DIT UNIVERSITY
Dehradun

Detailed Course Structure & Syllabus

of

B.Sc. (Hons.) in Physics/B.Sc. (Hons. with Research) in Physics

(4 Year Program with Minor)

Approved by the Academic Council in its 22nd Meeting held on 06.03.2023

Course Structure & Syllabus of B.Sc. (Hons.) in Physics/B.Sc. (Hons. with Research) in Physics, 4 Year Program Applicable for Batch: 2023-27

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.

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	Multidisciplinary	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. (Physics) Program

S.No.	Basket	Minimum credit requirement		Credit per Course	Total Courses		
		3 year UG	4 year UG		3 year UG	4 year UG (Honours)	4 year UG (Honours with Research)
1	Major (Core)	62	83	3-5	14	20	17
2	Minor	24	32	4-5	6	8	8
3	Multidisciplinary	13	13	3-5	2-3	2-3	2-3
4	Ability enhancement courses (AEC)	9	9	3	3	3	3
5	Skill enhancement courses (SEC)	9	9	3	3	3	3
6	Value added courses common for all UG	6	6	2	3	3	3
7	Summer Internship	2-4	2-4	2	-	-	-
8	Research Project/Dissertation	-	12	12	-	-	1
	Total	**123**	**164**		**31-32**	**39-40**	**37-38**

Course Baskets: B.Sc. (Physics)

For B.Sc. (Physics) with Minor in other Discipline					
Discipline Courses (62 credits for 3 year UG, 83 credits for 4 year UG)					
S.No.	**Name of Courses**	**L**	**T**	**P**	**C**
1	Mechanics	3	1	2	5
2	Waves and Optics	3	1	2	5
3	Mathematical Physics-I	3	1	0	4
4	Thermal Physics	3	1	2	5
5	Elements of Modern Physics	3	1	2	5
6	Nuclear and Particle Physics	3	0	0	3
7	Electricity & Magnetism	3	1	2	5
8	Analog Systems and Applications	3	1	2	5
9	Digital Systems and Applications	3	1	2	5
10	Electromagnetic Theory	3	1	0	4
11	Quantum Mechanics and Applications	3	1	0	4
12	Solid State Physics	3	1	2	5
13	Statistical Mechanics	3	1	0	4
14	Classical Mechanics	3	1	0	4
15	Atomic and Molecular Physics	3	1	0	4
16	Mathematical Physics-II	3	1	0	4
17	Nanoscale Science and Applications	4	0	0	4
18	Electrodynamics	4	0	0	4
19	Physics of Lasers and Applications	4	0	0	4
20	Medical Physics	3	0	0	3
21	Physics of Semiconductor Devices	3	0	0	3
22	Computational Physics – I	3	0	0	3
23	Computational Physics – II	3	0	0	3
24	Introduction to Astronomy and Astrophysics	3	0	0	3
25	Renewable Energy and Energy Harvesting	3	0	0	3
26	Earth Science	3	0	0	3

Course Structure & Syllabus of B.Sc. (Hons.) in Physics/B.Sc. (Hons. with Research) in Physics, 4 Year Program Applicable for Batch: 2023-27

For B.Sc. (Physics) without Minor in other Discipline					
Discipline Courses (62 credits for 3 year UG, 83 credits for 4 year UG)					
Core Courses (Compulsory)					
S.No.	**Name of Courses**	**L**	**T**	**P**	**C**
1	Mechanics	3	1	2	5
2	Waves and Optics	3	1	2	5
3	Mathematical Physics-I	3	1	0	4
4	Thermal Physics	3	1	2	5
5	Elements of Modern Physics	3	1	2	5
6	Nuclear and Particle Physics	3	0	0	3
7	Electricity & Magnetism	3	1	2	5
8	Analog Systems and Applications	3	1	2	5
9	Digital Systems and Applications	3	1	2	5
10	Electromagnetic Theory	3	1	0	4
11	Quantum Mechanics and Applications	3	1	0	4
12	Solid State Physics	3	1	2	5
13	Statistical Mechanics	3	1	0	4
14	Classical Mechanics	3	1	0	4
15	Atomic and Molecular Physics	3	1	0	4
16	Mathematical Physics-II	3	1	0	4
17	Nanoscale Science and Applications	4	0	0	4
18	Electrodynamics	4	0	0	4
19	Physics of Lasers and Applications	4	0	0	4
Elective Courses					
1	Medical Physics	3	0	0	3
2	Physics of Semiconductor Devices	3	0	0	3
3	Computational Physics – I	3	0	0	3
4	Computational Physics – II	3	0	0	3
5	Introduction to Astronomy and Astrophysics	3	0	0	3
6	Renewable Energy and Energy Harvesting	3	0	0	3
7	Earth Science	3	0	0	3
8	Experimental Techniques	3	0	0	3
9	Basic Instrumentation Skills	3	0	0	3

Interdisciplinary Courses (9 credits)				
Name of Courses	L	T	P	C
Calculus-I	3	1	0	4
Physical Chemistry-I	3	1	2	5

Ability Enhancement Courses (8 credits)				
Name of Courses	L	T	P	C
Professional Communication	2	0	2	3
Human Values	3	0	0	3
Corporate Communication and Soft Skills	2	0	2	3
Skill Enhancement Courses (9 credits)				
Name of Courses	L	T	P	C
Technical Writing with LATEX-I	2	0	2	3
Introduction to MATLAB	2	0	2	3
Aptitude and Skill Enhancement-I	3	0	0	3
Aptitude and Skill Enhancement-II	3	0	0	3
Aptitude and Skill Enhancement-III	3	0	0	3
Common Value Added Courses (6-8 credits)				
Name of Courses	L	T	P	C
Environmental Science	2	0	0	2
Indian Constitution	2	0	0	2
Yoga	0	0	4	2
Physical Education	0	0	4	2
Project (12 credits)				
Research Project	0	0	24	12

Discipline Courses (Semester-I)

Department offering the course	Physics
Course Code	PYFN107
Course Title	Mechanics
Credits (L:T:P:C)	3:1:2:5
Contact Hours (L:T:P)	3:1:2
Prerequisites (if any)	None
Course Basket	Discipline Course

COURSE SUMMARY

This course starts with the basic concepts of work, energy and collisions between particles. The course then covers the angular motion of bodies and moment of inertia, elasticity, fluid motion, laws of gravitation and special theory of relativity.

COURSE OBJECTIVE

The aim of this course is to introduce students to both elementary classical mechanics and the basic ideas of Special Relativity

Course Pre/Co- requisite (if any) Basic knowledge of vectors

COURSE OUTCOME

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

- 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
- Demonstrate rigid body and rotational dynamics using the concept of angular velocity and momentum.
- Demonstrate an understanding of intermediate mechanic's topics such as co-ordinate transformations, oscillatory motion, gravitation etc.
- Understand the concept of non-inertial frames of reference, Coriolis and centripetal accelerations and their applications
- Understand the postulates of Special Relativity and their consequences in terms of Time dilation and length contraction, Lorentz transformations, relativistic kinematics and the relation between mass and energy

CURRICULUM CONTENT

UNIT 1: Work, Energy and Collisions

Work and Kinetic Energy Theorem. Conservative and nonconservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. Elastic and inelastic collisions between particles. **7L**

UNIT 2

Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

10 L

UNIT 3

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

9 L

UNIT 4

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems **5 L**

UNIT 5

Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Transformation of Energy and Momentum. **8 L**

Text books

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

Reference books

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

SR.NO.	LIST OF EXPERIMENTS
1	To determine the Moment of Inertia of a Flywheel
2	To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method)
3	To determine the Modulus of Rigidity of a Wire by Maxwell's needle
5	To determine the elastic Constants of a wire by Searle's method
6	To determine the value of g using Bar Pendulum
7	To measure the Young's Modulus using Bending of Beam
8	To determine the value of g using Kater's Pendulum
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

Discipline Courses (Semester-II)

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	Discipline Course

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.

12 L

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

Minor Courses

Department offering the course	Computer Science and Engineering
Course Code	CSF101
Course Title	Programming for problem solving
Credits (L:T:P:C)	3:0:2:4
Contact Hours (L:T:P)	3:0:2
Prerequisites (if any)	None
Course Basket	Generic Elective

COURSE SUMMARY

This course contains the fundamental concepts about the computer hardware and intends to provide to students about the knowledge of C language.

Course objective

The objective of the course is to make the students to understand the key hardware components in a modern computer system and as to how the software is mapped to the hardware. The student shall also be able to learn make the computer programs using C language by exploring the various features of C.

COURSE OUTCOMES

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

1. To formulate simple algorithms for arithmetic and logical problems.
2. To implement conditional branching, iteration and recursion.
3. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
4. To use arrays, pointers and structures to formulate algorithms and programs.
5. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems

Curriculum Content

UNIT 1: Introduction to Computer, Programming & algorithms (8 L)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples, From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT 2: Arithmetic Expression, and Conditional statements, Loops, Expression: (7 L)

Arithmetic, Logical, Relational expressions and precedence.

Loops & Branching: Writing and evaluation of conditionals and consequent branching, Iteration and loops.

UNIT 3: Arrays & Functions **(7 L)**

Arrays: Arrays (1-D, 2-D), Character arrays and Strings.

Functions: functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

Searching & Sorting: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT 4: Recursion and Structure **(8 L)**

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc.

Structure: Structures, Defining structures and Array of Structures.

UNIT 5: Pointers & File handling **(7 L)**

Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list.

File handling: different modes of opening a file in C, reading, writing from files.

TEXT BOOKS

1. Byron Gottfried, "Schaum's Outline of Programming with C", 2nd edition 2006 McGraw-Hill.
2. E. Balaguruswamy, "Programming in ANSI C", 8th Edition 2019, McGraw-Hill Eduaction India.

References

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd edition 1988, Prentice Hall of India.

Teaching and learning strategy

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

List of experiments

S.NO.	EXPERIMENT NAME
1	Familiarization with programming environment.
2	Programming for Simple computational problems using arithmetic expressions.
3	Programming for Problems involving if-then-else structures.
4	Programming for Iterative problems e.g., sum of series.
5	Programming for 1-D Array manipulation.
6	Programming for Matrix problems, String operations.
7	Programming for Simple functions
8	Programming for Recursive functions.
9	Programming for Pointers and structures.
10	Programming for File operations
11	Programming for solving Numerical methods problems

Subject Code	ECON106	Subject Title	Microeconomics I						
LTP	3 1 0	Credit	4	Subject Category	UC	Year	2nd	Semester	III

Course Objectives

- To provide the students a thorough understanding of the principles of economics.
- To provide emphasis on the nature and functions of product markets.
- To provide the understanding on how decisions are made within the larger economic system.

Learning Outcomes

- Students will learn the basic concepts and tools of demand and supply.
- Students will learn the different market structures.
- Students would be able to apply micro economic concepts to analyse real life situations

Unit 1: Introduction and Basic concepts (5 Lectures)

Why study economics? Definition & Meaning**,** Nature and scope of micro economics, Basic Economic Problem - Choice and Scarcity, Inductive and Deductive methods, Positive vs. Normative Economics, Static and Dynamic Analysis.

Unit 2: Demand and Supply (10 Lectures)

Law of Demand, demand of a firm and Market; Concept of Elasticities –Price, Cross and Income Elasticity of Demand; Law of supply, types of supply, Elastcity of supply and its measurement.

Unit 3: Consumer Theory (10 Lectures)

Introduction to Utility, Cardinal vs ordinal Utility approach, Budget Constraint, Preferences; Indifference curve, Consumers equilibrium. MRS, Price, Income and Substitution effects (Hicks Allen & Slutsky method), Revealed Preference Theory, Consumer and Producer Surplus.

Unit 4:Theory of Production and Cost (10 Lectures)

Production Function –The Law of Variable Proportions; Returns to Scale-Isoquant; Isocost lines; Cobb-Douglas Production function, MRTS, Least Cost Combination and Producer's Equilibrium, Expansion path, concepts of Costs.

Unit 5: Market Structure (10 Lectures)

Prefect competition: Features, Price determination in short and long run, Equilibrium of Firm and Industry; Monopolistic competition; Monopoly: Price and output determination, Price discrimination; Monopsony: Features.

Text books

1. Modem Microeconomics: Theory and Applications, H.L. Ahuja, Sultan Chand and Co., New Delhi, 2006.
2. Modern Microeconomics, A. Koutsoyiannis, 2nd edition, Macmillan Press, London, 1979.
3. *Economics: Principles and Applications*, N. Gregory Mankiw, India edition by South Western, a part of Cengage Learning, Cengage Learning India Private Limited.

Reference books

1. Mathematical Statistics, John E. Freund, Prentice Hall, 1992.
2. An Introduction to Mathematical Statistics and its Applications, Richard J. Larsen and Morris L. Marx, Prentice Hall, 2011.
3. Basic Statistics, A.M. Gun, M.K. Gupta, B. Dasgupta, World Press Private Limited Nagar.
4. Kumar, Dinesh U. 2017. *Business Analytics: The Science of Data-Driven Decision Making*. India: Wiley India.

Interdisciplinary Courses

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	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, 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

Subject Code		Subject Title	PHYSICAL CHEMISTRY-I						
LTP	3 1 2	Credit	5	Subject Category	CC	Year	1st	Semester	I

Course Outline

The course covers the gaseous states kinetics and P-V-R relations in the first unit. The second unit is about the properties of liquids. The third unit renders details of the types of crystalline packing and symmetry for prototype crystalline solids. The 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 the basics 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 andequations regarding the Pressure-Volume-Temperature dependency of gaseous molecules. Students should also have a prior understanding of the crystalline nature of well-known salts (NaCl) to be further explained and the basis of homogenous solutions and colloidal suspensions.

Detailed Syllabus

Unit 1: 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.

Unit 2: 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. Explanationof cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of the structure of water.

Unit 3: Solid State:

Definition of space lattice, unit cell, Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of the rationality of indices (iii) Law of symmetry, Symmetry elements incrystals. Lattice sites and coordination number in the unit cell, 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 4: Thermodynamics and Thermochemistry:

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, 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.

Second Law: Concept of entropy; the 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 the third law, the concept of residual entropy, calculation of absolute entropy ofmolecules.

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, the effect of temperature (Kirchhoff's equations) and pressure on the enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

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.

Learning Outcome: -

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

CO1: Explain the kinetics of gaseous diffusion and viscosity based on various parameters;understand gaseous mixture separation based on partial pressures.
CO2: Determine of Physical properties of pure Liquids and mixtures (solutions).
CO3: Elucidate the structure of crystals using X-ray crystallography
CO4: State and apply the laws of thermodynamics in macroscopy systems and thermochemistry of chemical reactions.
CO5: Predict the spontaneity of reactions by using thermodynamic principles.

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).

SR.NO.	EXPERIMENT NAME
1	To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/strong acid and determine the enthalpy of ionization of the weak acid/weak base.
2	To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.
3	Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulphuric acid or enthalpy of neutralization), and (ii) heat gained equal to heat lost by cold water and hot water respectively
4	Determination of heat capacity of a calorimeter for different volumes using heat gained equal to heat lost by cold water and hot water respectively
5	Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6	Study of the solubility of benzoic acid in water and determination of ΔH.
7	Determination of integral enthalpy (endothermic and exothermic) solution of salts.
8	Calculation of enthalpy of ionization.

Ability Enhancement/Language Courses

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 Book

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,
5. Hyderabad. 2010.
6. 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

Department offering the course	Humanities & Liberal Arts
Course Code	LAF282
Course Title	Human Values
Credits (L:T:P:C)	3:0:0:3
Contact Hours (L:T:P)	3:0:0
Prerequisites (if any)	NIL
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

Textbooks

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

Reference Book

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

Subject Code	HLAN176	Subject Title	Aptitude & Skill Enhancement-I						
LTP	3 0 0	Credit	3	Subject Category	SEC I	Year	1	Semester	1

Course Summary

Aptitude and Verbal Ability training module is crafted to bridge the gap between skills possessed by the students and the abilities that are looked for by the organization. It not only provides career guidance about the selection process but also helps students in profile building and enhancing their cognitive skills and enhance their employability quotient.

Course Objectives

- Interpret the questions of aptitude building objectively and prepare for various competitive examinations/campus recruitment exams.
- 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:
By the end of this semester, students will be able to perceive and analyze the requirements of placement trends as detailed information about the selection process would be provided by career guidance. They will be more confident and will be able to develop a professional profile, both online and offline.

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 decimals 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.

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.

Simple / Compound Interest

Simple Interest and compound Interest: Basic concept of Principal, Time, Amount and Rate of Interest; Concept of Lent money.

Profit and Loss

Introduction; Concept of single, double and triple discount and marked price.

UNIT-2

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.

Deductive Logic

Conditional Arguments- If-then, only if then, If and only if , Either or; Premises and conclusion structure, Quality of deductive argument, Syllogism,

Blood Relation and Direction Sense

Blood Relation- Indicating form / puzzle form / coding form, Direction Sense, Direction puzzles.

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.

UNIT-3

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.

Textbook(s)

1. Quantitative Aptitude: How to prepare for Quantitative Aptitude, Arun Sharma, McGraw Hill
2. Logical Reasoning: A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Aggarwal, S Chand Publishing
3. Verbal Aptitude: English is Easy- Chetanand Singh, BSC Publication

Reference Books

1. Quantitative Aptitude: Quantitative Aptitude for Competitive Examinations- R.S. Agarwal S. Chand Publications
2. Quantitative Aptitude: Quantitative Aptitude- Saurabh Rawat and Anushree Sah Rawat Savera Publishing House
3. Logical Reasoning: Analytical & Logical Reasoning by Peeyush Bhardwaj-Arihant Publications
4. Logical Reasoning: Analytical Reasoning by M.K.Pandey BSC publishing
5. Verbal Aptitude: Oxford Guide to English Grammar- John Eastwood, Oxford University

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 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.

Common Value Added Courses

Department offering the course	Humanities & Liberal Arts
Course Code	LAF285
Course Title	Indian Constitution
Credits (L:T:P:C)	2:0:0:2
Contact Hours (L:T:P)	2:0:0
Prerequisites (if any)	NIL
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.

Department offering the course	Chemistry
Course Code	CHF201
Course Title	Environmental Science
Credits (L:T:P:C)	2:0:0:2
Contact Hours (L:T:P)	2:0:0
Prerequisites (if any)	None
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

- At the end of the course, the student will be able to:
- Demonstrate depleting nature of Environmental Resources and Ecosystem concepts.
- Able to identify the structure and functioning of natural ecosystems.
- Establish man-wildlife harmonious relationship.
- Adapt to 3R (Reuse, Recovery, Recycle). Identify the causes and control measures related to Pollutions.
- 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-labelling 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 books

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.