note-taking and Drawing Inferences; Introduction to Phonetics: Articulation of Consonants and Vowel sounds.

UNIT III:
Reading Skills & Technical Writing Skills (8)

Reading Strategies and Vocabulary Building; Reading Comprehension; Paragraph Development;
Intra-office Correspondence: Notice, Agenda, Minutes and Memorandum;
Technical Proposal and Technical Report

UNIT IV:
Communication at Work (7)

Business Letter Writing; Job Application Letter & Resume;
Interview Skills; Impression Management; SWOT Analysis; EQ and Its Dimensions,

Learning Outcome

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.

Text Books

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

1. Aslam, Mohammad. Introduction to English Phonetics and Phonology Cambridge.2003.
2. Ford A, Ruther. Basic Communication Skills; Pearson Education, New Delhi.2013.
3. Gupta, Ruby. Basic Technical Communication, Cambridge University Press, New Delhi.2012.
4. Kameswari, Y. Successful Career Soft Skills and Business English, BS Publications, Hyderabad. 2010.
5. Tyagi, Kavita& Padma Misra. Basic Technical Communication, PHI, New Delhi. 201

Lab

Lab 1: Neutralizing Mother Tongue Influence
Lab 2: Listening (Biographies through software) & Presentation of Biographies
Lab 3: Listening & Role Play on Situational/ Telephonic Conversation (through software)
Lab 4: Picture Perception
Lab 5: Public Speaking
Lab 6: Group Discussion
Lab 7: Case Studies
Lab 8: SWOT Analysis
Lab 9: Mock Interview
Lab 10: Final Evaluation

Skill enhancement courses (SEC) Courses (Semester-I)

Department offering the course	Mathematics and Career Development Centre
Course Code	MAF256
Course Title	Aptitude and Skill Enhancement- I
Credits (L:T:P:C)	2:0:0:2
Contact Hours (L:T:P)	2:0:0
Prerequisites (if any)	NIL
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.

Textbooks

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.
2. Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House, 1st edition-2016.
3. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications; 4th edition-2015.
4. Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing; 3rd edition -2009.
5. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University Press-2003.
6. Soft Skills: Talk like Ted – Carmine Gallo, St. Martin's Press.
7. Soft Skills: No Excuses – Dr Wayne Dyer, Hay House Inc.

Value added courses common for all UG Courses (Semester-I)

Subject Code	HLAN148	Subject Title	Indian Constitution and Polity						
LTP	3 0 0	**Credit**	3	**Subject Category**	Value Added	**Year**	I	**Semester**	I

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

UNIT I (8)
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.

UNIT II (8)
Union Government and its Administration
Structure of the Indian Union: Federalism, Centre-State relationship; President: Role, Power and Position; PM and Council of Ministers; Lok Sabha, Rajya Sabha, Parliament and Judiciary.

UNIT III
State Government and its Administration (6)
Governor: Role and Position; CM and Council of Ministers; State Secretariat: Organisation, Structure and Functions.

UNIT-IV (8)
Local Administration
District's Administration head: Role and Importance; Municipalities: Introduction, Panchayati Raj: Introduction; Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed Officials; Election Commission: Role and Functioning.

Course Outcomes
On successful completion of the course, students will be able to achieve the following:
- Enable the students to protect their rights
- The students will be engaged in the political system of India

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.

Discipline Course (Semester-II)

Department offering the course	Mathematics
Course Code	SAFN107
Course Title	Probability and Probability Distributions
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 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)**

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.

List of Practical
1. Problems based on simple probability, conditional probability and Baye's theorem.
2. Problems based on probability mass function, probability density function and distribution function.
3. Problems based on joint and marginal probability functions.
4. Problems based on expectations and moments.
5. Problems based on Binomial, Poisson and negative binomial distributions.
6. Problems based on area property of normal distribution.
7. Problems based on uniform distribution, exponential distribution, Cauchy distribution, beta distribution and gamma distribution.

Department offering the course	Physics
Course Code	PYFN117
Course Title	Waves and Optics
Credits (L:T:P:C)	3:1:2:5
Contact Hours (L:T:P)	3:1:2
Prerequisites (if any)	None
Course Basket	Inter-disciplinary

COURSE SUMMARY
This course develops a strong background of simple harmonic motion, their superposition, wave motion, interference and diffraction.

COURSE OBJECTIVE
This course introduces the physics of waves, oscillations and the formalism of wave behavior in the context of physical optics.

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

COURSE OUTCOME
On successful completion of the course, students will be able to achieve the following:
Having successfully completed this course the student will be able to:
1. Understand the principle of linear superposition of waves, use phasor description of waves and learn about construction of Lissajous figures
2. Develop the wave equation to find out the relationship between the speeds of propagation of waves.
3. Learn how stationary/standing waves are produced by the superposition of incident and reflected waves in a string fixed at both ends and understanding of wave impedance.
4. Understand different modes of vibrations in strings, air columns and rods and learn how different harmonics are produced and also find how stringed instruments work.
5. Understand how wave nature of light can be used to explain the phenomenon of interference and diffraction.

CURRICULUM CONTENT

Unit 1: Superposition of Collinear Harmonic oscillations
Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.
Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods, Lissajous Figures (1:1 and 1:2) and their uses **6 L**

Unit 2: Wave Motion

Plane and Spherical Waves, Longitudinal and Transverse Waves, Plane Progressive (Travelling) Waves, Wave Equation, Particle and Wave Velocities, Differential Equation, Pressure of a Longitudinal Wave, Energy Transport, Intensity of Wave. Water Waves: Ripple and Gravity Waves **5 L**

Unit 3: Superposition of Two Harmonic Waves

Vibrations of Stretched Strings, Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. **7 L**

Unit-4: Wave optics & Interference

Interference: Division of amplitude and wavefront. Young's double slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.
Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **9 L**

Unit- 5: Diffraction

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.
Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. **12L**

Text books

1. Optics, Ajoy Ghatak, McGraw Hill Education, 2017.
2. The Physics of Waves and Oscillations, N.K. Bajaj, Tata McGraw Hill, 2004

Reference books

1. The physics of vibrations and waves, H. J. Pain, Wiley, 2010
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, McGraw-Hill, 2011.

Sr No.	LIST OF EXPERIMENTS
1	To determine wavelength of sodium light using Newton's Rings.
2	To determine wavelength of sodium light using Fresnel's Biprism.
3	To determine wavelength of prominent lines of mercury using plane 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	To verify cosine square law (Malus Law) for plane polarized light.
7	To study the nature of polarization using a quarter wave plate.
8	To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula

Course Structure & Syllabus of B.Sc. (Statistics) 4 Year Program Applicable for Batch: 2023-27

Ability enhancement courses (AEC) Courses (Semester-II)

Subject Code	HLAN246	Subject Title	Human Values and Ethics						
LTP	2 0 0	Credit	2	Subject Category	AEC III	Year	II	Semester	III

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.

UNIT I:
INTRODUCTION (6)

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 II:
SOCIETAL VALUES & MATERIAL VALUES (6)

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 III:
PSYCHOLOGICAL & SPIRITUAL VALUES (6)

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 IV: **(6)**

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

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.

Textbooks

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.

Skill enhancement courses (SEC) Courses (Semester-II)

Department offering the course	Mathematics
Course Code	MAFN119
Course Title	Introduction to MATLAB
Credits (L:T:P:C)	2:0:2:3
Contact Hours (L:T:P)	2:0:2
Prerequisites (if any)	None
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 build in 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.