# SYLLABUS for ENTRANCE TEST in M.Sc. in BIOTECHNOLOGY/ M.Sc. in PLANT BIOTECHNOLOGY/ M.Sc. in BIOINFORMATICS

**PG Entrance Test** 



## DEPARTMENT OF MATHEMATICS AND STATISTICS, DDU GORAKHPUR UNIVERSITY GORAKHPUR-273009 (U.P.) INDIA



## **National Education Policy-2020**

## **Syllabus**

of

## **MATHEMATICS**

## (Effective from Academic Session 2021-2022)

For

**Three Years B.A. /B.Sc. Programme** 

### Course Structure of Mathematics as Major Subject in B.A. /B.Sc. Programme

SEMES'	FER-WISE TITL	ES OF THE PAPERS OF MATHI B.A. /B.Sc. PROGRAMM	EMATICS AS MAJOR S IE	UBJECT IN
YEAR	COURSE CODE	PAPER TITLE	THEORY/PRACTICAL	CREDITS
		SEMESTER-I		
	MAT 101	BASICS OF MATHEMATICS	THEORY	2
	MAT 102 (B030101T)	DIFFERENTIAL CALCULUS AND INTEGRAL CALCULUS	THEORY	4
	MAT 103 (B030102P)	PRACTICAL	PRACTICAL	2
FIDST		SEMESTER-II		
FINST	MAT 104 (B030201T)	MATRICES AND DIFFERENTIAL EQUATIONS	THEORY	3
	MAT 105 (B030201T)	GEOMETRY	THEORY	3
		SEMESTER-III	[	
	MAT 201	ALGEBRA	THEORY	3
	(B030301T)			c
	MAT 202	MATHEMATICAL METHODS	THEORY	3
	(B030301T)			5
		SEMESTER-IV	,	
SECOND	MAT 203 (B030401T)	DIFFERENTIAL EQUATIONS	THEORY	3
	MAT 204 (B020401T)	MECHANICS	THEORY	3
	(B0304011)	SEMESTER-V		
	MAT 301 (B030501T)	RING THEORY AND LINEAR ALGEBRA	THEORY	4
	MAT 302 (B030502T)	TENSOR ANALYSIS	THEORY	3
	MAT 303 (B030502T)	DIFFRENTIAL GEOMETRY	THEORY	3
		SEMESTER-VI		
THIRD	MAT 304 (B030601T)	METRIC SPACES AND COMPLEX ANALYSIS	THEORY	4
	MAT 305 (B030602T)	NUMERICAL ANALYSIS AND OPERATIONS RESEARCH	THEORY	4
	MAT 306 (B030603T)	PRACTICAL	PRACTICAL	2

### **Subject Prerequisites:**

To study this subject a student must had the subject(s) Mathematics in class 12<sup>th</sup>.

### **Program Outcomes (POs)**

**PO1:** It is to give foundation knowledge for the students to understand basics of mathematics including applied aspects for the same.

**PO2:** It is to develop enhanced quantitative skills in pursuing higher mathematics and research as well.

**PO3:** Students will be able to develop solution-oriented approach towards various issues related to their environment.

**PO4:** Students will become employable in various government and private sectors.

**PO5:** Scientific temper in general and mathematical temper in particular will be developed in students.

Year	Semester	Program Specific Outcomes (PSOs)
First	SEM-I	<b>PSO1</b> . Student should be able to possess recall basic idea aboutmathematics
	SEM-II	which can be displayed by them.
Second	SEM-III	<b>PSO2</b> . Student should have adequate exposure to many aspects of mathematical
	SEM-IV	sciences.
Third	SEM-V	PSO3. Student is equipped with mathematical modeling ability, critical
	SEM-IV	mathematical thinking, problem solving skills, etc. and apply his/her skill and knowledge in various field of studies including Science, Engineering, Commerce and Management etc.

	SEMESTER WISE PAPER TITLES WITH DETAILS				
Year	Semester	Paper	Paper Title	Prerequisite for Paper	Elective for Major Subjects
		Theory Paper - I	BASICS OF MATHEMATICS		
	SEM-I	Theory Paper - II	DIFFERENTIAL CALCULUS AND INTEGRAL CALCULUS		
FIRST	Semester         SEM-I         F         SEM-II         F         SEM-III         F         SEM-III         F         SEM-III         F         SEM-IV         F         SEM-IV         F         SEM-IV         F         SEM-V         F         SEM-V         F         SEM-V         F         SEM-V	Practical Paper - III	PRACTICAL (Practicals to be done using SageMath/Mathematica/ MATLAB / Maple /Scilab / C programming/ R programming/ Python etc.)	Mathematics in 12th	Open to ALL
	SEM-II	Theory Paper - I Theory	MATRICES AND DIFFERENTIAL EQUATIONS GEOMETRY	-	
	SEM-III	Paper - II Theory Paper - I Theory Paper - II	ALGEBRA MATHEMATICAL METHODS	Mathematics as Major Subject in B.A. /B.Sc. first	Open to ALL
SECOND SEM-IV	Theory <u>Paper - I</u> Theory Paper - II	DIFFERENTIAL EQUATIONS MECHANICS	year Programme		
		Theory Paper - I	RING THEORY AND LINEAR ALGEBRA		
	SEM-V	Theory Paper - II Theory Paper - III	TENSOR ANALYSIS         DIFFERENTIAL GEOMETRY	-	
THIRD	SEM-VI	Theory Paper - I Theory Paper - II Practical Paper- III	METRIC SPACES AND COMPLEX ANALYSIS NUMERICAL ANALYSIS AND OPERATIONS RESEARCH PRACTICAL (Practicals to be done using SageMath/Mathematica/ MATLAB Maple /Scilab / C programming/ R programming/ Python etc.)	Mathematics as Major Subject in B.A. /B.Sc. second year Programme	Statistics, Physics, Computer Sc. / App Chem., Bio-Chem, Geography, Economics, Defence & Strategic Studies, BCA, BBA B.Tech(Engg / Tech)

### B.A. /B.Sc. I (SEMESTER-I) PAPER-I

### **BASICS OF MATHEMATICS**

Class: B.A. /B.Sc.	Year: FIRST	Semester: FIRST
Subject: MATHEMATICS		
Course Code: MAT 101	Course Title: BAS	ICS OF MATHEMATICS

#### Course outcomes:

**CO1:** The program outcome is to give foundation knowledge for the students to understand basics of mathematics including applied aspect for developing enhanced quantitative skills and pursuing higher mathematics and research as well.

**CO2:** By the time students complete the course; they will have wide ranging application of the subject and have the knowledge of relations, functions along. They will also be able to know about Differentiation of functions, geometrical and physical significance of derivatives. Also, they have knowledge about Determinants and its applications, matrix theory, Integration of functions, properties of indefinite integrals.

**CO3:** The main objective of the course is to equip the student with necessary analytic and technical skills. By applying the principles of basic mathematics he/she learns to solve a variety of practical problems in science and engineering.

**CO4:** The student is equipped with standard concepts and tools at an intermediate to advance level that will serve him/her well towards taking more advance level course in mathematics.

Credits: 2	Core Compulsory / Elective
Max. Marks: 25+75	Min. Passing Marks: As per UGC/ University CBCS norm.

### Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0

Unit	Topics	No. of Lectures
	Assignment on "Indian Ancient Mathematics and Mathematicians" should be included under Continuous Internal Evaluation (CIE).	
	BASICS OF MATHEMATICS	
I	Set theory: Definition of sets, representation of sets, universal set, empty set, singleton set, finite and infinite set, equal set, cardinal number of finite set, equivalent set, set of set, subsets, proper subset, superset, power set, improper set, comparibility of sets, union and intersection of sets, complement of sets, de morgan's law, disjoint sets, difference and symmetric difference, algebra of sets, duality, counting principle, venn diagram and its applications.	8

Π	Ordered pair, Cartesian product of two sets, relations, domain, co-dom range of a relation, types of relations: identity relation, inverse relation relation, universal relation, reflexive relation, symmetric relation symmetric relation, transitive relation, equivalence relation. Funct mapping, domain, co-domain and range of a function, compose functions, types of function: one-one function, many –one function function, into function, one-one into function, one-one onto function one into function, many-one onto function, and invertible functions.	nain and n, empty n, anti- tions or ition of on, onto n, many-	7
III	Differentiation of functions, geometrical significance of derivatives, de of the product of functions, derivative of quotient of two functions, de of a function of function, Maxima and minima of a function of one v Integration of functions, properties of indefinite integrals, integration by sub integration by parts, integration of rational functions, integration using fractions. Definite integrals and its properties.	erivative erivative variable. stitution, g partial	8
IV	Principle of mathematical induction, Polynomials, Linear polynomial, opolynomial, cubic polynomial, roots of polynomial, Quadratic e Factorisation, Determinants and its applications, matrix theory, types of r Horizontal matrix, vertical matrix, square matrix, row matrix, column null matrix, identity matrix, diagonal matrix, scalar matrix, sub triangular matrix, comparable matrix, Operation on matrices: Matrix a subtraction, product of matrices, difference of two matrices, transport matrix, inverse of a matrix by adjoint method.	quadratic quations, natrices: matrix, matrix, iddition, ose of a	7
Suggested F 1. Seni 2. Adv 3. Mat 4. Mat 5. Cou Suggestive F • Nation • SWA • Mass • Uttar • Nation	Readings: or Secondary School Mathematics, R S Agrawal, Bharti Bhawan, 1995. vanced Engineering Mathematics, Erwin Kreyszig, Wiley, 2015. hematics ,R.D.Sharma,Dhanpat Rai Publications,1998. hematics,Sudhir Kumar Pundir,Shri Balaji Publication,2013. rse Books published in Hindi may be prescribed by the Universities. Digital Platforms/ Web Links: onal Programme on Technology Enhanced Learning (NPTEL) AYAM eachusetts Institute of Technology (MIT) Open Learning Pradesh Higher Education Digital Library (UPHEDL) onal Digital Library of India (NDLI)		
This course	can be opted as an elective by the students of following subjects: Open to a	all	
Internal Eva	luation shall be based on Class test, Presentation and Assignment. The marks	shall be as	follows:
S.No.	Assessment Type	Max. Mar	·ks
1	Class Test-I (Descriptive Questions)	5	
2	Class Test-II (Objective Questions)	5	
3	Presentation/ Class Interaction	5	
4	Assignment	10	
G	••		•

**Course prerequisites:** To study this course, a student must have the subject Mathematics in class12th.

### B.A. /B.Sc. I (SEMESTER-I) PAPER-II

### DIFFERENTIAL CALCULUS AND INTEGRAL CALCULUS

Class: B.A. /	B.Sc.	Year: FIRST	Semester: FIRST	
Subject: MA	THEMATICS			
Course Code	: MATH 102 (B030101T)	Course Title: DIFFERENTIAL CALCULUS AND INTEGRAL CALCULUS		
Course outco	mes:			
<b>CO1:</b> The princluding app well.	ogram outcome is to give foundation know lied aspect for developing enhanced quantita	ledge for the students ative skills and pursuin	to understand basic g higher mathemati	es of mathematics cs and research as
<b>CO2:</b> By the knowledge o sequence. Al	time students complete the course; they wil f real valued functions along with sequences so, they have knowledge about curvature, e	Il have wide ranging ap e. They will also be envelopeand evolutes, I	pplication of the sub able to know abou Riemann integral.	bject and have the to convergence of
<b>CO3:</b> The mather principles science and e	in objective of the course is to equip the stud of differential calculus and integral calcul ngineering.	dent with necessary and us he/she learns to sol	lytic and technical a ve a variety of practice of the practice	skills.By applying ctical problems in
CO4: The st him/her well	udent is equipped with standard concepts a towards taking more advance level course in	nd tools at an intermed mathematics.	diate to advance lev	vel that will serve
Credits: 4		Core Compulsory / E	lective	
Max. Marks	: 25+75	Min. Passing Marks:	As per UGC/ Univ	ersity CBCS norm.
Total No. of	Lectures-Tutorials-Practical (in hours per	r week): L-T-P: 4-0-0		
Unit	Тор	ics		No. of Lectures
	PAR	Т-А		
	DIFFERENTIAL	L CALCULUS		
I	Definition of a sequence, Theorems on limit sequences, Convergent sequence, Cau- Weierstrass theorem for sequence, Cauch theorems on limits, limit superior and limit on nested intervals, subsequence.	its of sequences, Bound chy's convergence ny sequence, Cauchy' t inferior of a sequence	ded and Monotonic criterion, Balzano s first and second c, Cantor's theorem	8
Π	Limit, Continuity and differentiability of definition, Heine's definition, equivalence o continuity, Borel's theorem, Bolzano's theo value theorem, Darboux's intermediate valu	f function of single of definition of Cauchy a prem, Intermediate valu the theorem for derivativ	variable, Cauchy's and Heine, Uniform e theorem, Extreme res, Chain rule.	7
III	Rolle's theorem, Lagrange and Cauchy Mea of higher order, Taylor's theorem with va differentiation, and Leibnitz theorem, Macla	an value theorems, mea arious forms of remai aurin's and Taylor's se	n value theorems nders, Successive ries expansion.	8
IV	Partial differentiation, Euler's theorem on l properties, Asymptotes, Curvature, Envelop concavity and convexity.	homogeneous function, os and evolutes, Multip	Jacobians and its ble points, Test for	7

Unit	Topics     No. of Lecture		
	PART-B INTECRAL CALCULUS		
v	Lower and upper bounds, Supremum and infimum of the subsets of R and its basic properties, Completeness of R. Riemann integral and its properties, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean value theorems of integral calculus, Differentiation under the sign of Integration.	8	
VI	Beta and Gamma functions, Tracing of curves in Cartesian and Polar forms, Improper integrals, their classification and convergence, Comparison test, µ-test, Abel's test, Dirichlet's test, quotient test.	7	
VII	Areas of Curve, Lengths of curve, Volumes of solid of revolution, Multiple integrals: Double and Triple integrals, Change of order of double integration, Area as a double integral in Cartesian form, Dirichlet's theorem, and Liouville's theorem for multiple integrals.	8	
VIII	Vector Differentiation, Point function, Vector differential operator, Gradient, Divergence and Curl, Normal on a surface, Directional Derivative, Second order differential operator, Laplacian operator. Vector Integration, Line integral, Circulation, Work done by a force, Surface integral, Volume integral, Gauss, Green, Stokes theorems with prove and related problems.	7	
Suggeste 1. 2. 3. 4. 5. 6. 7. Suggeste 1. 2. 3. 4. Suggeste 0. 4. 5. 6. 7. Suggeste 0. 1. 2. 3. 4. 5. 6. 7. Suggeste 0. 1. 2. 3. 4. 5. 6. 7. Suggeste 0. 5. 6. 7. Suggeste 0. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 7. 5. 6. 7. 5. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 5. 6. 7. 6. 7. 6. 7. 6. 7. 7. 6. 7. 6. 7. 7. 6. 7. 7. 6. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7	<ul> <li>d Readings :( Part-A Differential Calculus)</li> <li>R.G. Bartle &amp; D.R. Sherbert, Introduction to Real Analysis, John Wiley &amp; Sons T.M. Apostal, Calculus Vol. I, John Wiley &amp; Sons Inc. Gorakh Prasad, A text book on Differential Calculus, Pothishala Private Ltd., Prayagraj S. Balachandra Rao &amp; C. K. Shantha, Differential Calculus, New Age Publication. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.</li> <li>G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. Course Books published in Hindi may be prescribed by the Universities.</li> <li>d Readings:( Part-B Integral Calculus)</li> <li>T.M. Apostal, Calculus Vol. II, John Wiley Publication Gorakh Prasad, A text book on Integral Calculus, Pothishala Private Ltd., Prayagraj Shanti Narayan &amp; Dr. P.K. Mittal, Integral Calculus, S.Chand Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley &amp; Sons. Course Books published in Hindi may be prescribed by the Universities.</li> <li>ve Digital Platforms/ Web Links: National Programme on Technology Enhanced Learning (NPTEL) SWAYAM Massachusetts Institute of Technology (MIT) Open Learning Uttar Pradesh Higher Education Digital Library (UPHEDL) National Digital Library of India (NDLI)</li> </ul>		
This cou	rse can be opted as an elective by the students of following subjects: Open to all		
Internal	Evaluation Methods (Max. Marks: 25)		
Internal I	Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be a	is follows:	
1	Class Test-I (Descriptive Questions) 5		
2	Class Test-II (Objective Questions)		
3	Presentation/ Class Interaction 5	í	
4	Assignment 10	C	
Course	prerequisites:	· ·	
To stud	y this course, a student must have the subject Mathematics in class12th.		

### B.A./B.Sc. I (SEMESTER-I) PAPER-III

### PRACTICAL

Class: B.A.	/ <b>B.S</b>	с.	Year: FIRST	Semester: FIR	ST
Subject: MATHEMATICS		EMATICS			
Course Co	de: M	AT 103 (B030102P)	Course Title: PRACTICA	L	
Course out CO1. The r of equation /Maple / Sc	comes nain ol s by pl ilab /C	bjective of the course is to ecolotting the graphs using diff programming / R programm	quip the student to plot the d erent computer software suc ning etc.	ifferent graphs and solve ch as Sage Math/Mathem	the different types hatica /MATLAB /
CO2. After	compl ent wou	ald be able to Sketching para	ametric curves: Trochoid, C	ycloid, Epicycloid	
CO4. Stud Matrix ope	ent wo rations	uld be able to find numbers 3.	between two real numbers a	and plotting of finite and i	nfinite subsetof R,
Credits: 2			Core Compulsory / Electiv	ve	
Max. Marl	ks: 25+	-75	Min. Passing Marks: As p	er UGC/ University CBC	S norm.
Total No. o	of Lect	ures-Tutorials-Practical (i	n hours per week): L-T-P:	0-0-4	
Unit		Тор	ICS		No. of Lectures
	•	Practical / Lab work to be List of the practicals to be / Maple / Scilab / R progr	e performed in Computer done using Sage Math / M amming / Python / C prog	Lab. athematica /MATLAB ramming etc.	60
I.	Plott	ing the graphs of the followi	ng functions:		
	I.	ax			
	II.	[x] (greatest integer fun	ction)		
	III.	$x^{2n}$ ; $n \epsilon N$			
	IV.	$x^{2n^{-1}}$ ; $n \epsilon N$			
	V.	$\frac{1}{X^{2n-1}}$ ; $n \in N$			
	VI.	$\frac{1}{X^{2n}}$ ; $n \in N$			
	VII.	$\sqrt{ax+b}$ , $ ax+b $			
	VIII.	$ x $ for $x \neq 0$			
	IX.	$e^x$ for $x \neq 0$			
	Х.	$e^{-x}$ for $x \neq 0$			
II.	Plotti log <sub>e</sub> x	ng the graph of the following $c$ , sin x, cos x, tan x, sin hx,	g functions: cos hx, tan hx.		

III.	Sketching parametric curves: Trochoid, Cycloid, and Epicycloid.
IV.	By plotting the graph find the solution of the equation: $x = e^x$ , $x^2 + 1 = e^x$ , $1 - x^2 = e^x$ , $x = \log_{10} (x)$ , $\cos (x) = x$ , $\sin(x) = x$ , $\cos(y) = \cos(x)$ ,
	$\sin(y) = \sin(x).$
V.	Plotting the graphs of polynomial of degree 2, 3, 4 and 5.
VI.	Find numbers between two real numbers and plotting of finite and infinite subsetof R
VII	Matrix operations: I. Addition, II. Multiplication, III. Inverse, IV. Transpose.
VIII	Complex number and their representations: I. Addition, II. Multiplication, III. Division, IV. Modulus.

This course can be opted as an elective by the students of following subjects: Open to all

### Internal Evaluation Methods (Max. Marks: 25)

Practical Internal Evaluation shall be based on Practical File/Record, Class test, Viva-voce and Overall performance. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Test (Descriptive /Objective Questions)	5
2	Presentation of any one Practical / Class Interaction	5
3	Viva-voce	5
4	Practical File/Record	10

### External Evaluation Methods (Max.Marks: 75)

Practical External Evaluation shall be based on Viva-voce, Practical File/Record and Practical Exercises. The marks shall be as follows:

Practical Exercise : 01 x 25 Marks	25 Marks
Practical File/Record/ Overall Performance	20 Marks
Viva-voce	30 Marks

There shall be 04 Practical Exercises in Examination comprising 01 as Compulsory.

### Course prerequisites:

To study this course, a student must have the subject Mathematics in class12th.

### Any remarks:

- At least two Computer Programmers and two Computer Operators must be assigned in computer lab.
- There should be a Computer Lab with minimum of 25 computer systems for 50 students with licensed and Free Open Source softwares related to this course.

### B.A./B.Sc. I (SEMESTER-II) PAPER-I

### MATRICES AND DIFFERENTIAL EQUATIONS

Class: B.	A. /B.Sc.	Year: FIRST Semester: SECOND		
Subject: N	<b>IATHEMATICS</b>			
Course Co	ode: MAT 104 (B030201T)	Course Title: MATRICES	S AND DIFFERENTIA	L EQUATIONS
Course o	utcomes:			
<b>CO1:</b> The matrices	e topics of the course are include and eigen values from basic level	ed in such a way that they for to depth of knowledge.	ocus on developing math	ematical skills in
<b>CO2:</b> Th Formatio	e student will be able to find the not differential equations.	e rank, eigen values of matr	ices and study the Diffe	rential Equations,
CO3: Th matrices	e students will be capable of lear and Orthogonal Trajectories.	n and visualize the fundame	ental ideas about the ran	k, eigen values of
<b>CO4:</b> Or equations	a successful completion of the co and their properties. They have t	ourse students have gained he foundation for higher cou	knowledge about mat urse in Matrices and diffe	rices, differential rential equations.
Credits: 3		Core Compulsory / Electiv	ve	
Max. Mar	ks: 25+75	Min. Passing Marks: As p	er UGC/ University CBC	CS norm.
Total No.	of Lectures-Tutorials-Practical	(in hours per week): L-T-	P: 3-0-0	
Unit		Topics		No. of Lectures
	MATRICES	AND DIFFERENTIAL E	QUATIONS	
Ι	Elementary operations on Matri	ces, Rank of a Matrix, Ec	helon form of a Matrix,	
	Normal form or Canonical form	n of a Matrix, Inverse of	a Matrix by elementary	12
	operations. Complex matrix, Con	njugate of matrix, Transpose	e of Conjugate of matrix,	
	Hermitian matrix and Skew-, He	rmitian matrix, Periodic m	atrix, Idempotent matrix,	
	Unitary matrix. System of line	ar homogeneous and non-	homogeneous equations,	
	consistency and inconsistency	of a system of mear e	quations, Theorems on	
П	Vector Linear Dependence	and Independence of ver	rtors Dependence and	
	Independence of vectors of vector	ors by rank method. Eigen y	values, Eigen vectors and	11
	characteristic equation of a ma	atrix, Orthogonal Vectors.	Algebraic Multiplicity,	
	Geometric Multiplicity, Regular	eigen value, Caley-Hamilto	on theorem and its use in	
	finding inverse of a matrix, Dia	agonalisation of square mat	rix, Power of matrix by	
	Diagonalisation.			
ш	Order and Degree of a Different General Solution Particular S	ial Equations, Formation of Colution Geometrical mea	f differential equations,	11
	equation, Equation of first order and first degree, Equation in which the variables are			
	separable, Equation Reducible to Variable separable form, Homogeneous			
IV	differential equations, Equations Reducible to Homogeneous form.			11
11	differential equations. Equations	Reducible to Linear form.	First order higher degree	11
	differential equations solvable f	or p, y, x. Clairaut's differ	ential equation, Singular	
	Solutions, Determination of sing	alar solution, Orthogonal Tr	ajectories, Trajectories in	
	Cartesian form and Polar form.	-	-	

### Suggested Readings :

- 1. Felix R. Gantmacher, The Theory of Matrices, AMS Chelsea Publishing.
- 2. Roger A. Horn, Charles R. Johnson, Matrix Analysis, Cambridge University Press.
- 3. Thomas S. Shores, Applied linear algebra and matrix analysis, Springer
- 4. G.F. Simmons, Differential Equations, Tata Mcgraw Hill Publishing Company Ltd.
- 5. M. D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand and Company Ltd., New Delhi.
- 6. Richard Bronson, Gabriel B. Costa, Schaum's Outline of Differential Equations, McGraw-Hill Education
- 7. Zafar Ahsan, Differential equations and their applications, PHI.
- 8. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

This course can be opted as an elective by the students of following subjects: Open to all

### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follow

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

### **Course prerequisites:**

To study this course, a student must have the subject Mathematics in class12th.

### B.A./B.Sc. I (SEMESTER-II) PAPER-II

### GEOMETRY

Class: B	.A. /B.Sc.	Year: FIRST	Semester: SECO	ND
Subject: ]	MATHEMATICS			
Course C	ode: MAT 105 (B030201T)	Course Title: GEOMETR	Y	
Course CO1: The geometry	outcomes: he topics of the course are include y and three-Dimensional Coordina	ed in such a way that they f ites from basic level to depth	focus on developing math 1 of knowledge.	nematical skills in
CO2: The to develop	ne student will be able to find the c op problem solving skills for solvi	oncepts of three-Dimensionang various types of concepts	al geometry. The course ir in three-Dimensional ge	n geometry intends ometry.
CO3: The learn to o	he students will be capable of lear describe some of the surfaces by u	n and visualize the fundaments of analytical geometry.	ental ideas about coordir	nate geometry and
<b>CO4:</b> Or and their	n successful completion of the cou properties. They have the founda	rse students have gained kr tion for higher course in Geo	nowledge about regular g ometry.	eometrical figures
Credits: 3	3	Core Compulsory / Electiv	ve	
Max. Ma	rks: 25+75	Min. Passing Marks: As p	er UGC/ University CBC	S norm.
Total No.	of Lectures-Tutorials-Practical	(in hours per week): L-T-	P: 3-0-0	
Unit		Topics		No. of Lectures
		GEOMETRY		
I	Three-Dimensional Coordinates cosines and direction ratios, Pro the join of two points on a straig from a line.	in space, Distance betwee jection of a segment on a st ht line, Angle between two	en two points, Direction raight line, Projection of lines, Distance of a point	12
II	Plane, General equation of plane a plane through given points, St image of a point in a plane, Shor	e, Equation of the plane in va raight line in three dimensi test distance between two lin	arious forms, Equation of ons, Coplanar lines, The nes.	11
III	Sphere, Equation of a sphere w Intersection of sphere and a stra circular cone, enveloping cone.	vhose centre is given, Inter ight line, Cone ,Equation of	rsection of two spheres, f cone, Equation of right	11
IV	Cylinder, Right circular cylinder of the central conicoid in standar hyperboloid of two sheets, inters condition of tangency, director s plane.	, Enveloping cylinder, Cent d form, the ellipsoid, the hyp ection of line and a central c phere, normal to a conicoid	ral conicoid, properties perboloid one sheet, the conicoid, tangent plane, , polar plane, diametral	11

### Suggested Readings :

- 1. R. J. T. Bell, An Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., New Delhi, 1994.
- 2. Shanti Narayan, P.K. Mittal, Analytical Solid Geometry, S. Chand & Company, New Delhi, 2008.
- 3. M.M. Tripathi, Coordinate Geometry: Polar Coordinates Approach, Narosa Publishing House, New Delhi
- 4. P.R.Vittal, Analytical Geometry 3D, Pearson.
- 5. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

This course can be opted as an elective by the students of following subjects: Open to all

### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

#### **Course prerequisites:**

To study this course, a student must have the subject Mathematics in class12th.

### B.A./B.Sc. II (SEMESTER-III) PAPER-I

### ALGEBRA

Class: B	.A. / B.Sc.	Year: SECOND	Semester: THI	RD
Subject: I	MATHEMATICS			
Course C	ode: MAT 201 (B030301T)	Course Title: ALGEBE	RA	
Course ou	itcomes:			
CO1: Gro students to	oup theory is one of the building basic concepts of Group theory and	blocks of modern algebraic their properties.	ra. Objective of this cou	rse is tointroduce
CO2: A studen	student learning this course gets a course to basic course in advanced mathem	oncept of Integers, Grounatics particularly in Algorithms	p and their properties.Th ebra.	is course will lead
CO3: The	e course gives emphasis to enhance	students' knowledge of F	Permutation groups and N	ormal subgroups.
CO4: On and will h	successful completion of the cour elp him/her in going for higher studi	se students would have es and research.	acquire knowledge abou	ut Integers, Group
Credits: 3	3	Core Compulsory / Ele	ctive	
Max. Mai	rks: 25+75	<b>Min. Passing Marks:</b> A	s per UGC/ University C	BCS norm.
Total No.	of Lectures-Tutorials-Practical (in	n hours per week): L-T-	P: 3-0-0	
Unit		Topics		No. of Lectures
		ALGEBRA		
Ι	Properties of Integers, Divisor, D Euclidean algorithm, Fundamenta residue classes. Euler $\emptyset$ – functio Wilson's theorem.	ivision algorithm. Great theorem of arithmeme on and its properties, 1	est Common Divisor, etic, Congruences and Euler's, Fermat's and	12
п	Algebraic Structure, Definition of Subgroups, Generators of a group, Centre of group.	a group with examples Cyclic groups, Order of	s and simple properties, f an element of a group,	11
III	Permutation groups, Cyclic permut The alternating group, Cayley's Lagrange's theorem and its consequ	ation, Transposition, Eve theorem, Direct product tences.	en and odd permutations, s, Coset decomposition,	11
IV	Homomorphism and isomorphism Simple group, Quotient groups, Fu on isomorphism.	, Kernel of homomorph ndamental theorem of ho	ism, Normal subgroups, omomorphism, Theorems	11

### **Suggested Readings :**

- 1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, New Delhi, 1975.
- 2. Joseph. A. Gallian, Contemporary Abstract Algebra, Cengage Learning India Private Limited, Delhi., Fourth impression, 2015.
- 3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd., New Delhi, 1983.
- 4. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publication House, India.
- 5. David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa 1989.
- 6. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

#### This course can be opted as an elective by the students of following subjects: Open to all

#### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.First Year Programme.

### B.A./B.Sc. II (SEMESTER-III) PAPER-II

### MATHEMATICAL METHODS

Class: B	.A. / B.Sc.	Year: SECOND	Semester: THI	RD
Subject: I	MATHEMATICS		L	
Course C	urse Code: MAT 202 (B030301T) Course Title: MATHEMATICAL METHODS			
Course o	outcomes:			
CO1: La Objective two varia	place transforms and Fourier tra of this course is to introduce bles, Fourier series and their pro-	insforms is one of the but e students to basic concept operties.	uilding blocks of mode ots of limit and continu	ern mathematics. ity of function of
CO2: A propertie function	student learning this course ge s. This course will lead the st of two variables.	ets a concept of Laplace udent to basic course in	transforms, Fourier tran advanced mathematic	nsforms and their as particularly in
CO3: The and Fouri even and o	course gives emphasis to enhance er series, Fourier expansion of pie odd functions.	e students' knowledge of fu exewise monotonic function	unction of two variables, I is, Calculus of variations	Laplace transforms Fourier series for
<b>CO4:</b> Or of two va for highe	n successful completion of the ariables, Laplace transforms, I r studies and research.	course students would h Fourier series, Calculus of	nave acquire knowledge variations and will help	e about function him/her in going
Credits: 3	3	Core Cor	mpulsory / Elective	
Max. Ma	rks: 25+75	Min. Passing Marks: As	s per UGC/ University CF	BCS norm.
Total No.	of Lectures-Tutorials-Practical	(in hours per week): L-T-	P: 3-0-0	
Unit		Topics		No. of Lectures
	MATHEMA	ATICAL METHODS		
I	Limit and Continuity of function two variables, Taylor's theorem Maxima and minima for functio Exponential functions, hyperbo general exponential function. In inverse hyperbolic functions.	ns of two variables, Different for functions of two variables, Lagrations of two variables, Lagratic functions, logarithm on nverse Circular function of	entiation of function of tables with examples, nge multiplier method. If a complex number, of complex quantities,	12
II	Laplace transform, Existence the transform and their properties, La	eorem for Laplace Transfo aplace transform of the deri	rm, Linearity of Laplace vatives and integrals of a	11

function, Heaviside expansion formula. Initial and Final value theorem, Unit step function and their properties. Laplace transform of periodic function, Unit impulse function, Inverse Laplace transforms, Convolution theorem, Solution of ordinary

Periodic functions, Fourier series, Fourier expansion of piecewise monotonic

functions, Fourier series for even and odd functions, Half - range expansions. Fourier transforms (finite and infinite) and properties of fourier transform.

Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable,

differential equation by using Laplace transform.

Extremals, Functionals dependent on higher order derivatives.

Three Years B.A. /B.Sc. Mathematics Programme

III

IV

11

11

### **Suggested Readings :**

- 1. T.M. Apostal, Mathematical Analysis, Pearson
- 2. G. F. Simmons, Differential Equations with Application and Historical Notes, Tata -McGrawHill
- 3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- 4. A.C.Srivastava, Engineering Mathematics, PHI Publication.
- 5. N. Kumar, An Elementary Course on Variational Problems in Calculus, Narosa Publications, New Delhi.
- 6. A. S. Gupta, Text Book on Calculus of Variation, Prentice-Hall of India, New Delhi.
- 7. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

### This course can be opted as an elective by the students of following subjects: Open to all

#### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

#### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.First Year Programme.

### B.A./B.Sc. II (SEMESTER-IV) PAPER-I

### **DIFFERENTIAL EQUATIONS**

Class: B.A. / B.Sc.	Year: SECOND	Semester: FOURTH	
Subject: MATHEMATICS			
Course Code: MAT 203 (B030401T)	Course Title: DIFFEREN	TIAL EQUATIONS	
Course outcomes:			
<b>CO1:</b> The objective of this course is to equations, partial differential equations an	<b>CO1:</b> The objective of this course is to familiarize the students with various methods of solving differential equations, partial differential equations and to have qualitative applications.		
<b>CO2:</b> A student doing this course is able to solve differential equations and is able to model problems in nature using ordinary differential equations. After completing this course, a student will be able to take more courses on differential equations. These entire courses are important in engineering and industrial applications for solving boundary value problems.			
<b>CO3:</b> The object of the course is to give students knowledge of basic differential equations, partial differential equations such as Simultaneous Differential Equation and Total differential equation.			
<b>CO4:</b> The student, after completing the course can go for higher quality problems in Differential Equation. This will be helpful in getting employment in industry.			

Credits:	3 Core Compulsory / Elective	Core Compulsory / Elective		
Max. Ma	rks: 25+75     Min. Passing Marks: As per UGC/ University CBC	Min. Passing Marks: As per UGC/ University CBCS norm.		
Total No	al No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 3-0-0			
Unit	Unit Topics			
	DIFFERENTIAL EQUATIONS			
Ι	Linear differential equation with constant coefficients, Homogeneous Linear differential equation with constant coefficients, Equation Reducible to Homogeneous form.	12		
Π	Second order linear differential equations with variable coefficients: Use of a known solution to find another, normal form, Changing the independent variable, method of variation of parameters.	11		
III	Ordinary Simultaneous Differential Equation, Method of solving simultaneous linear differential equation with constant coefficients, Solution of simultaneous differential equation in a different form	11		
IV	Total differential equation, Necessary and sufficient condition for Integrability of total differential equation, Methods for solving the total differential equation: Solution by inspection, one variable regarded as constant, homogeneous equations, method of auxiliary equations.	11		

### **Suggested Readings:**

- 1. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata–McGraw-Hill
- 2. B. Rai, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa
- 3. M. D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand and Company Ltd., New Delhi.
- 4. L.E. Elsgolts, Differential Equation and Calculus of variations, University Press of the Pacific.
- 5. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

#### This course can be opted as an elective by the students of following subjects: Open to all

### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

#### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.First Year Programme.

### B.A./B.Sc. II (SEMESTER-IV) PAPER-II

### **MECHANICS**

Class: B.	.A. / B.Sc.	Year: SECOND	Semester: FOUI	RTH
Subject:	MATHEMATICS			
Course (	Code: MAT 204 (B030401T)	Course Title: ME	CHANICS	
Course CO1: T dimensi to have	outcomes: The objective of this course is to fam ons. Poinsot's central axis. Wrenches qualitative applications.	iliarize the students with s. Null lines and null plane	various methods of findin s. Conjugate lines and con	ng Forces in three njugate forces and
CO2: A this cour Catenar	A student doing this course is able to n rse, a student will be able to take mor y of uniform strength etc. These enti	nodel problems in nature u re courses on Virtual work, re courses are important ir	sing Statics & Dynamics. Stable and unstable equil engineering and industri	After completing ibrium, Catenary, ial applications.
CO3: T and forc	The object of the course is to give stuces.	dents knowledge of basic	mechanics such as motio	n under other laws
CO4: T hydrody	The student, after completing the connumber of the connumber of the student of th	ourse can go for higher of ng employment in industry	uality problems in mech 7.	nanics such as
Credits:	3	Core Compulsory / Elect	tive	
Max. Ma	arks: 25+75	Min. Passing Marks: As	per UGC/ University CB	CS norm.
Total No	. of Lectures-Tutorials-Practical (i	in hours per week): L-T-	P: 3-0-0	
Unit		Topics		No. of Lectures
	]	MECHANICS		L
Ι	Forces in three dimensions. Poin planes. Conjugate lines and conjug	sot's central axis. Wrenc gate forces.	hes. Null lines and null	12
П	Analytical conditions of equilibri unstable equilibrium, Catenary, Ca	ium of coplanar forces, Natenary of uniform strengtl	Virtual work, Stable and n.	11
III	Motion in a straight line: velocity a coordinate systems. Elastic and coefficient of restitution, Motion ir transverse direction, velocity and a Elastic strings.	ind acceleration, Accelerat inelastic collisions betw a plane: velocity and acce acceleration along tangentia	ions in terms of different veen two objects, The deration along radial and al and normal directions,	11
IV	Motion in resisting medium, Proproducts of inertia. The momenta Central orbits. Apses and apsidal dof a particle in three dimensions.	jectile motion in resisting I ellipsoid.Equimomental listances.Kepler's laws of	g medium Moments and systems. Principle axes. planetary motion, Motion	11

### Suggested Readings :

- 1. R.C. Hibbeler, Engineering Mechanics-Statics, Pearson.
- 2. S L Loney, The Elements of Statics & Dynamics Part-I (Statics), Arihant.
- 3. S L Loney, The Elements of Statics & Dynamics Part-II (Dynamics), Arihant.
- 4. A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill
- 5. J.L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill
- 6. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

#### This course can be opted as an elective by the students of following subjects: Open to all

#### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
 4	Assignment	10

#### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.First Year Programme.

### B.A./B.Sc. III (SEMESTER-V) PAPER-I

### RING THEORY AND LINEAR ALGEBRA

Class: B.A. / B.Sc.		Year: THIRD	Semester: FIF	ГН
Subject: N	<b>IATHEMATICS</b>			
Course Co	ode: MAT 301 (B030501T)	Course Title: RING THE	ORY AND LINEAR AI	LGEBRA
Course ou	tcomes:	ł		
CO1: Obj	ective of this course is to sustain t	the students in Abstract Algo	ebra of almost Advanced	Level.
CO2: Rin course is t	g theory and Linear Algebra is a ointroduce a student to the basics	basic course in almost all of Abstract Algebra, Linear	branches of science. The Algebra and some of its	e objective of this applications.
CO3: Afte	er successful completion of cour- nutative rings, vector spaces.	se, students will enable the	mselves to knowledge of	Polynomial rings
CO4: Stue After com	dent will use this knowledge in pletion of this course students wil	computer science, finance l appreciate its interdisciplir	mathematics and indust ary nature.	rial mathematics.
Credits: 4		Core Compulsory / Electiv	ve	
Max. Mar	ks: 25+75	Min. Passing Marks: As p	er UGC/ University CBC	S norm.
Total No.	of Lectures-Tutorials-Practical	(in hours per week): L-T-	P: 4-0-0	
Unit		Topics		No. of Lectures
		PART-A		
		<b>RING THEORY</b>		
Ι	Introduction to rings, integral of homomorphism, Ideals and que	domains and fields, Charac ptient rings.	teristic of a ring, Ring	8
II	Field of quotients of an integri ideals, principal ideal domai commutative rings.	ral domain, Euclidean dom in, Principal ideal rings,	ain, Prime and maximal Polynomial rings over	7
III	Division algorithm and consec polynomials, Reducibility tests factorization in Z[x].	quences, Principal ideal do s, Irreducibility tests, Eiser	mains, Factorization of nstein criterion, Unique	8
IV	Divisibility in integral domains Euclidean domains.	, Irreducible, Primes, Uniqu	e factorization domains,	7
Unit		Topics		No. of Lectures
		PART-B		
		LINEAR ALGEBRA		
V	Vector spaces, Vector Subspaces dependence of vectors, same and	s, Linear combination, Linea l same spaces, Basis and Dir	ar independence and mension, Quotient space.	8
VI	Linear transformations, The Alg	ebra of linear transformation matrices.	ns, Rank Nullity	7
VII	Linear functionals, Dual space, I forms.	Dual Basis and Dimension, I	Bilinear and Quadratic	8

VIII Change of basis, diag	onal forms, triangular forms, Inner product spaces and norms,				
Orthogonal vectors, O	Orthonormal sets and bases.	7			
Suggested Readings:( Part-A R	Ring Theory)				
1. I. N. Herstein, Topics in Al	gebra, Wiley				
2. Joseph. A. Gallian, Contem	porary Abstract Algebra, Cengage Learning India Private Limite	d, Delhi., Fourth			
impression, 2015.					
<b>3.</b> David S. Dummit, & Richa	rd M. Foote, Abstract Algebra (3rd ed.) (2016), Student Edition.	Wiley India.			
4. Course Books published in	Hindi may be prescribed by the Universities.				
Suggested Readings: :( Part-B	Linear Algebra)				
<b>I.</b> K. Hoffman and R. Kunze	e, Linear Algebra (2 <sup>nd</sup> ed.), Prentice-Hall of India.				
2. Gilbert Strang, Linear Alg	bebra and its Applications, Cengage Learning, 2018.				
<b>3.</b> Stephen H. Friedberg, Arn	(4th (2011) (1007) S	ed.). Pearson.			
4. Serge Lang, Linear Algebri	ra (3rd ed.) (1987), Springer				
5. S. Kumaresan, Linear Alg	ebra- A Geometric Approach, Prentice Hall of India, 1999				
0. Course Books published in Suggestive Digital Platforms/	Web Linke				
Suggestive Digital Trationins/					
National Programme on	Technology Enhanced Learning (NPTEL)				
• SWAYAM					
Massachusetts Institute o	f Technology (MIT) Open Learning				
• Uttar Pradesh Higher Edu	cation Digital Library (UPHEDL)				
National Digital Library	of India (NDLI)				
This course can be opted as an	elective by the students of following subjects:				
Statistics, Physics, Computer Sc	. / App Chem., Bio-Chem, Geography, Economics, Defence & S	strategic Studies,			
BCA, BBA, B. Tech (Engg / Tec	ch).				
Internal Evaluation Methods (	Max. Marks: 25)				
Internal Evaluation shall be base	d on Class test, Presentation and Assignment. The marks shall b	e as follows:			
S.No. Assessment Type	Max. Ma	arks			
1 Class Test-I (Descri	ptive Questions) 5				
2 Class Test-II (Objec	tive Questions) 5				
3 Presentation/ Class	Interaction 5				
4 Assignment	10	)			
Course prerequisites:					

; h ereq

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

### B.A./B.Sc. III (SEMESTER-V) PAPER-II

### **TENSOR ANALYSIS**

Class: B	.A. / B.Sc.	Year: THIRD	Semester: FIFTH	
Subject:	MATHEMATICS		1	
Course (	Code: MAT 302 (B030502T)	Course Title: TENSOR A	NALYSIS	
Course o	outcomes:			
CO1: Thunderstan	he course is aimed at exposing t nding various physical phenomena	he students to foundations a and gives the student the fo	of tensor analysis which bundation in mathematics.	will be useful in
CO2: At concepts	fter completion of this course the in Mathematics. This will be help	e student will have rigorous ful to the student in understa	s and deeper understandir anding pure mathematics a	ng of fundamental and in research.
CO3: Stu which wi	udents will be able to know the con ill prepare the students to take up t	cepts of tensor, basic concep further applications in the rel	ts and developments of dif levant fields.	ferential geometry
CO4: Th studies.	he course enables the students the b	basics of tensor and different	ial geometry for further ap	plication in higher
Credits:	3	Core Compulsory / Electi	ive	
Max. Ma	arks: 25+75	Min. Passing Marks: As J	per UGC/ University CB	CS norm.
Total No	). of Lectures-Tutorials-Practica	ll (in hours per week): L-T-	-P: 3-0-0	
Unit		Topics		No. of Lectures
		TENSOR ANALYSIS		
I	Tensor : Transformation of co tensors, Scalar invariants, Mixe Algebra of tensors, Contraction a	ordinates, Contravariant ar ed tensors, Symmetric and and inner product, Quotient 1	nd covariant vectors and skew –symmetric tensor, aw, Reciprocal tensors.	12
II	Associated tensors, Length of a v Riemannian Metric and Space ar	vector, Unit Vector, Null vec ad Christoffel symbols.	tor and orthogonal vector,	11
III	Covariant differentiation of vec Divergence of a contravariant Divergence of a contravariant ter (1,1), Laplacian of an invariant,	tor and tensor, Ricci's theo vector, covariant vector usor of order two, Divergence curl of a covariant vector.	orem, Gradient of scalar, and conservative vector, e of a mixed tensor of type	11
IV	Riemannian curvature tensor an curvature, Einstein space and Ein	d their properties, Flat space	e, Ricci tensor and scalar	11

### Suggested Readings:

- 1. David C. Kay, Tensor Analysis, Schaum's Outline Series, McGraw Hill 1988.
- 2. R. S, Mishra, A Course in Tensors with Applications to Reimannian Geometry, Pothishala Pvt.Ltd, Allahabad.
- 3. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

### This course can be opted as an elective by the students of following subjects:

Statistics, Physics, Computer Sc. / App Chem., Bio-Chem, Geography, Economics, Defence & Strategic Studies, BCA, BBA, B. Tech (Engg. / Tech).

### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

#### Course prerequisites:

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

### B.A./B.Sc. III (SEMESTER-I) PAPER-III

### DIFFERENTIAL GEOMETRY

Class: B.A	A. / B.Sc.	Year: THIRD	Semester: FIFTH	
Subject: N	<b>IATHEMATICS</b>			
Course Co	ode: MAT 303 (B030502T)	Course Title: DIFFEREN	TIAL GEOMETRY	
Course ou	tcomes:			
<b>CO1:</b> The understand	e course is aimed at exposing the ling various physical phenomena	ne students to foundations and gives the student the fo	of tensor analysis which undation in mathematics.	n will be useful in
CO2: Afte concepts in	er completion of this course the n Mathematics. This will be helpf	student will have rigorou ful to the student in understa	s and deeper understandi anding pure mathematics a	ng of fundamental nd in research.
CO3: Stuc which will	lents will be able to know the con prepare the students to take up fu	cepts of curve, basic concep urther applications in the rel	ots and developments of di evant fields.	fferential geometry
CO4: The studies.	course enables the students the b	asics of tensor and different	ial geometry for further a	pplication in higher
Credits: 3		Core Compulsory / Electi	ve	
Max. Mar	ks: 25+75	Min. Passing Marks: As p	oer UGC/ University CB	CS norm.
Total No.	of Lectures-Tutorials-Practical	(in hours per week): L-T-	-P: 3-0-0	
Unit		Topics		No. of Lectures
	DI	FFERENTIAL GEOMET	TRY	
I	Local theory of curves –space curves dependence of a plane and straight tangent to curve, Order of cont equation of osculating plane, intersection of two surfaces. Ta and rectifying plane.	urves, Regular curve and Pl line, equation of curves in act between curves and sur equation osculating plane ngent, principal normal and	ane curve, twisted curve, space, length of a curve, rfaces, osculating plane, at a point of curve of d binormal, normal plane	12
II	Curvature and torsion, Serret-F normal and binormal, Osculating curves Curve on surface, Regula parameters, Parametric curves, ta and arc length. Angle between ty	Frenet formulae, Direction g circle, Osculating sphere. r point and Singularities of s angent plane and normal lin wo curves on surface.	cosines of the principal Involutes and evolutes of surface, transformation of e, First fundamental form	11
III	Special tensors and its properti orthogonal trajectories. Second f of the second fundamental form,	es, orthogonal trajectories, undamental form of surface, Gauss and Weingarten equ	Differential equation of , Geometric interpretation ation.	11
IV	Identities based on Weingarte Meusnier's theorem. Definitio Equation.	en equation, Normal curv n and Basic Properties	vature and its equation, of Geodesics, Geodesic	11

### Suggested Readings :

- 1. Somasundaram, Differential Geometry, Narosa Publishing House
- 2. Andrew Pressley, Elementary Differential Geometry, Springar Verlag, 2014
- 3. M. P. do Carmo, Differential geometry of curves and surfaces, Prentice Hall 1976.
- 4. Gray, Differential Geometry of Curves and Surfaces, CRC Press, 1998.
- 5. S. Montiel and A. Ros, Curves and Surfaces, American Mathematical Society, 2005.
- 6. B. O'Neill, Elementary Differential Geometry, Elsevier 2006.
- 7. Course Books published in Hindi may be prescribed by the Universities.

### Suggestive Digital Platforms/ Web Links:

- National Programme on Technology Enhanced Learning (NPTEL)
- SWAYAM
- Massachusetts Institute of Technology (MIT) Open Learning
- Uttar Pradesh Higher Education Digital Library (UPHEDL)
- National Digital Library of India (NDLI)

### This course can be opted as an elective by the students of following subjects:

Statistics, Physics, Computer Sc. / App Chem., Bio-Chem, Geography, Economics, Defence & Strategic Studies, BCA, BBA, B. Tech (Engg / Tech).

#### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Class Test-I (Descriptive Questions)	5
2	Class Test-II (Objective Questions)	5
3	Presentation/ Class Interaction	5
4	Assignment	10

#### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

## B.A./B.Sc. III (SEMESTER-VI) PAPER-I METRIC SPACES AND COMPLEX ANALYSIS

Class: B	.A. / B.Sc.	Year: THIRD	Semester: SIXTH	
Subject:	MATHEMATICS			
Course	Code: MAT 304 (B030601T)	Course Title: METR	IC SPACES AND COMPLE	EX ANALYSIS
<b>Course o</b> <b>CO1:</b> Th various p	<b>butcomes:</b> the course is aimed at exposing the obysical phenomena and gives the	students to foundations of student the foundation is	of analysis which will be usefund in mathematics.	ıl in understanding
CO2: A	fter completion of this course th in Mathematics. This will be help	e student will have rigo oful to the student in und	rous and deeper understandi erstanding pure mathematics	ng of fundamental and in research.
CO3: St which wi	udents will be able to know the ill prepare the students to take up	concepts of metric spac further applications in th	e, basic concepts and develop e relevant fields.	pments of analysis
CO4: Th higher st	ne course enables the students the udies.	basics of metric spaces a	and contour integration for fu	rther application in
Credits:	4	Core Compulsory / E	lective	
Max. Ma	arks: 25+75	Min. Passing Marks:	As per UGC/ University CBC	CS norm.
Total No	). of Lectures-Tutorials-Practic	al (in hours per week):	L-T-P: 4-0-0	
Unit		Topics		No. of Lectures
		PART-A METRIC SPACE	s	
Ι	Definition of a Metric Space, I Metric Space, Pseudo-metric, S Metric Space, Distance of a Poi empty Subsets of a Metric Spac Interior Point and Interior of a and Boundary of a Set, Limit Po of a Set ,Dense Sets and Separal	Examples of Metric Spa ubspace of a Metric Spa nt from a Non-empty set e. Open and Closed Sphe Set, Open sets, Equivale int and Isolated Point, De ple Spaces.	ce, Bounded and Unbounded ce, Diameter of a Subset of a t, Distance between two Non- eres, Neighborhood of a point ent Metrics, Exterior, Frontier erived Set, Closed Set, Closure	8
II	Subspace of a Metric Space, Ex Metric Space Cauchy Sequence,	amples, Sequence in a M Complete Metric Space,	etric Space, Convergence in a Isometry and Isometric Space	7
III	Continuous mappings, Sequent Uniform continuity, Homeomo theorem.	al criterion and other clorphism, Contraction m	haracterizations of continuity happing, Banach fixed poin	8
IV	Cover, Compact Sets and Compactness, Continuity and Co Disconnected Space and Disco Components.	compact Space, Finite ompactness, Sequentially nnected Sets, Connected	Intersection Property and Compactness. Separated Sets d Space and Connected Sets	, 7

Unit	Topics	No. of Lectures			
	PART-B COMPLEX ANALYSIS				
V	V Complex numbers as ordered pairs, geometric representation of complex numb Stereographic projection, Continuity and Differentiability of complex function Analytic functions, Cauchy Riemann equations, Harmonic functions.				
VI	Complex integration, Cauchy-Goursat theorem, Cauchy's Integral formula, Formula for first, second and nth derivatives, Cauchy's Inequality, Liouville's Theorem.	le 7			
VII	Series of non-negative terms, convergence and divergence, Comparison test Cauchy's integral test, Ratio tests, Root test, Raabe's logarithmic, De Morgan ar Cauchy's condensation test, Taylor Series, Laurent Series and its examples.	s, d 8			
VIII	Zeroes and poles of order m, Isolated singular points, Types of isolated singular poin , Residues, Residues at poles and its examples, Residue at infinity, Cauchy's residu theorem, Evaluation of improper real integrals, Definite integrals involving sines ar cosines.	ts le 7 ld			
<ul> <li>Suggested Readings: (Part-A Metric Spaces)</li> <li>1. Shanti Narayan, A Course of Mathematical Analysis, S. Chand Publication.</li> <li>2. Satish Shirali and H. L Vasudeva. Metric Spaces, (2009), Springer, First Indian Print.</li> <li>3. S, Kumaresan. Topology of Metric Spaces (2nd ed.), (2014). Narosa Publishing House. New Delhi.</li> <li>4. G. F. Simmons, Introduction to Topology and Modern Analysis (2004), Tata McGraw Hill. New Delhi</li> <li>5. Course Books published in Hindi may be prescribed by the Universities.</li> <li>Suggested Readings: (Part-B Complex Analysis)</li> <li>1. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand Publications.</li> <li>2. J.W.Brown and R.V. Churchill Complex variables and Applications, McGraw-Hill Higher Education.</li> <li>3. T.M. Apostal, Calculus Vol. I, John Wiley &amp; Sons Inc.</li> <li>4. Course Books published in Hindi may be prescribed by the Universities.</li> <li>Suggestive Digital Platforms/ Web Links: <ul> <li>National Programme on Technology Enhanced Learning (NPTEL)</li> <li>SWAYAM</li> <li>Massachusetts Institute of Technology (MIT) Open Learning</li> <li>Uttar Pradesh Higher Education Digital Library (UPHEDL)</li> <li>National Digital Library of India (NDLI)</li> </ul> </li> <li>This course can be opted as an elective by the students of following subjects:</li> <li>Statistics, Physics, Computer Sc. / App Chem., Bio-Chem, Geography, Economics, Defence &amp; Strategic Studie</li> </ul>					
Internal I Internal E	Internal Evaluation Methods (Max. Marks: 25) Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:				
S.No.	Assessment Type Ma:	k. Marks			
1	Class Test-I (Descriptive Questions)	5			
2	Class Test-II (Objective Questions)	5			
3	Presentation/ Class Interaction	5			
4	Assignment	10			

### Course prerequisites:

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

### B.A./B.Sc. III (SEMESTER-VI) PAPER-II

### NUMERICAL ANALYSIS AND OPERATIONS RESEARCH

Class: B.A	A. / B.Sc.	Year: TH	IRD	Semester: S	IXTH	
Subject: N	<b>IATHEMATICS</b>					
Course Co	ode: MAT 305 (B030602T)	Course Title: RESEARCH	NUMERIC	CAL ANALYSIS A	ND OPERAT	IONS
Course ou	tcomes:					
<b>CO1:</b> The a	aim of this course is to teach the s	students the appli	cation of va	rious numerical techr	niques, application	on of
to underst Algebraic	gramming for variety of problems and the basic concept of Numeric and differential equation.	s occurring in dai cal Analysis, the	basic conce	te end of the course to t of linear programm	he student will b ing and to solv	e able
CO2: The Later he ca	main outcome will be that stude an opt for advance course in Num	nts will be able t erical Analysis a	o handle pro nd linear pro	oblems and finding ap ogramming in higher	oproximated sol Mathematics	lution.
CO3: The s of this pap problems a research. CO4: Afte	tudent will be able to solve variou er will enable the students to app and its related problems to apply er successful completion of this	us problems base bly the basic cond in further conce s course students	ed on numer cepts of nu pts and app s have basi	ical techniques. After merical techniques pl lication of Numerical c knowledge of Nur	successful com roblems, transpo Analysis and op merical Analysi	pletion ortation peration is and
operation i	research for higher study and Res	earch.	Core Cor	mulsom / Flooting		
Credits: 4				ipulsory / Elective	CDCC	
Max. Mar	ks: 25+75	Min. Passing	Marks: As	per UGC/ University	CBCS norm.	
Fotal No.	of Lectures-Tutorials-Practical	(in hours per w	eek): L-1-I	2: 4-0-0		
Unit		Topics			No. of Lec	ctures
		PART	-A			
	N	<b>IUMERICAL</b>	ANALYSI	S		
Ι	Error in numerical computat	ions ,Calculus	of finite d	ifferences, Differen	nce	
	operators, Fundamental theory	rem of differen	ntial calcul	us, Interpolation w	rith <sup>8</sup>	
	equal and unequal intervals,	Newton's forw	vard and b	ackward interpolat	ion	
	formulae, Divided difference	interpolation for	ormula, La	grange's interpolat	ion	
	formula.					
II	Solutions of algebraic and trans	scendental equation	ions, Direct	and iterative metho	ds,,	
	Bisection method, Regula-falsi r	nethod, Newton-	Raphson m	ethod, Iteration meth	Od. /	
	Solution of simultaneous linear	equations: Gauss	s-eliminatio	n method, Guass-Jor	dan	
	method, LO decomposition meth	iou, Guass-Seide	i metnoa.			
III	Numerical differentiation derivat	tives using forward	rd and backy	ward formula, Numer	ical	
	Integration, General Quadrature	formula, Trapez	zoidal rule, S	Simpson's one-third	and 8	
	three-eight formulae and Weddle	e's rules.				
IV	Numerical solution of ordinary	differential equ	ation Picar	d method Taylor ser	ries	
	method, Euler's method. Modifie	ed Euler's metho	d. Runge-K	utta method.	7	
	,, _,	/10	,			

Unit	Topics	No. of Lectures	
	PART-B OPERATIONS RESEARCH		
V	Developing mathematical models, Mathematical programming, Linear programming, Convex sets, Convex and concave functions, Theorems on convexity, Linear programming problem (LPP), Simple and general LPP, Solutions of simple LPP by graphical method, Analytical solution of general LPP, Canonical and standard forms of LPP, Slack and surplus variables.	8	
VI	Solution of general LPP by Simplex method. Use of artificial variables in simplex method, Big-M method and Two-Phase method, Concept of duality in linear programming, Theorems on duality, Dual simplex method.	7	
VII	Transportation problem, Solution of transportation problem, Methods for finding Initial basic feasible solution of transportation problem, Optimal solution of transportation problem by modified distribution (MODI) method, Degeneracy in transportation problem, Maximization transportation problem. Assignment problem, Balanced and unbalanced assignment problems. Solution of assignment Problem, Hungarian Method, Maximization Assignment problem.	8	
VIII	Game Theory: Competitive game, Two-Person Zero-Sum (Rectangular) game, Minimax-maximin criteria, Saddle points, Solution of rectangular game with and without saddle points, Huge rectangular games, Dominance rules, Solution of huge rectangular games using rules of dominance, Graphical method for 2xn and mx2 games without saddle points.	7	
<ul> <li>games without saddle points.</li> <li>Suggested Readings:(Part-A Numerical Analysis)</li> <li>1.M. K. Jain, S.R.K. Iyengar &amp; R.K. Jain, Numerical Methods for Engineering and scientificcomputation</li> <li>2.S. S. Sastry, Introductory methods of Numerical Analysis</li> <li>3. Course Books published in Hindi may be prescribed by the Universities.</li> <li>Suggested Readings: (Part-B Operation Research)</li> <li>1. Taha, Hamdy H, Opearations Research- An Introduction, Pearson Education.</li> <li>2. V. S. Verma, Linear Programming and Game Theory, Neelkamal Prakashan, Gorakhpur, 2011.</li> <li>3. Kanti Swarup, P. K. Gupta, Man Mohan Operations research, Sultan Chand &amp; Sons</li> <li>4. Hillier Frederick S and Lieberman Gerald J., Operations Research, McGraw Hill Publication.</li> <li>5. Winston Wayne L., Operations Research: Applications and Algorithms, Cengage Learning, 4<sup>th</sup> Edition.</li> <li>6. Hira D.S. and Gupta Prem Kumar, "Problems in Operations Research: Principles and Solutions", S Chand &amp; C Ltd.</li> <li>7. Kalavathy S., Operations Research, S. Chand.</li> <li>8. Course Books published in Hindi may be prescribed by the Universities.</li> <li>Suggestive Digital Platforms/ Web Links: <ul> <li>National Programme on Technology Enhanced Learning (NPTEL)</li> <li>SWAYAM</li> <li>Massachusetts Institute of Technology (MIT) Open Learning</li> <li>Uttar Pradesh Higher Education Digital Library (UPHEDL)</li> </ul> </li> </ul>			
<b>This cou</b> Statistics BCA, BE	rse can be opted as an elective by the students of following subjects: , Physics, Computer Sc. / App Chem., Bio-Chem, Geography, Economics, Defence & S BA, B. Tech (Engg / Tech).	StrategicStudies,	

### Internal Evaluation Methods (Max. Marks: 25)

Internal Evaluation shall be based on Class test, Presentation and Assignment. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks	
1	Class Test-I (Descriptive Questions)	5	
2	Class Test-II (Objective Questions)	5	
3	Presentation/ Class Interaction	5	
4	Assignment	10	

### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

### B.A./B.Sc. III (SEMESTER-VI) PAPER-III

### PRACTICAL

Class: B.A.	/ B.Sc.	Year: THIRD	Semester: SIXTH					
Subject: MA	ATHEMATICS							
Course Code: MAT 306 (B030603T) Course Title: PRACTICAL								
Course outo	Course outcomes:							
<b>CO1.</b> The n system of lin equations by programmin	CO1. The main objective of the course is to equip the student to solve the transcendental and algebraic equations, system of linear equations, Interpolation, Numerical Integration, ordinary differential equations, ordinary difference equations by using different computer software such as Sage Math/Mathematica /MATLAB / /Maple / Scilab /C programming / R programming etc.							
CO2. After	completion of this course studen	t would be able to solve the	transcendental and algebr	aic equations.				
Credits: 2		Core Compulsory / Electiv	Core Compulsory / Elective					
Max. Mark	s: 25+75	Min. Passing Marks: As p	er UGC/ University CBC	S norm.				
Total No. of	Lectures-Tutorials-Practical	(in hours per week): L-T-P	: 0-0-4					
Unit		Topics		No. of Lectures				
	<ul> <li>Practical / Lab work to be performed in Computer Lab.</li> <li>List of the practicals to be done using Sage Math / Mathematica / MATLAB / Maple / Scilab / R programming / Python / C programming etc.</li> </ul>		60					
I.	Solution of transcender	ntal and algebraic equations	by					
	i. Bisection meth	hod						
ii. Regula Falsi m		nethod						
iii. Newton Raphs		son method						
	iv. Iteration meth	od						
11.	Solution of system of li	inear equations by						
i. LU decomposit		ition method						
ii. Gaussian elimit		ination method						
	iii. Gauss-Seidel	method						
III. Interpolation by								
	i. Newton's forw	ard Interpolation						
	ii. Newton's back	ward Interpolation						
	iv. Divided difference interpolation formula							
IV.	IV. Numerical Integration by							
	<ul><li>i. Trapezoidal Rule</li><li>ii. Simpson's one third rule</li></ul>							
<b>V</b> .	V Numerical Integration by							
i. Simpson's three-eight rule								
	ii. Weddle's Rule							
VI.	VI. Solution of ordinary differential equations by							
	ii. Runge Kutta method							

VII.	Solution of ordinary difference equations by Picard method.	
VIII.	Solution of ordinary difference equations by Taylor series method.	

### Internal Evaluation Methods (Max. Marks: 25)

Practical Internal Evaluation shall be based on Practical File/Record, Class test, Viva-voce and Overall performance. The marks shall be as follows:

S.No.	Assessment Type	Max. Marks
1	Test (Descriptive /Objective Questions)	5
2	Presentation of any one Practical / Class Interaction	5
3	Viva-voce	5
4	Practical File/Record	10

#### External Evaluation Methods (Max.Marks: 75)

Practical External Evaluation shall be based on Viva-voce, Practical File/Record and Practical Exercises. The marks shall be as follows:

Practical Exercise : 01 x 25 Marks	25 Marks
Practical File/Record/ Overall Performance	20 Marks
Viva-voce	30 Marks

There shall be 04 Practical Exercises in Examination comprising 01 as Compulsory.

#### **Course prerequisites:**

To study this course, a student must have passed Mathematics as Major Subject in B.A. /B.Sc.Second Year Programme.

#### Any remarks:

- At least two Computer Programmers and two Computer Operators must be assigned in computer lab.
- There should be a Computer Lab with minimum of 25 computer systems for 50 students with licensed and Free Open Source softwares related to this course.
# **PROPOSED STRUCTURE OF SYLLABUS**

Deen Dayal Upadhyaya Gorakhpur University



दीनदयाल उपाध्याय गोरखपुर विश्वविद्यालय

# B.Sc. BOTANY (FACULTY OF SCIENCE)

# **National Education Policy-2020**

For the first three years of Higher Education (UG)

# UG Syllabus Specimen Structure Table

# Structure for a student of BSc with major <u>Botany</u>, Zoology, Chemistry, Microbiology and Defense and <u>Botany</u> in 3<sup>rd</sup> year

Year/ Semester	Subject Major 1	Subject Major 2	Subject Major 3	Minor/ Elective (other faculty)	Co- curricular minor	Vocational minor	Industrial/ Training/ Project	Credits (Major + Minor)	Remarks
1 <sup>st</sup> year/ I SEM	Botany 8 credits (4+2) +2	Zoology 8 credits (4+2) +2	Chemistry 8 credits (4+2) +2	Any 2 credit per Sem course as	NCC/ NSS/ Rovers			24+4= 28 (+2 co-curr.)	Basic course
1 <sup>st</sup> year/ II SEM	Botany 6 credits	Zoology 6 credits (4+2)	Chemistry 6 credits (4+2)	offered in other Departments during	Ranger/ Sports/ Cultural	2 credits per semester		18+4 = 22 (+2 co-curr.)	
2 <sup>nd</sup> year/ III SEM	Botany 6 credits	Zoology 6 credits	Chemistry 6 credits (4+2)	corresponding odd/ even semester	Activities etc. 2 credits			18+4 = 22 (+2 co-curr.)	
2 <sup>nd</sup> year/ IV SEM	Botany 6 credits	Zoology 6 credits	Chemistry 6 credits (4+2)	per semester			18+4 = 22 (+2 co-curr.)		
3 <sup>rd</sup> year/ V SEM	Botany 10 credits	Zoology 10 credits					4 credits	20+ (2+4)	Only 2 Major
3 <sup>rd</sup> year/ VI SEM	Botany 10 credits (8+2)	Zoology 10 credits (8+2)					4 credits	20+ (2+4)	to be opted
Total credits	46 credits	46 credits	26 credits	8 credits	12 qualifying credits	8 credits	8 qualifying credits	134 credits+ 20 qualifying credits	

The complete UG program shall be of 134 credits + 20 qualifying credits

	SEMESTER-WI	SE TITLES OF THE PAPERS IN B.SC. (BOTAN	<b>Y</b> )				
YEAR	COURSE CODE	PAPER TITLE	CREDITS				
		CERTIFICATE COURSE					
		Semester-I					
	BOT 001	Basics of Botany	2+0				
	<b>BOT 101</b>	Microbiology & Plant Pathology	4+0				
FIRST YEAR	<b>BOT 102</b> (B040102P)	Techniques in Microbiology & Plant Pathology	0+2				
		Semester-II					
	<b>BOT 103</b> (B040201T)	Archegoniates & Plant Architecture	4+0				
	<b>BOT 104</b> (B040202P)	Land Plants Architecture	0+2				
	, ,	DIPLOMA COURSE					
		Semester-III					
	<b>BOT 201</b> (B040301T)	Flowering Plants Identification & Aesthetic Characteristics	4+0				
SECOND	<b>BOT 202</b> (B040302P)	Plant Identification technology	0+2				
YEAR	Semester-IV						
	<b>BOT 203</b> (B040401T)	Economic Botany, Ethnomedicine & Phytochemistry	4+0				
	<b>BOT 204</b> (B040402P)	Commercial Botany & Phytochemical Analysis	0+2				
	, ,	BACHELOR OF SCIENCE					
		Semester-V					
	<b>BOT 301</b> (B040501T)	Plant Physiology, Metabolism & Biochemistry	4+0				
	<b>BOT 302</b> (B040502T)	Molecular Biology & Bioinformatics	4+0				
	<b>BOT 303</b> (B040503P)	Experiments in physiology, Biochemistry & molecular biology	0+2				
THIRD	<b>BOT 304</b> (B040504R)	Project in Botany for Pre-graduation	0+4				
YEAR	(201000111)	Semester-VI					
	BOT 305	Cytogenetics, Plant Breeding & Nanotechnology	4+0				
	(B040601T)						
	<b>BOT 306</b>	Ecology & Environment	4+0				
	(B0400021) POT 307	Cutogenatics Conservation & Environment management	0±2				
	(B040603P)	Cytogenetics, Conservation & Environment management	012				
	<b>BOT308</b> / (B040604R)	Project in Botany for Pre-graduation	0+4				
		TOTAL OPEDITS IN BS¢ BOTANV	$46 \pm 8 (PP)$				

# PROPOSED COURSE STRUCTURE FOR BOTANY (MAJOR)

# **SUBJECT: BOTANY**

#### Subject prerequisites:

- 1. To study Botany, a student must have had the subject Biology/Biotechnology learnt at 10+2 level.
- 2. Keen interest in plants and plant-related research, Potential in mathematics, biology and chemistry
- 3. Skills and aptitude for scientific study and research
- 4. Creativity and good comprehension while working on scientific procedures and research
- 5. Computer aptitude.

### **COURSE INTRODUCTION**

The new curriculum of B.Sc. in Science (Botany) offers essential knowledge and technical skills to study plants in a holistic manner. Students would be trained in all areas of plant biology using a unique combination of core, elective and vocational papers with significant inter-disciplinary components.

Students would be exposed to cutting-edge technologies that are currently used in the study of plant life forms, their evolution and interactions with other organisms within the ecosystem. Students would also become aware of the social and environmental significance of plants and their relevance to the national economy.

B.Sc. Botany Programme covers academic activities within the classroom sessions along with practical concepts at laboratory sessions. Infield, outstation activities and projects are also required to be organized for real-life experience and learning.

Candidates who have curiosity in plants kingdom, ecosystem, love exploring exotic places and wish to work as researchers or professions like Botanist, Conservationist, Ecologist, etc. can choose B.Sc. Botany course.

#### Programme outcomes (POs):

Transformed curriculum shall develop educated outcome-oriented candidature, fostered with discovery-learning, equipped with practice & skills to deal practical problems and versed with recent pedagogical trends in education including e-learning, flipped class and hybrid learning to develop into responsible citizen for nation-building and transforming the country towards the future with their knowledge gained in the field of plant science.

PO 1	CBCS syllabus with a combination of general and specialized education shall introduce the concepts of breadth
	and depth in learning
PO2	Shall produce competent plant biologists who can employ and implement their gained knowledge in basic and
	applied aspects that will profoundly influence the prevailing paradigm of agriculture, industry, healthcare and
	environment to provide sustainable development.
PO 3	Will increase the ability of critical thinking, development of scientific attitude, handling of problems and
	generating solutions, improve practical skills, enhance communication skill, social interaction, increase
	awareness in judicious use of plant resources by recognizing the ethical value system.
PO 4	The training provided to the students will make them competent enough for doing jobs in Govt. and private
	sectors of academia, research and industry along with graduate preparation for national as well as international
	competitive examinations, especially UGC-CSIR NET, UPSC Civil Services Examination, IFS, NSC, FCI,
	BSI, FRI etc.
PO 5	Certificate and diploma courses are framed to generate self- entrepreneurship and self-employability, if
	multiexit option is opted.
PO 6	Lifelong learning be achieved by drawing attention to the vast world of knowledge of plants and their
	domestication.

#### Programme specific outcomes (PSOs):

B.Sc. I Year / Certificate course in Microbial Technology & Classical Botany

This Programme imparts knowledge on various fields of plant biology through teaching, interactions and practical classes. It shall maintain a balance between the traditional botany and modern science for shifting it towards the frontier areas of plant sciences with applied approach. This syllabus has been drafted to enable the learners to prepare them for self-entrepreneurship and employment in various fields including academics as well as competitive exams. Students would gain wide knowledge in following aspects:

1. Diversity of plants and microbes, their habitat, morphology, architecture and reproduction.

2. Plant disease causing microbes, symptoms & control.

3. Economic value of plants and their use in Human Welfare.

#### Programme specific outcomes (PSOs): B.Sc. II Year/ (Diploma in Plant Identification, Utilization & Ethnomedicine)

This course provides a broad understanding of identifying, growing and using plants. This course is primarily aimed to introduce people to the richness of plant diversity found in surrounding areas. Lecture sessions are designed to cover fundamental topics concerning classification of plants and their utilization required for understanding the flora and vegetation. Practical sessions are organized following theory for easy understanding of the various parts of the plants, structural organization of floral parts and diversity therein. Participants are taken to different locations covering a variety of habitats and forest types to acquaint them with the native flora. in the long run, will contribute towards building momentum for people's participation in environmental conservation without compromising on academic rigor and our rich wealth of knowledge inherited over generations.

1. The course will cover conventional topics in Field Botany like Evolutionary History & Diversity ofplants, Complete Morphology, Nomenclature of plants, Systems of Classification, Keys toimportant Families of Flowering Plants, Field Data Collection & Herbarium Techniques.

2. The course is designed to become a commercial crop grower, florist, protected cultivator, greenbelt plant advisor to industries, pharmacologist & taxonomist.

### Programme specific outcomes (PSOs): B.Sc. III Year / Bachelor of Science

The learning outcomes of a three years graduation course are aligned with programme learning outcomes but these are specific to-specific courses offered in a program. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with a multi-dimensional and multidisciplinary approach.

1. Understanding of plant classification systematics, evolution, ecology, developmentalbiology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.

2. This course is suitable to produce expertise in conservation biology like ex-situ conservation, response to habitat change, genotype characterization and reproductive biology.

3.Understanding of various analytical techniques of plant sciences, use of plants asindustrial resources or as a human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants. 4. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.

5. Entrepreneurship Skill Development, Understand the issues of environmental contexts and sustainable development, Inculcation of human values,

6. Strengthen mathematical and computational skills. Enable students to use ICT&AI effectively.

7. Develop	good skills in the laboratory such as observation and evaluation by the use of modern tools and technology.
	Understanding the nature and basic concepts of all the plant groups, their metabolism, components at the
	molecular level, biochemistry, taxonomy and ecology.
	The course will make them aware of natural resources and the environment and the importance of conserving
PSO 1	it. Hands-on training in various fields will develop practical skills, handling equipment and laboratory use
	along with collection and interpretation of biological materials and data. Knowledge gained through theoretical
	and lab-based experiments will generate technical personnel in various priority areas such as genetics, cell and
	molecular biology, plant systematics and biotechnology.
	Botanists are able to contribute to all these fields and therefore, are mainly employed with educational
	institutions, government or public sectors or companies in industries, such as agriculture or forestry, oil,
	chemical, biotechnology, geological survey, environmental protection, drugs, genetic research, plant resources
PSO 2	laboratories, plant health inspection services, lumber and paper, food, fermentation, nursery, fruit and so on.
	Jobs available as a botanist: •Microbiologist, plant pathologist, Taxonomist • Plant Physiologist • Plant
	Biochemist • Researcher • Mycologist • Ecologist • Weed Scientist • Palaeobotanist • Conservationist • Fruit
	Grower • Morphologist • Cytologist • Ethnobotanist • Plant geneticists etc.
	Inculcate strong fundamentals on modern and classical aspects of Botany, understand knowledge of Botany is
PSO 3	an essential pre-requisite for the pursuit of many applied sciences. It will facilitate students for taking up and
	shaping a successful career in Botany and allied sciences.
	Introduction of research project will inculcate research aptitude and passion for higher education and scientific
PSO 4	research.

PROPOSED YEAR WISE STRUCTURE OF B.SC. IN BOTANY										
	(CORE	/ ELE	Subject	· Rot	ES &	PROJECTS)				
Course/ Entry –Exit levels	Paper 1	Credit/ Hrs.	Paper	2	Credit/ Hrs.	Paper 3	Credits /hrs.	Research Project	Credit/ Hrs.	Total Credits/ Hrs.
		1	1	]	[ Sem	ester				
Certificate Course (FIRST YEAR)	Basics of Botany	2/30	Microbiol & Plant Pathology	ogy	4/60	Techniques in Microbiology & Plant Pathology	2/60	Nil	Nil	8/120
II Semester										
	Archegoniates & Plant Architecture	4/60	Land Plan Architectu	its ire	2/60			Nil	Nil	6/120
		1		Ι	II Sen	nester				1
Diploma Course (SECOND YEAR)	Flowering Plants Identification & Aesthetic Characteristics	4/60	Plant Identificat technolog	tion y	2/60			Nil	Nil	6/120
		1	I	Г	V Sen	nester				1
	Economic Botany, Ethnomedicine & Phytochemistry	4/60	Commerc Botany & Phytocher Analysis	mical	2/60			Nil	Nil	6/120
				I	/ Sem	ester				
Bachelor of Science (THIRD YEAR)	Plant Physiology, Metabolism & Biochemistry	4/60	Molecular Biology & Bioinform	atics	4/60	Experiments in physiology, Biochemistry & molecular biology	2/60	*Project-I	4/45	14/ 205
	VI Semester									
	Cytogenetics, Plant Breeding & nanotechnology	4/60	Ecology & Environme	è ent	4/60	Cytogenetics, Conservation & Environment management	2/60	*Project-II	4/45	14/ 205
Comments Total of the * Sug	Credits/Hrs. / lectures: ( topics of each paper can gestive List of Projects n	Credits be taug nention	can be earned ght by on-line/ ed in Detailed	l from O ' Virtual Paper S	)n-line I / ICT ba yllabus	Portals of UGC to cre ased as per choice of	ate Aca the Inst	demic Bank ar itution)	nd 15%	54/ 890
Botany Course is One of the Major Subjects for Biology Students and Minor or Elective for students of other faculties; SecondMajor Subject Can be Zoology/ Biotechnology /Microbiology; Third Major Subject can be from Science or Any other faculty of UGC /AICTE – (Arts/ Agriculture/ Education/ law/ Commerce); Fourth Subject is Minor or Elective to be selected from any one of other Faculties as per student's own interest; One Vocational Course has to be opted from the list given in Syllabus as per NSDC guidelines; One Co-curricular Course is compulsory										
	Inter	nal As	ssessment d	& Exte	ernal .	Assessment			M	
Class Interaction				Marks		External Ass	Practical	s		arks
Quiz				<u> </u>	Report	of Botanical Excursio	n/ Lab V		1	.0
training/ Survey/Collection/ Models						15				
Assignments (Charts/ Flor Botanical Excur	a/ Rural Service/ Technol sion/ Lab Visits/Industria	ogy Dis l training	semination/ g)	/ 8		Practical Reco	ord File		1	.0
* Botanical Excursion/ La	TOTAL ab Visits/Industrial train	ing is c	ompulsory	25					7	75



		<b>CERTIFICATE COURSE /</b>	B.ScI			
	Programme/Course: <i>Certificate in Life Science</i> Year: I S					
		Subject: Botany			*	
Course	Code:	Course Title: Basics of Botany				
BOT	001					
Credits: 2		_	C	ore Com	pulsory	
Max. Mar	ks: 25+7	75	N	lın. Passır	ng Marks:	
<b>T</b> • •	01. 4.	Total No. of Lectures-Tutorials-Practical (in	hours per week): 2-	-0-0		
The studen 1. Understa 2. Differen 3. Understa 4. Learn th 5. Acquain	and the m tiste betw and the m e taxonom ted with	es: e able to: norphology, structure and importance of the org ween various groups of Algae, Fungi, Bryophyt norphology, structure and functions of various p mical terminology and understand the meaning basic concepts of Ecology and Environment.	ganisms tes and Pteridophyto parts of plants. g of the same.	es.		
Unit		Торіс			Lectures (30hrs)	
Ι	<b>Plant diversity: Study of lower plants</b> Study of general characteristics features of Algae, Fungi, Bryophyta, Pteridophyte and Gymnosperms.				8	
	Morphole infloresce	ogy of angiosperms with general account of ty ence, flower and fruit. Adaptation in plants.	pes of habit, root, l	eaf, shoot,	8	
III ]	Basic concepts of ecology and environment, components of ecosystem,7Environmental Pollution, its types and mitigation.7				7	
IV ]	Plant physiology and Biochemistry; basic concept of photosynthesis, respiration; mineral nutrition in plants; Plant Growth hormone: Auxin, Gibberellin and Ethylene.				7	
Course prere Qualification Skill Councils /biomedical S Facilities: Sm Other Requis Suggested Co Continuous In follows:	equisites: To stuc s/ Diplor cience. nart and sites: Vic ontinuou nternal E	dy this course, a student must have qualified 1 ma holder from ITI in (Biology/ Agriculture/ Interactive Class leo collection, Books, CDs, Access to On-line s Evaluation Methods: valuation shall be based on allotted Assignme	0+2 with Biology/ / Biotech/ Forestry e resources, Displa nt and Class Tests.	NSQF leve / Microbio y Charts . The mark	el 3 from Sector blogy/Gardening as shall be as	
Internal Assessment Marks						
Class Interaction 5						
		Quiz		5		
Vin on field area	ulr/ourouro	Seminar		7		
vinor nela woi	rk/excurs	ion/iad visit/technology dissemination etc.		8		
				25		

	CERTIFICATE COURSE/ B.ScI					
Progran	nme/ Course: (	Certificate Course in Microbial Technology & Classical Bo	tany	Year: I	Semester:I	
		Subject: Botony			Paper-II	
Car	rea Cada	Subject. Botany				
	OT101	Course Title: Microbiology & Pla	ant Pathology			
(B(	(40101T)					
Course	outcomes:					
After the completion of the course the students will be able to:						
1. Develop understanding about the classification and diversity of different microbes including viruses, Al						
	Lichens & the	eir economic importance.				
2.	Develop conc	ceptual skill about identifying microbes, pathogens, biofertilizers &	lichens.			
3.	Gain knowled	lge about developing commercial enterprise of microbial products.				
4.	Learn host –p	bathogen relationship and disease management.	0			
5.	Coin Vnovila	dation skills (oral & writing) in life sciences by usage of computer data shout usag of microbas in various fields	& multimedia.			
0.	Understand th	uge about uses of inferoduction of certain selected bacteria algae, fun	ai and lichens			
8.	Gain Knowle	dge about the economic values of this lower group of plant commu	igi and nenens			
		Credits: 4	C	Core Compu	lsory	
		Max Marks: 25+75	М	in Passing N	Jarks:	
		1107. 1101KS. 20115	141	III. I ussing i	iu ko.	
		Total No. of Lectures-Tutorials-Practical (in hours per	week): <b>4-0-0</b>			
	Unit	Topic			No. of Lectures	
					(60 hrs)	
	I	<ul> <li>Indian Botanists, in context with the holistic developmen technology, has to be taught, practiced and assessed via class self-study mentioned under Continuous Internal Evaluation (</li> <li>B. Microbial Techniques &amp; instrumentation</li> <li>Microscopy – Light, phase contrast, electron, scanning a microscopy, staining techniques for light microscopy. Common lab and principle of their working – autoclave, oven, lan Colorimetry and spectrophotometry, immobilization methods, fer</li> </ul>	t of modern interaction/ a CIE). and transmissi equipment of n ninar air flow mentation and	science and ssignments ion electron microbiology , centrifuge fermenters.	1 / 8	
	II	<b>Microbial world</b> Cell structure of Eukaryotic and prokaryotic cells, Gram pubacteria, Structure of a bacteria; Bacterial Chemotaxis, Bacter affecting growth of microbes; measurement of growth; Batch cu of microbes; Sporulation and reproduction and recombination in Viruses, general characteristics, viral culture, Structure of viruses of T4 &, $\lambda$ -phage; Lytic and Lysogenic cycles, viroid, Prions & r Actinomycetes & plasmids and their economic uses.	ositive and G erial Growth c ulture, Synchro bacteria. s, Bacteriophag nycoplasma& p	ram-negativo urve, factor onous growtl ges, Structuro phytoplasma	8 1 8	
	ш	Phycology Range of thallus organization in Algae, Pigments, Re Classification and life cycle of- <i>Nostoc</i> , <i>Hydrodictyon</i> , <i>Oedogonium</i> , <i>Chara; Sargassum</i> , <i>Ectocarpus</i> . Economic importance of algae-Role of algae in soil fertility fixation- Symbiosis;Commercial products of algae –biofuel, Agan	eserve food-R <i>Chlorella</i> , y- biofertilizer r.	eproduction Volvox - Nitrogen	- , 7	
	IV	Mycology General characteristics, nutrition, life cycle, Economic important upto class. Distinguishing characters of Myxomycota: Mastigomycotina, Zygomycota: <i>Rhizopus</i> , Ascomycota:Sau <i>Peziza</i> .Basidiomycotina:Puccinia, Agaricus; Deuteromycot Heterothallism, Physiological specialization, Heterokaryosis &Pa	nce of Fungi, C General ch ccharomyces, <b>ina:</b> Fusarium, urasexuality.	Classification naracters o Penicillium Alternaria	n f 7 ,	

V	Mushroom Cultivation, Lichenology & Mycorrhiza Mushroom cultivation. General account of lichens, reproduction and significance; <i>Mycorrhiza: ectomycorrhiza</i> and <i>endomycorrhiza</i> and their significance.	7
VI	<b>Plant Pathology</b> Disease concept, Symptoms, Etiology & causal complex, Primary and secondary inoculum, Infection, Pathogenicity and pathogenesis, Koch's Postulates. Mechanism of infection (Brief idea about Pre-penetration, Penetration and Post-penetration), Disease cycle (monocyclic, polycyclic and polyetic). Defense mechanism with special reference to Phytoalexin, Resistance- Systemic acquired and induced systemicfungicides- Bordeaux mixture, Lime Sulphur, Tobacco decoction, Neem cake & oil	7
VII	<b>Diseases and Control</b> Symptoms, Causal organism, Disease cycle and Control measures of –Late Blight of Potato, False Smut of Rice/ Brown spot of riceand 'White rust of Crucifers, Red Rot of Sugarcane, Wilting of Arhar, Mosaic diseases on tobacco and cucumber, yellow vein mosaic of bhindi; Citrus Canker, Little leaf of brinjal; Damping off of seedlings, Disease management: Quarantine, Chemical, Biological, Integrated pest disease management	8
VIII	Applied Microbiology Food fermentations and food produced by microbes, amino acids, Production of antibiotics, enzymes, alcoholic beverages, organic acid. Mass production of bacterial biofertilizers, blue green algae, <i>Azolla</i> and <i>mycorrhiza</i> . Plant growth promoting rhizobacteria & biopesticides— <i>Trichoderma sp.</i> and <i>Pseudomonas</i> , Single cell proteins, Organic farming inputs, Microbiology of water,Bioremediation, Production of biofuels, and biodeterioration of materials.	8
This course can b	e opted as an elective by the students of following subjects: Open to all but special	for

<u>B.Sc.</u> Biotech, <u>B.Sc.</u> Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS. Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

# Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:
https://indianculture.gov.in/rarebooks/economic-botany-india
https://community.plantae.org/tags/mooc
futurelearn com/courses/teaching-biology-inspiring-students-with-plants-in-science
https://www.coursera.org/courses?query=plants
http://egyankosh.ac.in/handle/123456789/53530
http://www.classcentral.com/tag/microbiology
https://www.edw.org/learn/microbiology
https://www.cdx.org/tean/incrobiology
https://www.mooc-nst.com/tags/microbiology
https://www.udemy.com/topic/iniciololology/
https://www.livescience.com/52272.what is a viewe html
$\frac{\ln(p_s)}{ w_w } = \frac{\ln(p_s)}{2} + $
https://gciambalnach.in/ims/Economic%20importance%2001%20Aigae.pdi
<u>nttps://www.slideshare.net/sardar1109/algae-notes-1</u>
https://www.onlinebiologynotes.com/algae-general-characteristics-classification/
https://www.sciencedirect.com/topics/immunology-and-microbiology/fungus
https://ucmp.berkeley.edu/fungi/fungi.html
https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf
http://ecoursesonline.iasri.res.in/mod/page/view.php?id=11293
http://www.hillagric.ac.in/edu/coa/ppath/lect/plpath111/Lect.%201%20%20Introduction-Pl%20Path%20111.pdf
http://www.jnkvv.org/PDF/11042020102651plant_pathology.pdf
https://www.apsnet.org/edcenter/disimpactmngmnt/topc/EpidemiologyTemporal/Pages/ManagementStrategies.aspx
https://learn.saylor.org/course/view.php?id=23&sectionid=6821
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy
http://physics.fe.uni-lj.si/students/predavanja/Microscopy_Kulkarni.pdf
https://lipidnanostructuresgroup.weebly.com/
https://zoology4civilservices.wordpress.com/2016/06/18/65/
https://microbenotes.com/laminar-flow-hood/
•

		<b>CERTIFICATE COURSE/ B.S</b>	cI	
Progr	amme/Course:	Certificate Course in Microbial Technology & Clas	ssical Botany Year:	I Semester: I/ Paper-III
		Subject: Botany		
Course Co BOT 102 (B040102	ode: P)	Course Title: Techniques in Microbio	ology &Plant Pathology	
Course of           1.         Un           1al           2.         Do           3.         Pr           4         les	<b>Itcomes:</b> After the instand the instand the instand the instance, evelop skills for actical skills in the interpret to identify Al	the completion of the course the students will be able: struments, techniques, lab etiquettes and good lab practi- identifying microbes and using them for Industrial, Agricu- he field and laboratory experiments in Microbiology & Pa gae. Lichens and plant pathogens along with their Symbio	ces for working in a micro ulture and Environment purp athology. otic and Parasitic association	biology oses.
5. Ca 6. Ca	in initiate his ow in start own enter	n Plant & Seed Diagnostic Clinic rprise on microbial products		
		Credits:2	Core Con	pulsory
	Max. Ma	arks: 25+75	Min. Passir	g Marks:
	Total N	No. of Lectures-Tutorials-Practical (in hours per week): 0-	-0-2	-
Unit	<u>Topic * (M</u>	inimum Any three from each unit depending on facili	ities)	No. of Lectures (60 hrs)
1.	INSTRUMEN 1. Labora 2. Princip centrif 3. Buffer 4. Cleani 5. Prepar 6. Inocula 7. Prepar 8. Phenol	<b>TS &amp; TECHNIQUES</b> ttory safety and good laboratory practices bles and application of Laboratory instruments-microscop- uge, LAF, filtration unit, shaker, pH meter. preparation & titration ng and Sterilization of glassware ation of media- Nutrient Agar and Broth ation and culturing of bacteria in Nutrient agar and nutrien ation of agar slant, stab, agar plate	e, incubator, autoclave, nt broth	7
Π	BACTERIAL IDENTIFICATION         1. Isolation of bacteria.         2. Identification of bacteria.         3. Staining techniques: Gram's, Negative, Endospore, Capsule and Cell Wall.         4. Cultural characteristics of bacteria on NA.         5. Pure culture techniques (Types of streaking).         6. Biochemical characterization:IMViC, Carbohydrate fermentation test, Mannitol motility test, Gelatin liquefaction test, Urease test, Nitrate reduction test, Catalase test, Oxidase test, Starchbydrolysis, Casein bydrolysis			
111	II MYCOLOGICAL STUDY: 1. Isolation of different fungi: Saprophytic, Coprophilous, Keratinophilic. 2. Identification of fungi by lactophenol cotton blue method. <i>Rhizopus, Saccharomyces,</i> <i>Penicillium, Peziza, Ustilago, Puccinia; Fusarium, Curvularia, Alternaria.</i> 3. <i>Agaricus</i> : Specimens of button stage and fullgrown mushroom; Sectioning of gills of <i>Agaricu.</i> 4. Lichens: crustose, foliose and fruticose specimens.			
IV         PHYCOLOGY:           1. Type study of algae and Cyanobacteria – Spirullina, Nostoc. Chlorophyceae - Chlorella, Volvox, Oedogonium, Cladophora, and Chara; Xanthophyceae – Vaucheria; Bacillariophyceae – PinnulariaPhaeophyceae – Sargassum Rhodophyceae - Polysiphonia				7
V	EXPERIMENTAL PLANT PATHOLOGY         1. Preparation of fungal media (PDA) &Sterilization process.         2. Isolation of pathogen from diseased leaf.         3. Identification: Pathological specimens of Brown spot of rice, Bacterial blight of rice, Loose smut of wheat Stam rat of mustard Late blight of rate of Slides of unside table)			

	pycnial& aecial stages of <i>Puccinia</i> , Few viral and bacterial plant diseases.	
	VI PRACTICALS IN APPLIED MICROBIOLOGY-1	
	1. Isolation of nitrogen fixing bacteria from root nodules of legumes.	8
	2. Enumeration of rhizosphere to non rhizosphere population of bacteria.	
	3. Isolation of antagonistic Pseudomonas from soil.	
	4. Microscopic observations of root colonization by VAM fungi.	
	5. Isolation of Azospirillum sp. from the roots of grasses.	
	6. Isolation of phyllosphere microflora.	
	7. Isolation of P solubilizing microorganisms.	
	VII PRACTICALS IN APPLIED MICROBIOLOGY-2	
	1. Wine production.	8
	2. Isolation of lactic acid bacteria from curd.	
	3. Isolation of lipolytic organisms from butter or cheese.	
	4. Immobilized bacterial cells for production of hydrolytic enzymes.	
	5. Enzyme production and assay – cellulase, protease and amylase.	
	6. Immobilization of yeast.	
	7. Isolation of cellulolytic and anaerobic sulphate reducing bacteria.	
	8. Isolation and characterization of acidophilic, alkalophilic and halophilic bacteria.	
	1. Cultivation of Spirulina, & Chlorella in lab for biofuel	
VIII	2. Visit to NBAIM. May, Varanasi(Kashi)/ IMTECH (Institute of Microbia	1 6
	Technology) Chandigarh for viewing Culture Repository	
	3 Visit to higher tilizers and higher tilizers unit to understand about the Unit operation	
	procedures	
	4 Mushroom cultivation for Protein	
	5 Alcohol production from Sugarcane Juice	
Suga	osted Deadings:	
Sugg	esicu Readings.	
Co	urse Books published in Hindi may be prescribed by the Universities.	
1.		
2	Dennen I Dhenker Shorme Trivedi ISDN Code: 078 81 S	142 607 0 65 PBD
۷.	Dubliching House Shivaii Nagar Civil Lines Jainur 302006 ( Pajasthan )	142-097-0 0J, NDD
2	rubiisiiniig riouse Silivaji Nagai Civii Lines, Jaipui - 302000 ( Najastilaii )	
5.		
4.	Practical Botany (Part I) ISBN #:81-301-0008-8 Sunit D Puronit, Gotam K Kukoa& Anamika S	Singnvi Edition:2013
-	Apex Publishing House Durga Nursely Road, Odalpur, Rajastnan (bilingual)	
5.	Nodern Mushroom Cultivation And Recipes (nindi) (nb)ISBN : 9788177545180Edition : 01	rear: 2017Author:
	Singn Riti, Singn UCPublisher: Agrobios (India)	
6.	Biofertilizer Production Manual (nindi) (nb) ISBN : 9788177541274Edition : 01 Year : 201	4Author : Geniot D
	Publisher : Agrobios (India)Language : Hindi	<b>D</b> 1 1 37
1.	Aneja, K. R. 1993. Experiments in Microbiology, Pathology and Tissue Culture, Vishwa	Prakashan, New
Dell	n.	
2.	Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company	y, Pvt. Ltd., New
Dell	ni.	
3.	Kodo, C.I. and Agarwal, H.O.1972. Principles and techniques in Plant Virology, Van N	ostrand, Reinhold
Con	inany. New York	,
4	Madhaveel atha P 2012 A Textbook of Immunology S Chand & Company Pyt Ltd New	Delhi
5	Danday, P.D. 2014 Modow Provision Potential Retention (Vol. 1), S. Chand and Company Dyt. Edd., New J	Jolhi
5.	Failed S. 2014 Modelli Fractical Botaly, (Vol-1) S. Chand and Company FV. Etc., New J	
<u>о</u> .	Sambamurty. A. V.S.S. 2006, A Textbook of Algae, I. K. International Publishing House, Pvt	Ltd.,
7.	Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New	Delh1.
8.	https://agrimoon.com/wp-content/uploads/Mashroom-culture.pdf	
9.	http://nhb.gov.in/pdf/Cultivation.pdf	
10.	https://www.k-state.edu/fungi/Greeting/Publications files/2006%20Handbook.pdf	
11	Sen, Suriit, Acharva, Krishnendu, Rai, Maniula 2019 IBSN - 978-93-88347-23-5 -	Biofertilizers and
Dia	seriada Tashnawald Vallata	Staterunizero und
B101	Desucides . 1 connoworld, Kolkata	

12. http://www.kvkkendrapara.org/pdf/Bio%20Fertilizer%20Production%20and%20marketing.pdf

13. http://www.gbv.de/dms/tib-ub-hannover/751302945.pdf

14. Hochman, Gal, Zilberman, David 2014 IBSN-1461493285- Algae Farming and Its Bio-Products Springer

18. Gokare A. Ravishankar , Ranga Rao Ambati 2019 Handbook of Algal Technologies and Phytochemicals Volume II: Phycoremediation, Biofuels and Global Biomass Production Print ISBN: 9780367178192

19. Amos Richmond Ph.D., Prof. Emeritus, Qiang Hu Ph.D 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, Second Edition Print ISBN:9780470673898

This course can be opted as an elective by the students of following subjects: Open to all but special for <u>B.Sc</u>. Biotech, <u>B.Sc</u>. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS.

# Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Minor field work/excursion/lab visit/technology dissemination etc.	8

#### Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Microbiology/biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Lab Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specimens, Permanent slides, Autoclave, incubator, Oven, laminar flow cabinet, balances, Fermenter, Anaerobic jar and Spectrophotometer.

## Suggested equivalent online courses:

https://community.plantae.org/tags/mooc

futurelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf

http://allaboutalgae.com/benefits/

https://repository.cimmyt.org/xmlui/bitstream/handle/10883/3219/64331.pdf

https://www.mooc-list.com/tags/microbiology

http://www.agrifs.ir/sites/default/files/A%20text%20book%20of%20practical%20botany%201%20%7BAshok%20Bendre%7D%20

<u>%5B8171339239%5D%20%281984%29.pdf</u>

https://www.coursera.org/courses?query=plants

http://egyankosh.ac.in/handle/123456789/53530

https://www.classcentral.com/tag/microbiology

https://www.edx.org/learn/microbiology

https://www.mooc-list.com/tags/microbiology

https://www.udemy.com/topic/microbiology/

	CER	TIFICATE COURSE / I	B.ScI		
Program	nme /Course: <i>Certificate Course in</i>	Microbial Technology & C	lassical Botany	Year: I	Semester: II Paper-I
		Subject: Botany			
Course <b>BOT 1</b> (B0402	Code: 03 01T)	Course Title: Are	chegoniates and I	Plant Arc	hitecture
Course After the 1. De Gymnos 2. Un 3. Un create a 4. Un	outcomes: e completion of the course the students evelop critical understanding on morpho sperms inderstanding of plant evolution and their inderstand morphology, anatomy, repro- knowledge base in understanding the b inderstand the details of external and inter-	will be able to: ology, anatomy and reproduction r transition to land habitat. duction and developmental char asis of plant diversity, econom ernal structures of flowering pla	on of Bryophytes, Pr nges therein through ic values & taxonon ants.	teridophyte h typologic: ny of plant	es and al study and s
creans.	<b>T</b>		Core Compulsor	y	
Max. Ma	arks: <b>25</b> +75		Min. Passing Mar	ks:	
	Total No. of Lectures-Tut	orials-Practical (in hours per w	veek): <b>4-0-0</b>		
Unit	Торіс				Lectures (60hrs)
I	<b>Introduction to Archegoniates &amp; Bryophytes</b> Unique features of archegoniates, Bryophytes: General characteristics, adaptations to land habit, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of <i>Riccia, Marchantia, Anthoceros and Sphagnum</i> . (Developmental details not to be included), economic importance of bryophytes			7	
П	Pteridophytes General characteristics, Early land p examples, Heterospory and seed hal	plants ( <i>Rhynia</i> ). Classification ( pit, stelar evolution, economic i	(up to family) with importance of Pteric	lophytes.	8
III	<b>Gymnosperms</b> Classification and distribution of gy Coniferales and Gnetales, their exar	mnosperms; Salient features of nples, structure and reproduction	f Cycadales, Ginkgo on; economic impor	ales, tance	8
IV	Palaeobotany           V         General account of Cycadofilicales, Bennettitales and Cordaitales; Geological time scale; Brief account of process of fossilization & types of fossils and study techniques; Contribution of Birbal Sahni			ale; Brief on of	8
V	Angiosperm Morphology (Stem, Roots, Leaves & Flowers, Inflorescence) Morphology and modifications of roots; Stem, leaf and bud. Types of inflorescences; flowers, flower parts, fruits and types of placentation: Definition and types of seeds.			owers,	7
VI	Plant Anatomy: Meristematic and permanent tissues, Organs (root, stem and leaf). Apical meristems & theories on apical organization - Apical cell theory, Histogen theory, Tunica - Corpus theory. Secondary growth - Root and stem- cambium (structure and function) annular rings, Anomalous secondary growth - Bignonia, Boerhaavia, Dracaena, Nyctanthes			7	
VII	Reproductive Botany Plant Embryology, Structure of a megasporangium and its types, meg types of pollination, Methods of pol gametophyte, Fertilization, structure fertilization, Apomixis and polyem	microsporangium, microsporog asporogenesis, Structure and ty lination, Germination of pollen e of dicot and monocot embryo pryony.	genesis, Structure of ypes of female game 1 grain, structure of 1 , Endosperm, Doubl	tophyte, male le	8
VIII	Palynology: Pollen structure, pol concepts, Palaeopalynology, Aero evidences.	len morphology, pollen allergy opalynology, Forensic palynolo	, Applied Palynolog ogy, Role in taxonon	gy: Basic nic	7

Suggested Readings: 2. \_\_\_\_\_\_\_ 3. 1. Gangulee H. S. and K. Kar 1992. College Botany Vol. I and II. (New Central Book Agency) Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India. 2. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad. 3. 4. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi. 5. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students - Pteridophyta, S. Chand and Company, 6. 7. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students - Gymnosperms, S. Chand and 8. Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot. Bhatnagar SP (1996) Gymnosperms, New Age International Publisher. 9. 10. Pandey BP (2010) College Botany Vol II S. Chand and Company, New Delhi 11. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London 12. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi. 13. Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House,. 14. P.K.K. Nair- A textbook of Palynology. 15. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin. 16. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press. 17. E.J.Eames . Morphology of Vascular Plants, Standard University Press. 18. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA. 19. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA. 20. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS **Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows: Internal Assessment Marks **Class Interaction** 5 Quiz 5 Seminar 7 Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination) 8 25 Course prerequisites: Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 4 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry). Facilities: Smart and Interactive Class ,wifi facility

Other Requisites: :Videos,Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts Suggested equivalent online courses:

https://www.anbg.gov.au/bryophyte/what-is-bryophyte.html

https://pteridoportal.org/portal/index.php

https://www.conifers.org/zz/gymnosperms.php

http://www.mobot.org/MOBOT/research/APweb/

https://milneorchid.weebly.com/plant-id-for-beginners.html

https://www.botany.org/PlantImages/PlantAnatomy.php

http://webapp1.dlib.indiana.edu/inauthors/view?docId=VAC0868&doc.view=print

https://palynology.org/

http://www2.estrellamountain.edu/faculty/farabee/biobk/Biobookflowers.html

<u>https://</u> https://	/ <u>www.sc</u> /palaeob	iencelearn.org.nz/resourc otany.org/	es/100-plant-reproduction			
		Cl	ERTIFICATE COURSE /	B.ScI		
Progra	amme/C	lass: <i>Certificate Course i</i>	in Microbial Technology & Classical I	Botany	Year: I	Semester: II Paper-II
Subje	ct: Bota	ny				
Cours BOT	se Code 104	2:	Course Title: L	and Plants Ar	chitecture	
(B04	0202P) Course	outcomes:				
1.	The stuc Through	lents will be made aware i field study they will be a	of the group of plants that have given r able to see these plants grow in nature a	ise to land hab and become far	it and the flo niliar with th	owering plants. ne biodiversity.
2.	Student pictures	s would learn to create th as well as videos in case	er small digital reports where they can they are able to find some rare structur	e or phenomen	omed in and	l zoomed out o these plants.
3.	Develop groups t	an understanding by obs o learn the process of evo	ervation and table study of representation in a broad sense.	ve members of	f phylogenet	ically important
4.	Understa	and morphology, anatomy	y, reproduction and developmental cha	nges therein th	rough typolo	ogical study and
5.	Understa Botanist	and the composition, mod	lifications, internal structure &architec	ture of flowerin	ng plants for	r becoming a
-	Credits:	2		Core Co	ompulsory	
]	Max. M	arks: <b>25</b> +75		Min. Pas	ssing Marks:	
		Total No. of	Lectures-Tutorials-Practical (in hours	per week): <b>0-0</b>	-2	
	Unit	Topic				No. of Lectures
	I Bryophytes: Marchantia- morphology of thallus, W.M. rhizoids and scales, V.S. thallus through Gemma cup, W.M. gemmae (all temporary slides), V.S. antheridiophore, archegoniophore, L.S. sporophyte (all permanent slides). <i>Sphagnum</i> - morphology, W.M. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, L.S. capsule and protonema				8	
]	II	Pteridophytes:         Lycopodium: Habit, stem T. S. stobilus V. S., Selaginella: Habit, rhizophore T. S,         stem T. S, axis with strobilus, V.S. of strobilus, Megasporophyll and         microsporophyll.         Equisetum - Habit, rhizome and stem T.S. and V. S. of strobilus.				7
]	III	Gymnosperms		T. C £1. C	-4 1	0
		1. Cycas – seedling Rachis, micro and	g, coralloid root and coralloid root T. S megasporophyll, male cone V. S., mici	., 1. S. of leafle osporophyll T.	S. entire	8
		and V. S. of ovule. and needle R.L.S a	<i>Pinus</i> - Branch of indefinite growth, sp nd T. L. S. of stem, male and female c	our shoot, T. Soone, V.S. of ma	of old stem ale and	
		female cone. 2. <i>Ephedra</i> & <i>Thuja</i>	Habit, stem T. S (young and mature)	, leaf T. S, mal	e and female	
]	IV	Palaeobotany & F	male and female cone, ovule V. S. and Palynology	seed.		

	1. Morphology of <i>Rhynia</i> and fossils gymnosperms & other groups.	6
	2. Visit Birbal Sahni Institute of Palaeosciences or virtual conference with their scientist	
	to learn fossilization.	
	3. Mark and know about Indian geographical sites rich in plant fossils.	
V	Angiosperm Morphology	
	1. To study diversity in leaf shape, size and other foliar features.	0
	2. To study monopodial and sympodial branching.	8
	5. Morphology of Fruits	
	4. Innoisecence types- study from fresh/ preserved specifiens	
	6 Fruits, study from different types from fresh/preserved specimens	
	7 Study of oxules (nermanent slides/ specimens/photographs)- types (anatropous	
	orthotronous amphitronous and campylotronous)	
	8. Modifications in Roots stems, leaves and inflorescences	
	Plant Anatomy:	
VI	Normal & Anomalous secondary thickening - <i>Bignonia</i> , <i>Dracaena</i> , <i>Boerhaaviadiffusa</i>	8
	Nvctanthes	U
	Study of primary and secondary growth in the root and stem of monocots and dicots by	
	section cutting and permanent slides.	
	Study of internal structure of dicot and monocot leaves.	
	Study of structure of stomata.	
	Reproductive Botany	
VII	1. Structure of anther, microsporogenesis and pollen grains	
	2. Structure of ovule and embryo sac development (through slides).	8
	3. Study of embryo development in monocots and dicots.	
	4. Vegetative propagation by means of cutting, budding and grafting exercises.	
	5. Study of seed germination.	
	6. Study of pollen morphology of the following plants – <i>Hibiscus, Vinca, Balsam, Ixora,</i>	
	<i>Crotalaria, Bougainvillea</i> by microscopic observation.	
	7. Calculation of pollen viability percentage using in vitro pollen germination techniques.	
VIII	L Azolla production	/
• 111	2 Production technology of Resins	
	3. Production and propagation of Ornamental <i>Pteris</i> . Cycadales. Conjferales for	
	landscaping.	
	4. Lab method for qualitative testing/ extraction of Ephedrine , Taxol and <i>Thuja</i> oil.	
Suggested	Readings:	
Course Ro	aks nublished in Hindi may be prescribed by the Universities	
Course Do	oks published in filmal may be prescribed by the Universites.	
	),,,,,	
	];	
		<b>-</b> •
	······································	L
	1 = 1, $1 = 1$ , $1$	
Pandey, BP	and Irivedi, P.S. 1997. Bolany Vol. I(10th edition). Vikas Publishing House.	
Pandey, Br	; Misra; Trivedi, P.S. 1997. Botany Vol. II. Vikas Publishing House.	
Pandey, B	P and Chadha. 1997. Botany Vol. III. Vikas Publishing House.	
Santra, SC	and Chatterjee. 2005. College Botany Practical Vol. I. New Central Book Agency	(P) Ltd.
Kumar, S a	and Kashyap. 2003. Manual of Practical Algae. Campus Books International, New	Delhi
Bendre and	Kumar A text book of Practical Botany. Vol I,II., Rastogi Pub. Meerut.	
Suresh Ku	mar , Amar Singh Kashyap Manual of Practical Algae Campus Books Internet , N	lew Delhi.
Santra, SC. 20	05. College Botany Practical Vol. II. New Central Book Agency (P) Ltd.	

This course canbe opted as an elective by the students of following sub	jects:	
Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agricultu	ire, B. Pharma, B.	А.
Suggested Continuous Evaluation Methods: Continuous Internal Evaluation	shall be based on a	allotted
Assignment and Class Tests. The marks shall be as follows:		
Internal Assessment	Marks	
Class Interaction	6	
Field work /Virtual/E-learning /Participation in group discussions	7	
Industrial or Central laboratory training of two weeks in summer/winter	12	
(Compulsory)	25	
Course prerequisites:		
Qualification: To study this course, a student must have qualified 10+2 with Biology	/ NSQF level 3 from	n Sector Skill
Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).		
Facilities: Smart and Interactive Class		
Other Requisites: Microscopes, Stains, Dissection box, Haemocytometer, Specim	ens, Permanent sli	des, Autoclave,
incubator, Oven, laminar flow cabinet, balance		
Suggested equivalent online courses:		
https://www.easybiologyclass.com/topic-botany		
http://www3.botany.ubc.ca/bryophyte/index.html		
http://ecflora.cavehill.uwi.edu/bio_courses/bl14apl/practical_3.1.htm		
http://mydunotes.blogspot.com/p/botany.html		
http://www.fao.org/3/a-v9236e.pdf		
https://iinrg.icar.gov.in/library/nrg/nrg.pdf		
https://agritech.tnau.ac.in/banking/nabard pdf/Azolla%20Cultivation/Model projet	on Azolla cultivati	on.pdf
http://arnoldia.arboretum.harvard.edu/pdf/articles/1977-37-1-propagation-manual-of	-selected-gymnosper	ms.pdf
https://www.fs.fed.us/rm/pubs_other/wo_AgricHandbook730/wo_AgricHandbook727	153 175.pdf	



DIPLOMA COURSE/ BSC II				
Programme /Class: <i>Diploma in Plant Identification, Utilization &amp; Ethnomedicine</i> Year: II				
	Subject: Botany		•	
de:	Course Title: Flowering Plants Identification	ation & Aesthetic	<b>Characteristics</b>	
1T)				
tcomes:				
ompletion of the course the	students will be able to:			
an understanding of the his	tory and concepts underlying various approa	ches to plant taxor	omy and	
ation.				
the major patterns of diver	sity among plants, and the characters and typ	bes of data used to	classify plants.	
are the different approache	s to classification with regard to the analysis	OI data. davalan in danth l	mourlades of the	
ne familiar with major taxa	and their identifying characteristics, and to a	develop in deptil k	nowledge of the	
ver and use diverse taxono	mic resources, reference materials, herbariun	a collections mubl	ications	
ntrepreneur career in plant	s, one can establish a nursery. Start a landsca	ping business. Set	up a farm Or	
antation consultancy firm	,	18,	1	
•	Core Compulsory			
s: <b>25</b> +75	Min. Passing Marks:			
Total No. of Lec	tures-Tutorials-Practical (in hours per week)	: 4-0-0		
	Topic		No. of Lectures	
	-		(60hrs)	
Taxonomic Resources	& Nomenclature			
Components of taxonon	ny (identification, nomenclature, classificatio	n); Taxonomic		
resources: Herbarium- f	unctions & important herbaria, Botanical gar	dens, Flora,	7	
Keys- single access and	multi-access.			
Principles and rules of	Botanical Nomenclature according to ICN (ra	anks and names;		
publication)	ionnal system, type method, author citation,	vanu-		
Types of classification	& Fvidences			
Artificial. natural and pl	volgenetic. Bentham and Hooker (upto serie	s).		
Engler and Prantl (upto	series) angiosperm phylogeny group (APG I	V) classification.	8	
	lass: Diploma in Plant Ide le: IT) tomes: ompletion of the course the understanding of the histition. the major patterns of diver are the different approache ne familiar with major taxa ixonomy of a major plant f ver and use diverse taxonon ntrepreneur career in plants antation consultancy firm s: 25+75 Total No. of Lec Taxonomic Resources Components of taxonon resources: Herbarium- f Keys- single access and Principles and rules of 1 principles of classification Artificial, natural and pl Engler and Prantl (upto	DIPLOMA COURSE/ BSC I           lass: Diploma in Plant Identification, Utilization & Ethnomedicine           subject: Botany           de:         Course Title: Flowering Plants Identification.           IT)         Course Title: Flowering Plants Identification.           IT)         the major plants of the history and concepts underlying various approaction.           the major patterns of diversity among plants, and the characters and typ are the different approaches to classification with regard to the analysis ne familiar with major taxa and their identifying characteristics, and to exonomy of a major plant family.           ver and use diverse taxonomic resources, reference materials, herbarium ntrepreneur career in plants, one can establish a nursery, Start a landsca antation consultancy firm           S: 25+75         Min. Passing Marks:           Total No. of Lectures-Tutorials-Practical (in hours per week)         Topic           Taxonomic Resources & Nomenclature         Components of taxonomy (identification, nomenclature, classification resources: Herbarium- functions & important herbaria, Botanical gar Keys- single access and multi-access.           Principles and rules of Botanical Nomenclature according to ICN (rr principle of priority, binomial system; type method, author citation, publication).           Types of classification & Evidences         Artificial, natural and phylogenetic. Bentham and Hooker (upto series angiosperm phylogeny group (APG I	DIPLOMA COURSE/ BSC II           lass: Diploma in Plant Identification, Utilization & Ethnomedicine         Year: II           subject: Botany	

III	Identification of Angiospermic families -I: (Families can be chosen University wise as per local available flora)	8		
	A study of the following families with emphasis on the morphological peculiarities and economic importance of its members (based on Bentham & Hocker's system)	-		
	Ranunculaceae, Malvaceae, Rutaceae, Fabaceae, Myrtaceae, Cucurbitaceae,			
	Rubiaceae, Asteraceae, Apocynaceae, Acanthaceae, Asclepiadaceae, Solanaceae.			
IV	Identification of Angiospermic families -11: (Families can be chosen University wise as per local available flora)	7		
	A study of the following families with emphasis on the morphological peculiarities			
	Amaranthaceae, Euphorbiaceae, Papaveraceae, Apiaceae, Lamiaceae,			
V	Orchidaceae, Liliaceae, Musaceae, Poaceae. Modern trends in Plant taxonomy:	8		
	Brief idea on Phenetics, Biometrics, Cladistics (Monophyletic, polyphyletic and paraphyletic groups; Plesiomorphy and apomorphy).	o		
VI	TOOLS & SOFTWARES IN PLANT IDENTIFICATION-	7		
VI	Digital Taxonomy (e-flora), Description Language for Taxonomy – DELTA			
	Internet directory for botany.	7		
VII	MS Office: PPT, Microsoft Excel, data entry, graphs, aggregate functions, formulas and	7		
	functions, number systems, conversion devices, secondary storage media. GPS tagging, Plant Identification Apps.			
	Aesthetic Characteristics of Plants:	8		
VIII	Aesthetic characteristics of plants, English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden, Trees, shrubs and shrubberies, climbers and			
	creepers. Some Famous gardens of India.			
Suggestee	d Readings: Rooks published in Hindi may be preserihed by the Universities			
1. 0000				
		] 🗆 🗆 ,		
2	। । । । । । । । । । । । । । । । । । ।			
3. Propaga S.K., Soni	tion And Nursery Management (hindi) (hb) ISBN : 9788177546200Edition : 01Year : 2016 N.Publisher : Agrobios (India)	Author : Pandey		
4. Dr. Ama	ar Singh. DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDD	y Ayurveda in our		
Books colle	ection. Uttar Pradesh Hindi Sansthan, Lucknow			
1. Plant Syster	natics. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House.			
2. Bole, P. V. a	and Vaghani, Y. (1986) Field guide to the common trees of I ndia. Oxford University Press;	Bombay.		
4. Dallwitz, M	. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://delta-intkey	.com		
5. https://www	v.naace.co.uk/school-improvement/ict-mark/			
6. https://www	v.socitm.gov.uk, (2002) Learning in the 21st century Executive briefing A Socitm Insight p	ublication, July		
7. K. B. Aniat	1. ia. (2015)"Electronic Herbarium and Digital Database Preparation of Common Trees of An	and District.		
Gujarat" MI	RP submitted to UGC, WRO, Pune 2015 (unpublished)	,		
8. LizeronErer	nias and R. Subash. (2013) "E-Content Development: A Milestone In The Dynamic Progres	s Of E- Learning"		
9. Pandey, B.	1 Journal of Teacher Educational Research (IJTER) Vol.2 No.1 January, 2013 ISSN: 2319- P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics. Structu	4642 1re. Development		
and Reprodu	action in Flowering Plants. S. Chand & Company Ltd,New Delhi.			
10. Stace, C. A	A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.			
12. Dutta A.C.	2016. Botany for Degree Students. Oxford University Press.			
13. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.				

14. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.

15. Austin, R. 2002. Elements of planting design. New York: John Wiley & Sons.

16. Bertauski, T. 2005. Designing the landscape: An introductory guide for the landscape designer. Upper Saddle River, NJ: Pearson Prentice Hall.

17. Thomas, H., and S. Wooster. 2008. The complete planting design course: Plans and styles for every garden. London: Octopus Publishing Group.

18. Scarfone, S. 2007. Professional planting design: An architectural and horticultural approach for creating mixed bed plantings. New York: John Wiley & Sons.

19. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.Sc. Biotech B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

Suggested Continuous Evaluation Methods: Continuous Internal Evaluation shall be based on allotted Assignment an follows:	d Class Tests. The marks shall be as
Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25
Qualification: To study this course, a student must have qualified 10+2Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ ForesFacilities: Smart and Interactive ClassOther Requisites: : Video collection, Books, CDs, Flora, Herbarium, Charts	with Biology/ NSQF level 3 from Sector stry). Access to On-line resources, Display
Suggested equivalent online courses:         https://www.easybiologyclass.com/topic-botany/         http://egyankosh.ac.in/handle/123456789/53530         https://www.delta-intkey.com/www/desc.htm         https://milneorchid.weebly.com/plant-id-for-beginners.html         https://plants.usda.gov/classification.html         https://www.senecahs.org/pages/uploaded_files/Plant%20Classification.html         https://www.ladykeanecollege.edu.in/files/userfiles/file/Dr_%20S_%20N         https://www.brainkart.com/article/Bentham-and-Hooker-s-classification-         Gymnospermae-and-Monocotyledonae_1000/         https://libguides.rutgers.edu/c.php?g=336690&p=2267037         https://www.delta-intkey.com/	<u>pdf</u> <u>Vongbri%20III%20Sem%20ppt.pdf</u> <u>-of-plantsDicotyledonae,-</u>

		<b>DIPLOMA COURSE/ E</b>	BSC II			
Programme/Cla	Programme/Class: <i>Diploma in Plant Identification, Utilization &amp; Ethnomedicine</i> Year: II Seme Pape					
		Subject: Botany		•		
Course Co BOT 202 (B040302	ode: P)	Course Title: Plant Iden	tification technology			
Cours After t 1. To lea 2. To ob. termin 3. To gai 4. To dev 5. To ide 6. To rec 7. To Un 8. Comp	<ul> <li>Course outcomes: After the completion of the course the students will be able:</li> <li>1. To learn how plant specimens are collected, documented, and curated for a permanent record.</li> <li>2. To observe, record, and employ plant morphological variation and the accompanying descriptive terminology.</li> <li>3. To gain experience with the various tools and means available to identify plants.</li> <li>4. To develop observational skills and field experience.</li> <li>5. To identify a taxonomically diverse array of native plants.</li> <li>6. To recognize common and major plant families.</li> <li>7. To Understand aesthetic characters of flowering plants by making-landscapes,gardens,bonsai,min</li> <li>8. Comprehend the concepts of plant taxonomy and classification of Angiosperms.</li> </ul>					
Cleans	Credits: 2 Core Compulsory					
Max. Mark	s: 25+75		Min. Passing Marks:			
	Т	Total No. of Lectures-Tutorials-Practical (in hours per	week): 0-0-2			
Unit		Topic* *(Perform Any three experiments from each	unit as per facility)	No. of Lecture (60Hrs)		
I	I       Herbarium: Plant collecting, Preservation and Documentation:         Stepwise Practicing Herbarium techniques: a. FIELD EQUIPMENTS, Global Positioning         System (GPS) instrument & Collection of any wild 25 plant specimens b.Learn to handle         Herbarium making tools c. Pressing and Drying of collected plant specimens d. Special         treatments for all varied groups of plants e. Mount on standard herbarium sheets f. Label         domming Standard herbarium sheets f. Label		7			
Π	II       Taxonomic Identification using plant structure         a. Classify 25 plants on the basis of Taxonomic description (Plant Morphology, Anatomy, Reproductive parts, Habit, adaptation anomalies) according to Bentham and Hooker natura system of classification in the following families: Malvaceae, Fabaceae (Papilionaceae), Solanaceae, Scrophulariaceae, Acanthaceae, Labiatae (Lamiaceae), Rubiaceae.			8		
III	III         Identification during excursions           a.Conducting Spot identification (Binomial, Family) of common wild plants from families included in the theoretical syllabus (list to be provided) and making FIELD NOTE BOOK and filling Sample of a page of field-book, used in Botanical Survey of India.		8			
	b. Descril ovaries, f families	be/compare flowers in semi-technical language giving floral diagrams and Floral Formulae. Identify and ass giving reasons.	g V.S. of flowers, T.S. of ign them to their respective			

IV	COLLECTION, PRESERVATION AND STORAGE OF ALGAE, FUNGI	7		
<b>X</b> 7	BRYOPHYTES, PTERIDOPHYTES (Two each)			
V	Botanical Nomenciature & reporting Method:	7		
	<b>a.</b> Orve nomenciature to concerce plants as per ICN fulles and prepare labels as per DSI <b>b.</b> Author Citation Effective Publication and Principle of Priority: To show a specime	/		
	paper on Basic structure of a taxonomic Research published on a new species in taxonomic			
	iournal			
VI	COMPUTERS			
	1. Learning to use EXCEL Microsoft PowerPoint and Word., WORKING	7		
	WITH FOLDER AND WINDOWS UTILITY., CREATE AND MANAGE			
	FILES AND FOLDER TREE			
	2 Dractice browsing different sites using search angines practice and			
	2. I factice blowsing different E Meil services Optical: Values meil redifferent et al.			
	understand different E-Mail services – Outlook, Yanoo mail, rediffmail etc.			
	Practice Creating E-Mail accounts, Sending, Receiving & Storing of mails.			
	3. Create and Participate in virtual conferencing in an interactive Zoom			
	Meeting			
VII	Computer Application in taxonomy			
	1. Use Taxonomic Softwares (Dichotomous Key)	8		
	2. Practicals on Phylogenetic analysis			
	3. Make line drawing of Plants for description			
	4. Using of plant identification apps on android phones			
VIII	1. Create a Bonsai of any plant	8		
	2. Develop a miniature garden			
	5. Draw Layouts of various types of gardens 4. Plant Propagation methods practice			
Suggester	4. 1 fant 1 topagation methods practice			
Course B	coaks nublished in Hindi may be prescribed by the Universities			
	nooks puolisheu in 11inui muy be prescribeu by ine Oniversilies.	חחחחחח		
:00000000	100000.0000			
:00000000				
$1 \mathbf{D} = \mathbf{C} \mathbf{C} \mathbf{C}$	002) A Art of Ministern Plant Caltana A anthia La llura India	House		
1.Day, S.C. (2	003)A Art of Miniature Plant Culture Agrobios. Joanpur, India.			
2. Practical Tax	onomy of Angiosperms By: R K Sinha ISBN: 9/89386/68520 I.K International Publishing.	House Pvt. Ltd.		
1.Day, S.C. (2	(2003) Complete Home Gardening. (2003) Agrobios, Joanpur, India.			
2. Dhopte, A.N	4. (2003) Principles and Techniques for Plant Scientists Agrobios, Jodnpur, India.			
3.Khan, M.R.	(1995) Horticulture and GardeningNiraliPrakashan, Pune. India.			
4.PramilaMeh	ra Gardening for everyone Hind pocket book private limited, New Dehli.			
5.Kumarsen V	. Horticulture ,Saras Publication			
6.Ramesh Bar	igia Learning Computer Fundamentals.,., Khanna Book Publishers			
7.Bose T.K. & Mukherjee, D., 1972, Gardening in India. Oxford & IBH PublishingCo New Delhi.				
8.Sandhu, M.I	K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.			
9. Randhawa, 0	G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.			
10 Bole P	V and Vaghani V (1986) Field guide to the common trees of India Oxford Univers	sity Press.		
Rombay	. and subman, 1. (1900) Fred galac to the common aces of mula. Oxford Onivers	510y 11000,		
11 Way	law I.C. 1001 Diant collecting and hadron in the second second			
11. womers	11. Womersley, J. S. 1981. Plant collecting and herbarium development: A manual.			
12. Brandis	, D. (1906) Indian Trees (London, 5th edition. 1971). International Book Distributors	s; DehraDun.		
13. Dallwitz	z, M. J., Paine, T. A. and Zurcher, E. J. (2003). Principles of interactive keys. http://do	elta-intkey.com		
https://www.n	aace.co.uk/school-improvement/ict-mark/			
14. Manilal	K. S. and M. S. Muktesh Kumar (ed.) (1998) A Hand book of Taxonomy Training, I	DST,N. Delhi		

- 15. Naik, V. N. (1984) Taxonomy of Angiosperms Tata McGrow-Hill Publication Com. Ltd., New Delhi
- 16. Primak, R. B. (2004) A Primer of Conservation Biology. Sinauer Associates, Inc. Publishers
- 17. Quicke, Donald, L. J. (1993) Principles and Techniques of Commemoratory Taxonomy. Blakie, Academic and Professional, London

18. Singh, G (2004) Plant Systematics: Theory and practice Oxford and YBH Publishing Co. Pvt. Ltd., New Delhi.

19. Bridson, D. & L. Forman. eds. 1998. The Herbarium Handbook. 3rd ed. Royal Botanic Gardens,Kew (Reprinted 1999).

20. De Vogel, E.F. 1987. Manual of Herbarium Taxonomy: Theory and Practice. UNESCO, Jakarta.

21. Fosberg, F.R. & M.-H. Sachet. 1965. Manual for tropical herbaria. Int. Bur. Pl. Tax.

&Nom.,RegnumVegetabile Vol. 39. Utrecht.

22. Jain, S.K. & R.R. Rao. 1977. A handbook of field and herbarium methods. Today & Tomorrow's Printers an Publishers, New Delhi.

23. Victor, J.E., M. Koekemoer, L. Fish, S.J. Smithies, M. Mossmer. 2004. Herbarium essentials: the Southern African Herbarium user manual. Southern African Botanical Diversity Network Report No. 25. SABONET, Pretoria.

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.S Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

**Suggested Continuous Evaluation Methods:** 

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Botanical Excursion- compulsory	12
Assignment	8
	25

## **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

## Facilities: Smart and Interactive Class

Other Requisites: : Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts Lab Requisites: Microscopes (Compound, Stereo) Dissection box, stain, Herbarium, Herbarium press, Dryers, Grinder, Reference Flora

Suggested equivalent online courses:

- 1. http://egyankosh.ac.in/bitstream/123456789/13096/1/Unit-5.pdf
- 2. <u>https://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp18.pdf</u>
- 3. <u>https://www.researchgate.net/publication/267510854\_The\_Flowering\_Plants\_Handbook</u>

# Any Other :

**Botanical Excursions:** One teacher along with a batch not more than 7 students be taken for botanical excursion to places of Botanical interest, one in each term. If there are female students in a batch of 7 students, one additional lady teacher is permissible for excursion.

Each excursion will not be more than SEVEN days during college working days. T.A. and D.A. for teachers and nonteaching staff participating in excursions should be paid as per rules. Tour report duly certified by tour in charge teacher and Head of the Department should be submitted at the time of practical examination. For every study tour take the prior permission of the head of the department and Principal.

The marks will be counted under Internal assessment and external assessment both. In external assessment student will have to present his excursion report along with industrial training/central labs visits and BSI or Museum visits.In internal assessment he shall have to label the campus plants with botanical details/develop herbal/floristic

garde A pro idea a hills/0 Herba	n/conserve plants in l ject supported along ubout different types of Oceans/Deserts inclu arium (CNH). Central	ootanical garden/contribute specimens via with photographs taken during field study of inflorescence, flowers and fruits/ At lea ding one Compulsory excursion to Botan Research Institutes/Hot Spots	a collection . / to be submitted g ast three field excu ical Garden, FRI/I	giving comprehens ursions at BSI and Central Na	ive ational
		DIPLOMA COU	RSE/ BSC I	[	
Programm	ne /Class: <b>Diploma in</b>	Plant Identification, Utilization & Ethn	omedicine	Year: II S	emester: IV Paper-I
		Subject: Botany			
Course BOT 2 (B040	e Code: 203 0401T)	Course Title: Economic Botan	ny, Ethnomedicir	ne and Phytochem	listry
After the con 1. Und 2. Und proc 3. knov plan mod	mpletion of the cou lerstand about the u lerstand phytochen ducts produced by the w about the impor- the international states in our daily life lern times.	rse the students will be able to: ses of plants —will know one plant-on nical analysis related to medicinally ne plants tance of Medicinal plants and its use and also about the traditional medici	e employment y important pla eful parts, econo nes and herbs, a	nts and econom omically importa nd its relevance	ic nt in
		Credits: 4		Core Compulso	ory
	Max. Marks: 2	5+75	1) 400	Min. Passing Ma	rks:
Unit		Topic	per week): <b>4-0-0</b>		No. of Lectures (60hrs)
Ι	I Origin and domestication of cultivated plants Centers of diversity of plants, origin of crop plants.Concepts of sustainable development; cultivation, production and uses of Cereals, legumes.			7	
II	Botany of oils, Fibers, timber yielding plants & dyes           Study of the plants with Botanical names, Family, part used, and economic uses yielding Edible           & essential oils; Sugar, Starch; Fibers; Paper, Fumitories & Masticatories, Rubber,Dyes, Timber,biofuel crops.			7	
III	Commercial produced Commercial green Hydroponics.	action of Flowers, Vegetables, and fruit nouse cultivation of rose, tomato, bell p	t <mark>s (To be Chosen</mark> epper, cucumber,	area wise) strawberry using	7
IV	IPR & Traditiona IPR and WTO (TI Infringement, Cop Digital Library, Pro	l <b>Knowledge</b> RIPS, WIPO), Patent Act 1970 and its yrights, Trademarks, Geographical In tection of Traditional Knowledge	amendments,TIFA dications, Tradit	AC,NRDC,Rights, ional Knowledge	8

V	Ethnobotany			
	Methodologies of ethnobotanical research: Field work, Literature, Herbaria and Musea and			
	other aspects of ethnobotany. Importance of ethnobotany in Indian systems of medicine	8		
	(Siddha, Ayurveda and Unani), Role of AYUSH, NMPB, CI-MAP			
VI	Medicinal aspects			
	Study of common plants used by tribes (Aegle marmelos, Ficus religiosa, Eclipta alba,	8		
	Ocimum sanctum and Trichopuszevlanicus) Ethnobotanical aspect of conservation and	_		
	management of plant resources, Preservation of primeval forests in the form of sacred groves			
	of individual species and Botanical uses depicted in our epics.			
	Plants in primary health care: common medicinal plants: Tinospora, Acorus,			
VII	Pharmacognosy	8		
	Preparation of drugs for commercial market - Organoleptic evaluation of drugs - Microscopic			
	evaluation of drugs - Physical evaluation of drugs - Sources of crude drugs – roots, rhizome,			
	bulb, corm, leaves, stems, flowers, fruits and seeds;			
	organoleptic study of Adhatodavasica, Andrographis paniculata, Azadirachta indica, ,Datura			
	metel, Emblica officinalis, Vinca rosea and Zingiber officinale.			
	Herbal Preparations & Phytochemistry :	7		
VIII	Collection of wild herbs - Capsules - compresses - Elixirs - Glycerites - Hydrotherapy or Herbal			
	bath - Herbal oils - Liquid extracts or Tincture - Poultices - Salves - Slippery elm slurry and			
	gruel - Suppositories - Teas. Glycosides and Flavonoids and therapeutic applications.			
	Anthocyanins and Coumarins and therapeutic applications, Volatile oils and and Alkaloids and			
Suggested	plialina cological activities.	<u> </u>		
Suggesteu	Keaungs.			
Cour	se Books published in Hindi may be prescribed by the Universities.			
1. 🗆 🗆 🗠				
2	JUUUUUU, JUUUUUUUUUUUU			
3.	11 and $11$ and $1$			
4. Ausn	aniyePoudne (Hindi) by R.P. Sharma   1 January 2013 YKING BOOKS			
<ol> <li>Kochhar</li> <li>Sambam</li> <li>Singh, D</li> <li>Reddy P</li> <li>Amit Do</li> </ol>	, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edi urthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. 1 .K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency, . Parvatha. 2016. Sustainable crop protection under protected cultivation. Springer, Singapore. ecogrirkar. 2019. A Text Book on Protected Cultivation and Secondary Agriculture. Rajlaxme	tion. New Delhi. India. iPrakashan,		
Auranga 6. Singh, B India.	bad, India. ., B. Singh, N. Sabir and M Hasan. 2014. Advances in protected cultivation. New India Publishin	ng Agency,		
7. Sharma,	OP. 1996. Hill's Economic Botany (Late Dr. AF Hill, adopted by OP Sharma). Tata McGraw Hi	ll Co. Ltd.,		
New Del	hi.			
8. Joe J. Ha	nan. 1997. Greenhouses: Advanced Technology for protected horticulture. CRC Press.			
9. Krishnar	nurthy, K.V. (2004). An Advanced Text rbook of Biodiversity - Principles and Practices. Oxfor	d and IBH		
Publicati	ons Co. Pvt. Ltd. New Delhi			
10. N.K. Ac 11. Manjula (2003)	<ul> <li>10. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).</li> <li>11. Manjula Guru &amp; M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2002).</li> </ul>			
12. P. Gangu	ili, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).			
13. Arthur R Group P	<ol> <li>Arthur Raphael Miller, MichealH.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).</li> </ol>			
14. Jayashre 15. Jain, S. 16. Jeffrey, O 17. Joshi, S.	e Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh,Dehradun C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.London. G. 2000. Medicinal Plants. Oxford and IBH. New Delhi.	Oxford.		
18. Kokate,	C. and Gokeale- Pharmocognacy- NiraliPrakashan, NewDelhi.			
19. Lad, V.	1984. Ayurveda – The Science of Self-healing. Motilal Banarasidass, New Delhi.			
20. Lewis, V	V. H. and M. P. F. Elwin Lewis. 1976. Medical Botany. Plants Affecting Man's Health. A			
a. Wiley In	ter science Publication. John Wiley and Sons, New York.			
21. Farooqui	A. A. and Sreeraman, B. S. 2001. Cultvation of medicinal and aromatic crops. Universities Press.			
DOT				
ROL	ANY-UG-2020 Page25			

22. Harborne, J. B. 199	8. Phytochemical methods	- a guide to modern	techniques of plant	analysis 3 rd edition,	Chapman
and Hall.		-			_

- 23. Yesodha, D., Geetha, S and Radhakrishnan, V. 1997. Allied Biochemistry. Morgan publications, Chennai.1. Gurdeep Chatwal, 1980. Organic chemistry of natural productis. Vol. I. Himalaya Publishing house.
- 24. Kalsi, P. S. and Jagtap, S., 2012. Pharmaceutical medicinal and natural product chemistry. N.K. Mehra for Narosa Publishing House Pvt. Ltd. New Delhi.
- 25. Wallis, T. E. 1946. Text book of Pharmacognosy, J & A Churchill Ltd.
- 26. Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- 27. Jain S. K. 1989. Methods and approaches in Ethnobotany, Society of Ethnobotanists, Lucknow.
- 28. SharolTilgner, N. D. 1999. Herbal medicine From the heart of the earth.Edn. 1, Printed in the USA by Malloy Lithographing Inc.
- 29. Pal, D.C. & Jain, S.K., 1998. Tribal Medicine. Naya Prakash Publishers, Calcutta.
- 30. Datta & Mukerji, 1952. Pharmacognosy of Indian roots of Rhizoms drugs. Bulletin No.1 Ministry of Health, Govt. of India.
- 31. Young Ken, H.W., 1948. Text Book of Pharmacognosy. Blakiston C., Philadelphia.
- 32. Shukla, R.S., 2000. Forestry for tribal development. A.H. Wheeler & Co. Ltd., India.
- 33. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi.
- 34. Bajpai, P.K. 2006. Biological Instrumentation and methodology. S. Chand & Co. Ltd.
- 35. K. Wilson and J. Walker Eds. 2005. Biochemistry and Molecular Biology. Cambridge University Press.
- 36. k. Wilson and KH Goulding. 1986. Principles and techniques of Practical Biochemistry. (3 edn Edward Arnold, London.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Archaeology, B.A. Geology, BAMS

### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

# Facilities: Smart and Interactive Class

Other Requisites: : Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts Suggested equivalent online resources:

https://www.pnas.org/content/104/suppl\_1/8641

https://www.journals.uchicago.edu/doi/pdfplus/10.1086/659998

https://bsi.gov.in/page/en/ethnobotany

http://www.legalserviceindia.com/article/198-Intellectual-Property-and-Traditional-knowledge.html

https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,-Timber-yielding-plant\_1095/ https://www.loc.gov/rr/scitech/tracer-bullets/economic-botanytb.html

http://nsdl.niscair.res.in/bitstream/123456789/127/1/Fibre%20crops%2C%20bamboo%2C%20timber%20-%20Final.pdf https://www2.palomar.edu/users/warmstrong/econpls.htm

https://www.longdom.org/proceedings/phytochemistry-and-phytoconstituents-of-herbal-drugs-and-formulations-1668.htm

		DIPLOMA COURS	E/ BSC II			
Programme: Diploma in Plant Identification, Utilization & EthnomedicineYear: IISemen PaperPaper					ester: IV er-II	
		Subject: Botan	y			
Course Code: <b>BOT 204</b> (B040402P)						
Course of	outcomes: A	$\frac{1}{\sqrt{1}}$	udents will be a	ble to:		
1.Know a 2.Gain th 3.Unders 4.Learn a 5.Can be	about the com e knowledge tand about the bout the chen come a protec	mercial products produced from plants. about cultivation practices of some economic e ethnobotanical details of plants. histry of plants &herbal preparations ted cultivator, aromatic oil producer, Pharma	crops. cologist or quality	y analyst in dru	ıg comp	oany.
Credits: 2 Core Compulsory						
	Max. 1	Marks: <b>25</b> +75		Min. Passing	Marks:	1
	Tota	al No. of Lectures-Tutorials-Practical (in hou	rs per week): <b>0-0-</b>	2		
Unit		Topic (Denfermentining of the second second second		No. of Lectures (60hrs)		
	Fconomi	c Botany & Microtechnique	its if oin cach un	n.)		
I	Cereals: Wheat (habit sketch, L.S./T.S. of grain, starch grains, micro-chemical tests); rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests) Legume: Pea or ground nut (habit, fruit, seed structure, micro-chemical tests) Source of sugars and starches: Sugarcane (habit sketch; cane juice- micro-chemical tests); potato (habit sketch, tuber morphology, T.S. of tuber to show localization of starch grains, W.M. of starch) grains, micro-chemical tests. Tea- tea leaves, tests for tannin Mustard- plant specimen, seeds, tests for fat in crushed seeds Timbers: section of young stem. Jute- specimen, transverse section of stem, tests for lignin on T.S. of stem and study of fiber following maceration technique			8		
	Commerci	al Cultivation				8
II         Field visit to Green houses for understanding Floriculture & vegetables production           Development of hydroponics nutrient solutions & running models for cultivation of vegetables           Development of hydroponics nutrient solutions & running models for cultivation of fodder						
Ш	Cultivating a. Lemon g	g Medicinal and aromatic plants & Essen rass/ Neem/ Zinger /Rose/Mint	ntial oil extractio	on		7

IV.	Documentation from Traditional Knowledge Digital Library,	7	
Mark the Geographic Indications on Map,			
	Understand – Nakshtra Vatika, Navgrahvatika and develop in your college		
	To extract the names of the plants and Botanical uses depicted in our epics.		
	Visit NISCAIR,New Delhi		
V	Ethnobotany		
	Study of common plants used by tribes. Aegle marmelos, Ficus religiosa, Cynodon		
	dactylon.	7	
	Visit a tribal area and collect information on their traditional method of treatment using		
	crude drugs.		
	Familiarize with at least 5 folk medicines and study the cultivation, extraction and its		
	medicinal application.		
Observe the plants of ethnobotanical importance in your area.			
	Visit to an Ayurveda college or Ayurvedic Research Institute / Hospital		
VI	Instrumentation and herbal Preparations		
	Develop Capsules of herbs/ Develop Herbal oils/ Develop Poultice/cream	8	
	Analyse some active ingredients using chromatography /Spectrophotometry		
VII	Pharmacognosy	8	
	Organoleptic studies of plants mentioned in the theory :		
	1. Morphological studies of vegetative and floral parts.		
	2. Microscopic preparations of root, stem and leaf.		
	3. Stomatal number and stomatal index.		
	4. Vein islet number.		
	5. Palisade ratio.		
	6. Fibres and vessels (maceration).		
	7. Starch test		
	8. Proteins and lipid test		
	Phytochemistry:	7	
VIII	Determination of the percentage of foreign leaf in a drug composed of a mixture of leaves.		
	Dimensions of Calcium oxalate crystals in powdered crude drug.		
	Preliminary phytochemical tests for alkaloids, terpenoids, glycosides, volatile oils, tannins		
	& resins.		
~	Any 5 herbal preparations.		
Suggeste	d Readings: Course Books published in Hindi may be prescribed by the Universities.		
1. Pla	nt Ecology And Economic Botany by Dhankar - Sharma - Trivedi, RBD Publication		
2.	Description Control Co		
3. PF	ARMACOGNOSYHindi Edition (Paperback, Hindi, Dr. AkanchaRashi, KHUSHAL JASV	VAND.	
R	A Publication	,,,	
	100000000 <b>2</b>		
<b>-.</b>			
1 1 1 1	T = 1046 Torthealt of Dhamman grants I. C. A. Charach: 11 I. + 1		
1. wallis,	1. E. 1940. Textbook of Pharmacognosy, J & A Churchill Ltd.		
2. Kosenne, A. 2011. Final macognosy. MJF Fublishers, Cheminal.			
4 Pal D C & Jain S K 1998 Tribal Medicine Nava Prakash Publishers Calcutta			
$5$ Datta $\delta$	5. Datta & Mukerij 1952. Pharmacognosy of Indian roots of Rhizome drugs. Bulletin No.1 Ministry of Health		
Govt o	f India	manul,	
6.Young	Ken, H.W., 1948. Text Book of Pharmacognosy Blakiston C. Philadelphia		
7. Shukla	R.S., 2000. Forestry for tribal development A H Wheeler & Co Ltd India		
8. Raychudhuri, S.P., 1991, (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol 1 Today&			
Tomorrow's printers and publishers. New Delhi.			
9. Khasir	nS.MBotanicalMicrotechniques: Principles and Practice-		
10. Samba	murthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Public	lishers.	

lew Delhi.

11. Singh, D.K and K.V. Peter. 2014. Protected cultivation of horticultural crops. New India Publishing Agency

This course can be opted as an elective by the students of the following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.A. (Curators), B.A. Arch, BAMS

# Suggested Continuous Evaluation Methods:

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

## **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry).

Facilities: Smart and Interactive Class

**Other Requisites:** Video collection, Books, CDs, Flora, Herbarium, Access to On-line resources, Display Charts **Lab requisites:** Repository of economic products, Microscopes/ Botanical /Herbal Garden, TLC, Spectrophotometer.

Suggested equivalent online courses:

https://www.entrepreneurindia.co/Document/Download/pdfanddoc-144615-.pdf

http://nopr.niscair.res.in/handle/123456789/45825

https://www.wipo.int/export/sites/www/tk/en/resources/pdf/medical\_tk.pdf

https://www.bentoli.com/commercial-farming-agriculture/



		BACHELOR OF SC	IFNCE/ BSc II	ſ		
	Programme/Class: Bachelor of Science Year: III					
		Subject: BC	TANY			
Course BOT (B040	urse Code: <b>BOT 301</b> Course Title: <b>Plant Physiology, Metabolism &amp; Biochemistry</b> 040501T)					
After the 1. Under 2. Learn 3. Assim 4.Know 1 antioxida	<ul> <li>Course outcomes:</li> <li>After the completion of the course the students will be able to: <ol> <li>Understand the role of Physiological and metabolic processes for plant growth and development.</li> <li>Learn the symptoms of Mineral Deficiency in crops and their management.</li> <li>Assimilate Knowledge about Biochemical constitution of plant diversity.</li> </ol> </li> <li>Know the role of plants in development of natural products, nutraceuticals, dietary supplements, antioxidants.</li> </ul>					
	Credits: 4 Core Compulsory					
	Max. Marks: 25+75 Min. Passing Marks:					
	Total	No. of Lectures-Tutorials-Practical (in ho	urs per week) 4 <b>-0-0</b>			
Unit		Торіс			No. of Lectures(60hrs)	
I	Plant wa Importar significa Criteria deficience Transpor phloem s Carbon Krebs c	ant water relation, Mineral Nutrition, Transpiration and translocation in phloem portance of water, water potential and its components; Transpiration and its nificance; Factors affecting transpiration; Root pressure and guttation. Iteria of essentiality of elements; Role of essential elements; Symptoms of mineral ficiency in major crops, ansport of ions across cell membrane, active and passive transport, Composition of loem sap, girdling experiment; Pressure flow model. <b>rbon Oxidation</b> ebs. cycle. Glycolysis, fate of pyruvate- aerobic and anaerobic respiration and		7 7 7		
	fermentation, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of Krebs cycle, mitochondrial electron transport, oxidative phosphorylation, ATP-Synthetase, Chemiosmotic mechanism, P/O ratio, cyanide-resistant respiration, factors affecting respiration.					

III	<b>Nitrogen Metabolism</b> Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes), Physiology and biochemistry of nitrogen fixation, Ammonia assimilation (GS-GOGAT), reductive amination and transamination, amino acid synthesis.	8
IV	Lipid Metabolism & Photosynthesis Lipid Metabolism: Synthesis and breakdown of triglycerides, -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilization of lipids during seed germination, - oxidation.; Photosynthesis: Pigments, Action spectra and Enhancement effect, Electron transport system and Photophosphorylation, C3 & C4 photosynthesis, CAM- Reaction and Significance	7
V	<b>Plant Development, Movements, Dormancy &amp; Responses</b> Developmental roles of Phytohormones (auxins, gibberellins, cytokinins, ABA, ethylene.), Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red-light responses on photomorphogenesis, Seed physiology & Dormancy, Vernalization	8
VI	<b>Biomolecules</b> <i>Carbohydrates:</i> Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol); Disaccharides(sucrose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin,; storage – starch, inulin). <i>Lipids</i> : Storage lipids: Fatty acids structure and functions, Structural lipids: Phosphoglycerides; Introduction of lipid micelles, monolayers, bilayers	8
VII	<b>Proteins</b> : Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins <b>Nucleic acids</b> : Structure of nitrogenous bases; Structure and function of nucleic acids, Nucleic acid denaturation & Re-naturation.	7
VIII	<b>Enzymes:</b> Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; mechanism of action (activation energy, lock and key hypothesis, induced- fit theory), enzyme inhibition and factors affecting enzyme activity,Allosteric enzymes Introductory concept of -Phytonutrients, Nutraceuticals, dietary supplements and antioxidants	8

# Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities.

- 2. \_\_\_\_\_\_
- 3. ПОПОПОПОПОПОПОЛ. Madan Kumar. 2020.
- 4. Plant Physiology and BiochemistryISBN #:81-301-0035-5Sunil D Purohit, K. Ahmed &Gotam K Kukda Edition: 2013Pages: 368 + VIII Text Book (Hindi)
- 1. Hopkins, W.G. & Hiiner, N.P. Introduction to Plant Physiology (3rd ed.) 2004, John Wiley & Sons.
- A Handbook On Mineral Nutrition And Diagnostic Techniques For Nutritional Disorders Of Crops (pb)ISBN : 9788177543377Edition : 01Year : 2011Author : Pathmanabhan G , Vanangamudi M , Chandrasekaran CN , Sathyamoorthi K , Babu CR , Babu RC , BoopathiPNPublisher : Agrobios (India)
- 3. Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company.
- 4. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 19992, Wadsoworth Publishing Company.
- 5. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd.
- 6. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency.
- 7. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pthways 2008, New
Central Book. Agencies.

- 8. Voet, D. and Voet, J.G., Bio-Chemistry (3rd ed.), 2005, John Wiley & Sons.
- 9. Mathews, C.K., Van Holder, K.E. & Ahren, K.G. Bio-Chemistry (3rd ed.), 2000, Pearson Education.
- 10. Lehninger Principles of Biochemistry. Sixth Edition. 2013. David L. Nelson, Michael M. Cox. Freeman, Macmillan.
- 11. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
- 12. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
- 13. Buchanon, Gruissen and Jones. Plant Physiology & Biochemistry: Biochemistry and Molecular Biology of plants, 2000, I.K. International.
- 14. Ramesh Gupta. Efficacy, Safety and Toxicity brings together all current knowledge regarding nutraceuticals and their potential toxic effects. 2016. Elsevier.
- 15. Harborne, J.B. 1973 . Phytochemical Methods. John Wiley & Sons, New York.
- 16. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.

17. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017

This course can be opted as an elective by the students of following subjects: Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech,

Suggested Continuous Evaluation Methods:Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech//Gardening)

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://www.classcentral.com/course/swayam-plant-physiology-and-metabolism-17732

https://www.wiziq.com/course/3249-plant-physiology-in-10-live-online-classes

https://www.easybiologyclass.com/plant-physiology-free-lecture-notes-online-tutorials-lecture-notes-ppts-mcqs/

https://onlinecourses.swayam2.ac.in/cec19\_bt09/preview

	BACHEL	OR OF	SCIENCE/ BSc I	II	
Programme	/Class: <i>Bachelor of Science</i>		Year: III	Se	emester: V Paper-II
		Subjec	t: <b>BOTANY</b>		
Cours BOT (B04	se Code: 7 <b>302</b> -0502T)	Course	Title: Molecular Biolog	y & Bioinformat	ics
Course ou After the c 1. Underst and transcr 2. Know a 3. Gain wo	<b>Itcomes:</b> completion of the course the stude and nucleic acids, organization of DNA iption process. bout Processing and modification of RN orking knowledge of the practical and the	ents will in prokar	be able to: yotes and Eukaryotes, DNA uslation process, function a oncepts of bioinformatics	A replication mech nd regulation of e	nanism, genetic code xpression.
-	Credits: 4		CC / 1	Elective	
	Max. Marks: 25+75		Min. P	assing Marks:	
	Total No. of Lectures-Tu	torials-Pra	ctical (in hours per week)	4-0-0	
Unit		Topic			No. of Lectures(60hrs)
I	Genetic material Miescher to Watson and Crick- histo experiments, Hershey-Chase, bacteri types of genetic material. DNA conservative. DNA replication (Pro semi–conservative, semi discontinue replication of linear, dsDNA, repli- replication enzymes.	ric perspectiophage ex replication okaryotes a ous RNA icating the	tive, Griffith's and Avery periment, DNA structure, on (Prokaryotes and euk und eukaryotes): bidirecti- priming, Ø (theta) mode 5 éend of linear chromo	's transformation types of DNA, caryotes): semi- onal replication, e of replication, psome including	7
II	<b>Transcription &amp; Regulation of g</b> Types of structures of RNA (mRN Translation, (Prokaryotes and eukary Prokaryotes: Lac operon; and in Euka	gene expre A, tRNA, rotes), gene aryotes	e <b>ssion</b> rRNA), RNA polymerase tic code. Regulation of ge	e- various types; ne expression in	7
III	Principles & Techniques of gene Blotting techniques: Northern, Sor markers i.e. RAPD, RFLP, S Transcriptase-PCR. Introductory antibodies ELISA and Immunode	etic engine uthern and SNPs; DI concept stection	e <mark>ering</mark> I DNA Fingerprinting; N NA sequencing, PCR s of -Hybridoma an	Aolecular DNA and Reverse d monoclonal	8

		1
IV	Applications of Genetic engineering Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); Industrial enzymes (Aspergillase,); Biosafety concerns	7
V	<b>Bioinformatics &amp; its applications</b> Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.	8
VI	<b>Biological databases :</b> Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss- Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, )	8
VII	Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)	7
VIII	<ul> <li>Phylogenetic analysis</li> <li>Introductory concepts of -Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA);</li> <li>Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.</li> </ul>	8
Suggeste Co	ed Readings: Purse Books published in Hindi may be prescribed by the Universities. Dr Pooia Rai.	
2. S ( 3. F 4. 1 5. F 6. F	Sharma       -       Trivedi       Molecular       Biology       And         Sharma       -       -       Sharma       -       Biology       And         Plant Physiology and Biochemistry ISBN #:       81-301-0035-5Author:       Sunil D Purohi         & Gotam K KukdaEdition:       2013Pages:       368 + VIIIType:       Text Book (Hi         Molecular Biology Biotechnology ISBN #:       81-301-0033-9Author:       Sunil D Purohi         Kukda Edition:       2013Pages:       366 + XType:       Text Book (Hindi) Apex Publishing I         Jdaipur, Rajasthan       Bioinformatics Paperback – 1 January 2015 by Dr Archana Pandeya (Author), Santosh       Choubey (Editor), & 2 More Hindi AISECT Ltd.         BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archna       BIOTECHNOLOGY AND GENETIC ENGINEERING (Hindi, Hardcover, Dr. Archna	<b>Biotechnology</b> it, K. Ahmed ndi) it &Gotam K House, Nigam)
<ol> <li>Primr</li> <li>E.J. 0</li> <li>Watsa editio</li> <li>Freife</li> <li>P.K. 0</li> <li>Ghosi Unive</li> <li>Baxey Protes</li> </ol>	rose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York. on, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology on. Cold Spring Harbour Lab. Press, Pearson Pub. elder - Molecular Biology. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): h, Z., Mallick, B. (2008). Bioinformatics – Principles and Applications, 1st edition. New Delh ersity Press. vanis, A.D. and Ouellette, B.F., John (2005). Bioinformatics: A Practical Guide to the Analys ins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.	of the Gene 6th 2016-2017. i, Delhi: Oxford is of Genes and

8. Roy, D. (2009). Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.

9. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.

10. Pevsner J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.

11. Xiong J. (2006). Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press

12. A Textbook Of Basic And Molecular Genetics (pb)ISBN : 9788188826193Edition : 01Year : 2018Author : Dr. Parihar P

#### This course can be opted as an elective by the students of following subjects:

Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophysics, B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture.

**Suggested Continuous Evaluation Methods:**Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### **Course prerequisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://www.edx.org/learn/molecular-biology

https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering

https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090

https://www.coursera.org/courses?query=genetics

https://www.coursera.org/courses?query=molecular%20biology

https://www.edx.org/learn/genetic-engineering

https://www.mooc-list.com/tags/genetic-engineering

https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907

https://nptel.ac.in/courses/102/103/102103013/

		BACHELOR OF SC	IENCE/ BSc III	
	Programme/C	lass: Bachelor of Science	Year: III	Semester: V Paper-III
		Subject: B	otany	
Co <b>B</b> ( (E	ourse Code: OT 303 8040503P)	Course Title: <i>Experiments in</i>	Physiology, Biochemistry &M	<sup>'olecular Biology</sup>
Course	outcomes:			
After th	e completion of the	course the students will be	e able to:	
	<ol> <li>Know and a their metabolic</li> <li>Identify Min</li> <li>Understand engineering</li> </ol>	authentic the physiologica olism neral deficiencies based on and develop skill for con	l processes undergoing in visual symptoms nducting molecular exper	plants along with iments for genetic
	Crea	lits: 2	Core Com	pulsory
	Max. Marks	: 25+75	Min. Passin	g Marks:
	Total No.	of Lectures-Tutorials-Practical	(in hours per week) 0-0-2	
Unit		Topic* <i>*(Perform any three from</i> )	each unit based on facility)	No. of Lectures(60 hrs)
Ι	Plant water relation1. Determination oleaves of Rhoeo /2.Osmosis – by pota3.Effect of temperaof Q10.4.Experiment to der5.Experiment for de6.Structure of stoma7.Determination of8.Experiment to me9.Experiment to me10. Effect of Temp11. Study of miner	n, Mineral Nutrition and trans f osmotic potential of plant c Tradescantia. ato osmoscope experiment ture on absorption of water monstrate the transpiration pl emonstration of Transpiration ata (dicot & monocot) rate of transpiration using co asure the rate of transpiration asure the rate of transpiration erature on membrane permea	by storage tissue and detern enomenon with the bell jar by Four-Leaf Experiment: balt chloride method. by using Farmer's Potomet by using Ganong's potome ability by colorimetric metho	8 nination method er ter od.

II	Nitrogen Metabolism, Photo Synthesis & Respiration	
	1. A basic idea of chromatography: Principle, paper chromatography and column	
	chromatography; demonstration of column chromatography.	8
	2. Separation of plastidial pigments by solvent and paper chromatography.	
	3. Estimation of total chlorophyll content from different chronologically aged leaves	
	(young, mature and senescence) by Arnon method.	
	4. Effect of HCO <sub>3</sub> concentration on oxygen evolution during photosynthesis in an aquatic	
	plant and to find out the optimum and toxic concentration (either by volume measurement	
	or bubble counting).	
	5. Measurement of oxygen uptake by respiring tissue (per g/hr.)	
	6.Determination of the RQ of germinating seeds.	
	7. Effect of light intensity on oxygen evolution in photosynthesis using Wilmott' bubble	
III	Plant Development, Movements, Dormancy & Responses	
	1. Geotropism and phototropism — Klinostàt	8
	2. Hydrotropism	
	a. Measurement of growth — Arc and Liver Auxonometer	
	3 To study the phenomenon of seed germination (effect of light)	
	4. To study the induction of amplace activity in germinating grains	
	4. To study the induction of anylase activity in germinating grants.	
	5. Test of seed viability by TTC method.	
	6. To study the effect of different concentrations of IAA on Avena	
	coleoptile elongation (IAA bioassay)	
	Techniques for biochemical analysis	
137	1. Weighing and Preparation of solutions -percentage, molar & normal	8
IV	solutions, dilution from stock solution etc.	
	2. Separation of amino acids by paper chromatography.	
	3 Detection of organic acids: citric tartaric ovalic and malic from laboratory	
	samples	
	4 Qualitative Analysis of earbohydrates	
	4. Qualitative Analysis of carbonyurates,	
	5. Estimation of reducing sugar by anthrone method,	
	6. Qualitative Analysis of Lipids	
	7. Qualitative analysis of Amino acids and Proteins	
	8. Quantitative Analysis of Nucleic Acids,	
	9. Analysis of dietary supplements, nutraceuticals & antioxidants	
	10. Testing of adulterants in food items.	
v	Genetic material	7
V V	1. Instruments and equipments used in molecular biology.	
	2. Preparation of LB medium and cultivating E.coli on it.	
	3 Isolation of Genomic DNA	
	4. Lealation of DNA from alanta	
	4. Isolation of DNA from plants	
	5. Examination of the purity of DNA by agarose gel electrophoresis.	
	6. Quantification of DNA by UV-spectrophotometer	
	7 Estimation of DNA by diphenylamine method	
	7. Estimation of DTAX by diplicity/dilline method.	
VI	Propagation of models/ charts:	
V 1	1 Study of averagiments actablishing nucleis acid as constinum tarial (Avery et al.	
	1. Study of experiments establishing nucleic acid as genetic material (Avery et al,	7
	Griffith's, Hersney & Chase's and Fraenkel & Conrat sexperiments)through	1
	photographs	
	2. Numericals based on DNA re-association kinetics (melting profiles and Cot	
	curves)	
	3. Study of DNA replication through photographs: Modes of replication - Rolling	
	circle. Theta and semi-discontinuous : Semiconservative model of replication	
	(Messelson and Stahl's experiment). Telomerase assisted end-renlication of	
	linear DNA	
	$\begin{array}{c} \text{Initial DIVA} \\ \text{A Starky of structures of a (DNA (2D or 1.2D)), and 2D)} \\ \end{array}$	
	4. Study of structures of : tRNA (2D and 3D); prokaryotic RNA polymerase and	

		· · · · · · · · · · · · · · · · · · ·	
	eukaryotic RNA polymerase II through photographs		
	5. Study of the following through photographs: Assembly of Spliceosome		
	machinery; Splicing mechanism in group I & group II introns; Ribozymes and		
	Alternative splicing		
	6. Understanding the regulation of lactose (lac) operon (positive & negative		
	regulation) and tryptophan (trp) operon (Repression and De-repression &		
	Attenuation) through photographs.		
	7. Understanding the mechanism of RNAi by photographs		
VII	Genetic Engineering		
	1. Isolation of protoplasts.	7	
	2. Construction of restriction map of circular and linear DNA from the data		
	provided.		
	3. Isolation of plasmid DNA.		
	4. Restriction digestion and gel electrophoresis of plasmid DNA		
	(demonstration/ photograph).		
	5. Calculate the percentage similarity between different cultivars of a species		
	using RAPD profile. Construct a dendrogram and interpret results.		
	6. Agarose gel analysis of plasmid DNA		
	7. Restriction digestion of plasmid DNA -Demonstration of PCR		
	Applications of Genetic engineering	7	
	1. ELISA Test,		
VIII	2. Viability tests of cells		
	3. Study of methods of gene transfer through photographs: Agrobacterium-		
	mediated, direct gene transfer by electroporation, microinjection, microprojectile		
	bombardment.		
	4. Study of steps of genetic engineering for production of Bt cotton, Golden rice,		
	FlavrSavr tomato through photographs.		1
S	uggested Readings:		
	Course Books published in Hindi may be prescribed by the Universities.		
			-
	1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. J	onn wiley & S	sons.
	2. A Laboratory Manual Of Plant, Physiology, Biochemistry And Ecology ISBN : 9/881	//544589Edit	10n :
	01 Year : 2012 Author : Akhtar InamPublisher : Agrobios (India)		
	3. Advanced Methods In Physiology And Biochemistry (pb)ISBN : 9789381191132Edit	ion : 01Year :	
	2016Author : Padmanaban G, Chandrasekaran CN, Thangavelu AU, Dr. Sivakuma	r R, Kalimuth	uΝ,
	Dr. Boominathan P, Dr. AnbarasanP, Agrobios.		
	4. Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRO	C Press.	
	5. Wilson and Walker .Practical Biochemistry: Principles and Techniques. Cambridge U	niversity Press	.U.K.
	6. Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publisher	s.	
	7. Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall,	London	
	This course can be opted as an elective by the students of following subjects:		
	Open to all but special for following: B.Sc. Math, B.Sc. Statistics, B.Sc. Nutrition, B.Sc. Biophy	sics, B.Sc. Biote	ech,
	B.Sc. Forestry, B.Sc. Agriculture.	,	,
	Suggested Continuous Evoluation Mathads.		

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment Marks

Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

#### Course prerequisites:

Qualification: To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech//Gardening) Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts Lab requisites: Electrophoresis units, Gelrocker, UV-transilluminator, Vortex Mixer, Shaker, CVT, HiMedia Biotechnology & Molecular biology Kits/Chemicals, Micropippettes, Elisa reader/Microtitre Reader

Suggested equivalent online courses:

https://www.edx.org/learn/molecular-biology

https://krishikosh.egranth.ac.in/handle/1/5810039999

https://www.classcentral.com/course/swayam-genetic-engineering-theory-and-application-14090

https://www.coursera.org/courses?query=genetics

https://www.coursera.org/courses?query=molecular%20biology

https://www.edx.org/learn/genetic-engineering

https://www.mooc-list.com/tags/genetic-engineering

https://www.classcentral.com/course/edx-molecular-biology-part-1-dna-replication-and-repair-2907

ELOR OF SCIE	ENCE/ BSc III	[
f Science	Year: III	Semester:V Paper-IV
Subject: BOTANY		
Course	Title: Project in Bot	tany for Pre-graduation
mental learning and oply gained knowledge uiry in learners. s, laboratories and her media, internet etc. a ton writing.	deviations from cl e and understanding t bariums and learn in along with data docu	assroom and laboratory for selecting, solving and nportance of discussions, umentation, compilation,
	Core	: Compulsory
	Min. Pass	ing Marks:
actical (in hours per we	eek): <b>0-0-4</b> .	
gestive List Of PROJ	ECTS	
iversity of Village, Soi omotion of WASH in v series and orchards. particular area ervation & domestication Screening of sensitive ence documentaries of zation for plant biodiv teir antimicrobial, nutra	il & seed testing serv villages on /tolerant plant specie innovators , Interne ersity conservation s aceutical and antioxie	vice provision to farmers, es at various locations in t Science ( Social media, ensitization of public. dant properties
	CLOR OF SCIE f Science Subject: BOTANY Course mental learning and oply gained knowledge uiry in learners. s, laboratories and her media, internet etc. a on writing. interest. ctical (in hours per we gestive List Of PROJ iversity of Village, Soi pomotion of WASH in v eries and orchards. particular area rvation & domesticatio Screening of sensitive nce documentaries of zation for plant biodiv eir antimicrobial, nutra	CLOR OF SCIENCE/ BSc III         f Science       Year: III         Subject: BOTANY         Course Title: Project in Bot         mental learning and deviations from cl         opply gained knowledge and understanding         uiry in learners.         s, laboratories and herbariums and learn in         media, internet etc. along with data doct on writing.         linterest.         Core         Min. Pass         ctical (in hours per week): 0-0-4.         gestive List Of PROJECTS         iversity of Village, Soil & seed testing server opmotion of WASH in villages         eries and orchards.         particular area         rvation & domestication         Screening of sensitive/tolerant plant specient         nce documentaries of innovators , Internet         zation for plant biodiversity conservation seir antimicrobial, nutraceutical and antioxitrs

#### **Suggested Continuous Evaluation Methods:**

Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Seminar	10
Thesis/dissertation	10
	25

#### Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: All listed under all papers of the course.

#### Suggested equivalent online courses:

https://ndl.iitkgp.ac.in/

https://asiafoundation.org/what-we-do/books-for-asia?gclid=CjwKCAiA7939BRBMEiwA-hX5J-

 $\underline{OhBITSyPnvj3r8yeio-L9f5uTy1a6oEoALCLa9Ebu0pyz858yQZxoC5wkQAvD\_BwE}$ 

http://www.dli.ernet.in/

http://www.ulib.org/

http://www.tkdl.res.in/

 $\underline{http://www.vigyanprasar.gov.in/digilib}$ 

Directory of Open Access Repositories (DOAR) http://www.opendoar.org

Registry of Open Access Repositories (ROAR)<u>http://roar.eprints.org/</u>

http://www.iscnagpur.ac.in/knowledge\_learning\_files/5.7\_General\_Open\_Access\_e-Resources.pdf

	BACHE	LOR OF SCIEN	NCE/ BSc III	
Pro	gramme/Class: Bachelor of Science	Year: III	Se Pi	emester: VI aper-I
		Subject: Botany		
(	Course Code:	Course Title: Cytoger	netics, Plant Breeding & Na	anotechnology
E E	<b>3OT 305</b> B040601T)			
Course	<b>outcomes:</b> After the completion of the cour	se the students will be a	ible:	
1.Acq	uire knowledge on cell ultrastructure.			
2. Uno	derstand the structure and chemical composit	tion of chromatin and co	oncept of cell division.	
3. Inte	erpret the Mendel's principles, acquire know	ledge on cytoplasmic in	heritance and sex-linked inh	eritance.
4. Uno	derstand the concept of 'one gene one enzym	e hypothesis' along wit	th the molecular mechanism	of mutation.
	Credits: 4		Core Co	mpulsory
	Max. Marks: 25+75		Min. Pass	ing Marks:
	Total No. of Lectures-Tuto	rials-Practical (in hours	per week): <b>4-0-0</b>	0
Unit	Т	opic		No. of Lectures (60hrs)
I	<b>Cell biology</b> Structure and function of cell wall, plasn golgi apparatus, mitochondria, chloropla Organization of nucleus: nuclear envelope Chromosomal nomenclature- chromatic constriction.Organization of chromoson classification. Lampbrush chromosomes idiogram.Cell cycle: G0, G1, S and G2 ph - meiosis. Variation in Chromosome n Euploidy-haploidy, polyploidy- significant inversion and translocation.	na membrane, ribosom st, lysosomes, peroxiso , nucleoplasm and nucle ds, centromere, telon mes- Nucleic acid a s and polytene chror nases – mitosis: open an umber (Numerical abe nee (Structural aberratio	es, Endoplasmic reticulum, omes and cell inclusions - eolus. nere, satellite, secondary and histones- types and mosomes- Karyotype and ad closed mitosis – amitosis errations)- anueploidy and ons) - deletion, duplication,	8
II	<b>Genetics</b> Chromosome theory of inheritance, crossin codominance; Interaction of Genes; Multij Polygenic inheritance; Extra-nuclear Inher determination and Sex chromosomes: Patt	ng over and linkage; Inc ple alleles, Lethal allele itance, Linkage, crossir erns of Sex determinati	complete dominance and s, Epistasis, Pleiotropy, ng over, Concept of sex on in plants	7

III	Plant breeding	
	Selection - mass selection, pure line selection and clonal selection. Genetic basis of selection	8
	methods, Hybridization: Procedure of hybridization, inter generic, inter specific, inter	
	Varietal hybridization with examples. Composite and synthetic varieties, Male sterility,	
	Breeding for pest nathogenic diseases and stress resistance	
IV	Biostatistics:	7
	limitations and uses of statistics Biometry: Data Sample Population random sampling	/
	Frequency distribution- definition only, Central tendency– Arithmetic Mean, Mode and	
	Median; Measurement of dispersion-Coefficient of variation, Standard Deviation, Standard	
	error of Mean; Test of significance: chi- square test for goodness of fit.	
	Plant tissue culture	
V	Principles, components and techniques of <i>in vitro</i> plant cultures, Callus cultures, Cell culture,	8
	cell suspension cultures, Embryogenesis and organogenesis, Protoplastisolation and	
	fusion and somatic hybridization- selection of hybrid cells. Somaclonal variation Plant	
	secondary metabolites production.	
	Nanotechnology	
VI	Fundamentals of nanoscale self-assembly process involved in important functional	7
	biomolecules such as Nucleic acid (DNA and RNA), Proteins, Enzymes. Cell structure and	
	organelles, nanoscale assembly of cellular components (cell membrane and liposomes).	
	Nanoscale assembly of microorganisms (virus). Advantages and applications of biologically	
	Artificial Intelligence in Plant Sciences	
VII	Introductory concepts of -Big Data Analytics, 3-D Printing, Machine learning, Algorithms	8
	of Machine Learning, Expert systems and Fuzzy logic.	
	Introduction to use of Digital technologies – AI& ICT in Botany	
VIII	Educational software- INFLIBNET, NICNET, BRNET, internet as a knowledge repository-	7
	google scholar, science direct, resource management, weather forecasting. ICT Applications	
	to unrefer crops and norreuture.	
Sugges	sted Readings:	
Sugges C	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities</i> .	
Sugges (	sted Readings: Course Books published in Hindi may be prescribed by the Universities.	
Sugges C	sted Readings: Course Books published in Hindi may be prescribed by the Universities.	
Sugges C 1.	ted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i>	
Sugges C 1. 2.	Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities.	ivedi by
Sugges ( 1. 2.	sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescription. Course published in Hindi may be	ivedi by
Sugges ( 1. 2. 3. 4.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i>	ivedi by
Sugge: ( 1. 2. 3. 4.	Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course published by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course published in Hindi may be prescribed by the Universities. Course published by the Unive	ivedi by ons niversity
Sugges ( 1. 2. 3. 4. 5.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Reading Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books publisher</i> <i>Reading Course Course of the Course of th</i>	ivedi by ons niversity 32Edition :
Sugges ( 1. 2. 3. 4. 5.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Bound of the Universities.</i> <i>Bound</i>	ivedi by ons niversity 32Edition :
Sugges ( 1. 2. 3. 4. 5. 6.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books publisher</i> <i>Course Books publisher</i> <i>Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication</i> <i>PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct</i> <i>PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U</i> <i>Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447</i> <i>03Year : 2018Author : Dr. Purohit SS , Mathur S</i> <i>Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani</i>	ivedi by ons niversity 32Edition : i Pubishers
Sugges ( 1. 2. 3. 4. 5. 6.	Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071	ivedi by ons niversity 32Edition : i Pubishers
Sugges ( 1. 2. 3. 4. 5. 6. 7.	Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-6	ivedi by ons niversity 32Edition : i Pubishers
Sugges ( 1. 2. 3. 4. 5. 6. 7.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books publisher</i> <i>Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit &amp; Gotam K Kukda, Apex Publishing House</i>	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8.	sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing I David	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8.	Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication Publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House Baden Prainaen (Hindi) Handaevan 1 Lanuary 2016 by Chandra Prainach Shali	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9.	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books published in Hindi may be prescribed by the Universities.</i> <i>Course Books publisher</i> <i>Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0 <i>D Purohit &amp; Gotam K Kukda, Apex Publishing House</i> <i>Genetics and Biotechnology Sunil D Purohit, K. Ahmed &amp; Gotam K Kukda Apex Publishing House</i> <i>PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author) Pointer Publishers Lainur</i></i>	ivedi by ns niversity 32Edition : i Pubishers 0066-1Sunil x
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9.	sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi 2/e PBGupta P K (Hindi) rastogi Publication Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author)Pointer Publishers, Jaipur PLANT BREFDING - PRINCIPLE F AND METHODS B D SINCH - IN HINDI	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil x
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9. 10	sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher is a statement of the prescribed by the Universities. Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publicatic PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-6 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author)Pointer Publishers, Jaipur P. LANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil x 1
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11	sted Readings: <i>Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Course Books publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 <i>Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit &amp; Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed &amp; Gotam K Kukda Apex Publishing House PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author)Pointer Publishers, Jaipur D. PLANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI .</i></i>	ivedi by ons niversity 32Edition : i Pubishers 0066-1Sunil k l
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11	sted Readings: Sted Readings: Sourse Books published in Hindi may be prescribed by the Universities. Sharma and Tr RBD Publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publication PLANT BIOTECHNOLOGY (HINDI) October 2019 Publisher: Kindle Direct PublishingISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author)Pointer Publishers, Jaipur D. LANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI . Description: Commission for Scientific ant Technical Terminology (CSTT)	ivedi by niversity 32Edition : i Pubishers 0066-1Sunil x l
Sugges ( 1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11 12	sted Readings: Sted Readings: Course Books published in Hindi may be prescribed by the Universities. Course Books published in Hindi may be prescribed by the Universities. Sharma and Tr RBD Publisher Cell Biology And Genetics (Hindi) 2/e PBGupta P K (Hindi) rastogi Publicatic Publishing ISBN: ISBN: 9781698665283 Authors:H. R. Dagla Jai Narain Vyas U Biotechnology: Fundamentals And Application (hindi) (hb) ISBN : 97881775447 03Year : 2018Author : Dr. Purohit SS , Mathur S Biotechnology (Hindi) (Hindi, Paperback, B.D.Singh) Hindi Publisher: Kalyani ISBN: 9789327246070, 9327246071 Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-4 D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House PadapPrajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shuk (Author)Pointer Publishers, Jaipur D. PLANT BREEDING : PRINCIPLE AND METHODS B D SINGH - IN HINDI . Description: Commission for Scientific and Technic Terminology (CSTT)	ivedi by ns niversity 32Edition : i Pubishers 0066-1Sunil x 1 nd

- 1. G.M. Cooper. (2015). The cell: A Molecular Approach. 7th Edition. Sinauer Associates.
- Alberts, B., Johnson, A.D., Lewis, J., Morgan, D., Raff, M., Roberts, K., Walter, P. (2014). Molecular Biology of Cell. 6th Edition. WW. Norton & Co.
- 3. Campbell, M.K. (2012) Biochemistry, 7th ed., Published by Cengage Learning.
- 4. Campbell, P.N. and Smith, A.D. (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
- 5. Tymoczko, J.L., Berg, J.M. and Stryer, L. (2012). Biochemistry: A short course, 2nd ed., W.H.Freeman.
- 6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) Biochemistry, W.H.Freeman and Company
- 7. Nelson, D.L. and Cox, M.M. (2008). Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed., W.H. Freeman and Company.
- 8. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
- 9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell. 8<sup>th</sup>edition.Pearson Education Inc. U.S.A.)
- 10. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th e
- 11. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India.5th edition.
- 12. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A..
- 13. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.
- 14. M K Raxdan An Introduction to Plant Tissue Culture -; Oxfird& IBH Publishing Co.Pvt. Ltd., New Delhi
- 15. Aggarwal SK (2009) Foundation Course in Biology, 2nd Edition, Ane Books Pvt. Ltd
- 16. Allard RW (1960) Principles of Plant Breeding. John willey and Sons. Inc. New York
- 17.BD Singh (2003) Plant Breeding. Kalyani Publishers
- 18. Cohn, N.S. (1964) Elements of Cytology. Brace and World Inc, New Delhi
- 19. Darnel, J.Lodish, Hand Baltimore, D. (1991) Cell and molecular biology. Lea and Fibiger, Washington.
- 20. De Robertis, E.D.P and Robertis, E.M.P (1991) Cell and molecular biology Scientific American books.
- 21. Dobzhansky, B (1961) Genetic and origin of species, Columbia university Press New York
- 22. Durbin (2007) Biological Sequence Analysis. Cambridge University Press India Pvt. Ltd
- 23. Gerald Karp (1985) Cell biology, Mc Graw Hill company..
- 24. Lewin, B, (1994) Genes, Oxford University Press, New York.
- 25. Lewis, W.H (1980) Polyploidy. Plenum Press, New York.
- 26. Nicholl T (2007) An Introduction to Genetic Engineering, Cambridge University Press India Pvt. Ltd
- 27. Roy S.C. and Kalayankumar De (1997) Cell biology. New central Boos Calcutta
- 28. Sandhya Mitra,(1998) Elements of molecular biology. Macmillan, India Ltd.
- 29. Sharma JR (1994) Principles and Practices of Plant Breeding. Tata McGraw-Hill Pub. Co. New Delhi
- 30. Sharma, A.K and Sharma A (1980) Chromosome technique Theory and practice, Aditya Books, New York
- 31. Swanson, C.P (1957) Cytology and Genetics. Englewood cliffs, NewYork.
- 32. Taylor (2008) Biological Sciences. Cambridge University Press India Pvt. Ltd
- 33. Twymann, R.M. (1998) Advanced molecular biology Viva books New Delhi.
- 34. Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd
- 35. A. J. Nair . Basics of Biotechnology- Laxmi Publications, New Delhi.
- 36. S S Purohit and S K Mathur; Biotechnology-Fundamentals and Application- Agrobotanica, India.
- 37. A. J. Nair Introduction to Genetic Engineering &Biotechnology.Jones& Bartlett Publishers, Boston,USA.
- 38. H S Chawla Introduction to Plant Biotechnology-; Oxford & IBH publishing Co.Pvt.Ltd., New Delhi.
- 39. H D Kumar Modern concept of Biotechnology, Vikas Publishing House, Pvt. Ltd., New Delhi.
- 40. P C Trivedi ,Plant biotechnology, Recent Advances Panima Publishing Corporation, New Delhi.
- 41.Du, C., and S. A. Jackson. 2019. Machine learning and complex biological data. Genome Biology 20: 76. https://doi.org/10.1186/s13059-019-1689-0
- 42. Alexis and Mathew Leon., Fundamentals of Information Technology Leon Vikas
- 43. Plant R. E., Stone N. D. (1991). Knowledge-based systems in agriculture. McGraw-Hill, Inc. 1221 Avenue of the Americas, New York, NY 10020.
- 44. Han S., Steward B.L., Tang L. (2016). Intelligent agricultural machinery and field robots. In Zhang Q. Precision agriculture technology for crop farming (pp.133-176). CRC Press, Taylor&Francis Group, New York.
- 45. Lucci S., Kopec D. (2013). Artificial intelligence in the 21st century. 22841 Quicksilver Drive Dulles, VA

20166.

- 46. V.Rajaraman Introduction to Information Technology,., Prentice Hll.
- 47. Ramesh Bangia Learning Computer Fundamentals., Khanna Book Publishers
- 48.Bass, Joel,E and et. al., Allyn & Bacon, 2009 .Methods for Teaching Science as Inquiry, The truth of science, Newton R.G.,
- 49. R. Rangaswami (2009) A Text book of Agriculture Statistics .New Age International (P) Limited, Hyderabad.
- 50. Nageshwar Rao G.(2007) Statistics for Agriculture Sciences BS Publications. New Delhi
- 51. NigamA.K. andGupta, V.K. (1979) Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi.
- 52. Panse V.G. Sukhatme P.V. (1985) Statistical methods for Agricultural workers . Indian Council of Agricultural Research, New Delhi
- 53. Snedecor GW. & Cochran WG. (1989) Statistical Methods . Iowa State University Press.
- 54. Design and Analysis of Experiments by Das M.N. and GiriN.C.(1986). Wiley Eastern Ltd., New Delhi.
- 55. Gomez, A.A. and Gomez, A.A.(1984) Statistical Procedures for Agricultural Research .John Wiley and Sons. New York.
- 56. Gupta, S.C. (2016) Fundamentals of Statistics .Himalaya Publishing House Mumbai 400004, Maharashtra, India.
- 57. V.K. Kapoor (2007) Fundamentals of Applied statistics by Sultan Chand and Sons, New Delhi- 110 002
- 58. YubingXie. 2012. Nanotechnology. CRC Press. The Nanobiotechnology Handbook. CRC Press.
- 59. Sulabha K. Kulkarni. 2014 Nanotechnology : Principles and Practices. CP publishing, New Delhi.
- 60.B S Murty, P Shankar, Baldev Raj, B B Rath, James Murday. 2012. Textbook of Nanoscience and Nanotechnology. Springer
- 61.K. K. Chattopadhyay and A. N. Banarjee. 2009. Introduction to Nanoscience and Nanotechnology. PHI Publication.
- 62. Sharma A.K. 2005. Text Book Of Biostatistics I, Discovery Publishing House.
- 63. Annadurai, B. 2007. Text Book of Biostatistics. New Age International.
- 64. Gurumani, N. 2010. An Introduction to Biostatistics (2nd Edn). MJP Publishers.
- 65. David S. Goodshell. 2004. Bionanotechnology-Lessons from nature. John Wiley Publications.
- 66. R. Stephen Crespi, Tibtech, Patenting in Biotechnology Part I, Vol. 9, 117-122, 1991.
- 67. Pattnaik, P.K., Kumar, R., Pal, S., Panda, S.N. (Eds.)IoT and Analytics for Agriculture, 2020
- 68. https://www.springer.com/gp/book/9789811391767
- 69. https://www.springer.com/gp/book/9789811550720
- 70. Petersen Roger G. (1994) Agricultural Field Experiments Design and Analysis by Marcel Dekker, NewYork.

#### This course can be opted as an elective by the students of following subjects:

Open to all but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agriculture, B. Pharma, B.Sc. Food Science, B.A. (Curators), B.A. Geology.

**Suggested Continuous Evaluation Methods:** Continuous Internal Evaluation shall be based on allotted Assignment and Class Tests. The marks shall be as follows:

Internal Assessment	Marks
Class Interaction	5
Quiz	5
Seminar	7
Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8
	25

### **Course pre-requisites:**

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)

### **Facilities: Smart and Interactive Class**

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

## Suggested equivalent online courses:

https://www.cytology-iac.org/educational-resources/virtual-slide-library https://www.asct.com/ASCTWeb/Content/Cytopreparation\_Online\_Course.aspx

https://www.mooc-list.com/tags/genetics

https://www.coursera.org/learn/genetics-evolution https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

# **Further Suggestions:**

Access to Statistics, Chemistry, Math and Biotechnology resources will be required

BACHELOR OF SCIENCE/ BSc III				
Prog	ramme/Class: <i>Bachelor of Science</i>	Year: III	Semeste Paper-I	r: VI I
		Subject: Botany		
С	ourse Code:	Course	Title: Ecology & Enviro	ıment
B	OT 306			
()	30406021)			
<ol> <li>Course outcomes:         <ol> <li>acquaint the students with complex interrelationship between organisms and environment;</li> <li>make them understand methods for studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.</li> </ol> </li> <li>This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.</li> </ol>				
	Credits: 4 Core Compulsory/Elective			
Max. Marks: 25+75 Min. Pas			assing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): 4-0-0				
Unit	nit Topic		No. of Lectures (60 hrs)	
I	Natural resources & Sustainable utilization: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water , Wetlands; Threats and management strategies, Ramsar sites ,Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy , Contemporary practices in resource management.7			7
П	Ecology & EcosystemIIDefinition of Ecology, Ecological Factors, Positive and negative interactions. Ecosystem – Concept of an ecosystem-structure and function of an ecosystem.Abiotic and biotic com-Energy flow in an ecosystemEcological Succession-Definition & types. Processes and types (autogenic,allogenic,autotrophic,heterotrophic,primary & secondary), Hydrosere and Xerosere.Food chains and food webs, Ecological pyramids, production and productivity;And components.Types of ecosystems: Forest Ecosystem, Grassland,Crop land, aquatic Ecosystems Ecological Adaptations – Hydrophytes, Xerophytes, Halophytes, Epiphytes.8			8

III	Soil Formation, Properties & Conservation Soil: Origin, Formation, composition, Soil types, Soil Profile, Soil Microorganisms, soil processes, Soil Erosion, Biogeochemical cycles of carbon, water, Soil Conservation: Biological– Contour farming, Mulching, Strip cropping, Terracing and Soil reclamation.	7	
IV	<b>Biodiversity and its conservation:</b> Definition -genetic, speciesand ecosystem diversity.Value of biodiversity:hotspots of Biodiversity threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India.Ecological niche,ecotypes,ecological indicators. <i>Conservation of Biodiversity:</i>	7	
	Ex-situ and in-situ conservation, Introduction to Red data book, botanical gardens, National park, Sanctuaries and Bioreserves. Role of Seed Bank and Gene Bank Valuing plant resources, ecotourism, Role of BSL		
V	<b>Phytogeography:</b> Introductory concepts of -Biogeographic regions of India & world, Agroecological & Floristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Vegetational types in Uttar Pradesh.	7	
VI	Environmental audit & Sustainability		
	Introductory concepts of environmental audit; Guidelines of environmental audit; Concept of energy and green audit, Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice.	8	
VII	<b>Pollution,Waste management &amp; Circular Economy</b> Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, digesters, fixed film reactors, bioscrubbers, biotrickling filters; case study: Ganga Action Plan; implementation of CNG;Waste- Types, collection and disposal, Recycling of solid wastes (hazardous & non-hazardous) - classification, collection and segregation, Incineration, Pyrolysis and gasification, Sanitary landfilling ; composting, Biogas production.	8	
VIII	<b>Environmental ethics, Carbon Credits &amp; Role of GIS</b> Introduction to Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies	8	
Sugge	ested Readings:		
<ul> <li>Course Books published in Hindi may be prescribed by the Universities.</li> <li>Environmental Studies (Hindi)ISBN 81-301-0004-5B. L. Chaudhary &amp; Jitendra Pandey Edition: 2013Pages: 340 + XII Apex Publishing House</li> <li>Soil and Water Conservation ISBN #: 978-81-301-0071-5S. C. Mahnot&amp; P. K. Singh Apex Publishing</li> <li>House</li> </ul>			
4.	Ecology And Environmental Biology (	□□□) by RBD	
Publis	sher Author: Bhatia - Jain - Kohli - Shrivastava - Singh – Verma		
5. 🗆 🗆			
	Demonstrating Devict till 5- (Uin di) Demonstration - 20 February 2020 Maii d Useria		
0. 7	Five party available for the second s	v Gotam K	
/. Kukd	a& Jitendra Kumar Joshi	y, Gotalli K	
8.	Ugc Unified: Environmental Sciences (hindi) (pb) ISBN: 9788177545814Edition : 01Year	: 2015Author :	
Dr. P	urohit SS, Dr. Deo PP, Dr. Agrawal Ashok KPublisher : Agrobios (India)		
1.Chap 2.Shuk	man and Riss. Ecology: Principles and Applications, Latest Ed., Cambridge Universit la, R.S. & Chandel, P.S. Plant Ecology, Latest Ed., S. Chandel and Co.	y Press	

3.Kumar, H.D. Modern Concept of Ecology, Latest Ed. Vikas Publishing House

- 4. Begon, M., Herper, J.L. and Townsend, C.R. Ecology- Individuals, Populations and Communities (3rd ed.), Oxford Blackwell Science
- 5. Verma, P.S. & Agarwal, U.K. Concept of Ecology, Latest Ed., S. Chand & Company
- 6. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders
- 7. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications
- 8. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors
- 9. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag.
- 10. Mackenzie et al. Ecology, Latest Ed., Viva Books.
- 11. Gurevitch, J. (et al.)., The Ecology of plants, 2002, Sinauer Associates.
- 12. Kimar, U. & Asija, M.J. Bio-diversity: Principles & Conservation, 2005, Student Edition, Agrobios (India)
- 13. Krishnamurthy, K.V. An Advanced Text Book on Biodiversity, 2003, Oxford & IBH Publishing Co. Ltd.
- 14. Mitra, D., Guha, J.K., Chowdhury, S.K. Studies in Botany, Vol. II (7th ed.) Moulik Library.
- 15. Primack, R.B. Essentials of Conservation Biology, 1993, Sinauer Associates.
- 16. Lo, C.P. & Yeung, A.K.W. Concepts and Techniques of Geographic Information Systems, 2002, Printice-Hall of India.
- 17. Cain, Bowman, Hacker. Ecology. 2014. 3rd Ed. Sinauer Associates
- 18. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
- 19. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
- 20. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
- 21. Abbasi, S. A. (1998). Environmental Pollution and its Control. Cogent International, Pondicherry.
- 22. Abbasi, S. A. and Ramasamy, E. V. (1999). Biotechnological Methods of Pollution Control. Universities Press (India) Limited, Hyderabad.
- 23. Peavy, H. S., Rowe, D. R. and Tchobanoglaus, G. (1985). Environmental Engineering, Mc Graw Hill Book Company, Singapore.
- 24. Rand, M. C., Greenberg, A. E. and Taras, M. J. (Ed.) (1995). Standard methods for the examination of water and wastewater: 19th edition, American Public Health association (APHA), Washington, D.C.
- 25. Scragg, A. (1999). Environmental Biotechnology, Addison Wesley Longman, Singapore.
- 26. Tchobanoglaus, G. (1988). Wastewater Engineering: Treatment, Disposal, Reuse. Tata Mc Graw Hill, New Delhi.
- 27. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid waste engineering. Cengage reading, USA.
- 28. George, T., Hilary, T. and Samuel, A. V. (1993). Integrated solid Waste Management, Engineering Principles and Management Issues, Mc Graw Hills.
- 29. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second edition). Mc Graw Hills.
- 30. Kanthi, L. S. (2000). Basics of Solids and hazardous waste management Technologies. Prentice Hall.
- 31. Anonymous. 1997. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New York.
- 32. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal Commentaries
- 33. with Policy and Science Considerations. MartinusNijhoff Publishers.
- 34. Hardy, J.T. 2003. Climate Change: Causes, Effects and Solutions. John Wiley & Sons.
- 35. Harvey, D. 2000. Climate and Global Climate Change. Prentice Hall.
- 36. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
- 37. Maslin, M. 2014. Climate Change: A Very Short Introduction. Oxford Publications.
- 38. Mathez, E.A. 2009. Climate Change: The Science of Global Warming and our Energy Future. Columbia University Press.
- 39. Mitra, A.P., Sharma, S., Bhattacharya, S., Garg, A., Devotta, S. &Sen, K. 2004. Climate Change and India. Universities Press, India.
- 40. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition).Sage Publications.
- 41. Demers, M.N. 2005. Fundamentals of Geographic Information System. Wiley & Sons.
- 42. Richards, J. A. & Jia, X. 1999. Remote Sensing and Digital Image Processing. Springer.
- 43. Sabins, F. F. 1996. Remote Sensing: Principles an Interpretation. W. H. Freeman.
- 44. Gaston, K J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London,
- 45. Singh, J. S. & Singh, S. P. 1987. Forest vegetation of the Himalaya. The Botanical Review 53:80-192.
- 46. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
- 47. Sodhi, N.S., Gibson, L. & Raven, P.H. 2013. Conservation Biology: Voices from the Tropics.Wiley-Blackwell, Oxford, UK.

This course can be opted as an elective by the students of following subjects: Open to all but special for B.Sc. Biotech, B.Sc. Microbiology, B.Sc. Agriculture, B.A. (Curators), B.A. Archaeology, B.A. Geology

### Course prerequisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Biotech/ Forestry/ Microbiology/Gardening /biomedical Science.

Facilities: Smart and Interactive Class

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts

Suggested equivalent online courses:

https://community.plantae.org/tags/mooc

uturelearn.com/courses/teaching-biology-inspiring-students-with-plants-in-science

https://www.coursera.org/courses?query=plants http://egyankosh.ac.in/handle/123456789/53530

BACHELOR OF SCIENCE/ BSc III					
Programme	e/Class: Bach	elor of Science	Year: III	S P	emester: VI aper-III
		Subject: Botany			
Course BOT 3 (B040	Course Code:BOT 307(B040603P)			agement	
Course outco	mes: After the	e completion of the course the students will b	e able:		
1. To per field, 2. Can b	<ol> <li>To perform all experiments related to the semester-i.e. Plant tissue cultured plants, conducting breeding on field, conserving and depolluting the environment.</li> <li>Can be employed in environment impact assessment companies &amp; start his own venture</li> </ol>				breeding on
	Credits: 2 Core Compulsory				ompulsory
	Max. Marks: 25+75 Min. Passing Marks:			sing Marks:	
	То	tal No. of Lectures-Tutorials-Practical (in ho	ours per week): (	)-0-2	
Unit		Торіс			No. of Lectures(60hrs)
Ι	Cell biolog 1. Stuc Onion/Rh 2. Mea 3. Cou (Yeast/po 4. Dete stages in p	y dy of plant cell structure with the help of noeo/Crinum surement of cell size by the technique of nting cells per unit volume with the help ollen grains) ermination of mitotic index and frequ ore-fixed root tips of Allium cepa.	epidermal pea f micrometry. of haemocyto ency of diffe	l mount of meter rent mitotic	7

Π	Genetics	
	1. Monohybrid cross (Dominance and incomplete dominance)	2
	2. Dihybrid cross (Dominance and incomplete dominance)	8
	3. Gene interactions (All types of gene interactions mentioned in the	
	syllabus)	
	a. Recessive epistasis 9: 3: 1.	
	b. Dominant epistasis 12: 3: 1	
	c. Complementary genes 9: /	
	a. Duplicate genes with cumulative effect 9: 6: 1	
	e. Infibility genes 15:5	
	4. Observe the genetic variations among inter and intra specific plants.	
	s. Demonstration of Directing techniques-rivorialization, case studies of mutation, polyploidy emasculation experiment	
ш	Biostatistics:	
	1 Univariate analysis of statistical data: Statistical tables mean mode	7
	median standard deviation and standard error (using seedling nonulation /	
	leaflet size).	
	2. Calculation of correlation coefficient values and finding out the	
	probability. 3.Determination of goodness of fit in Mendellian and modified	
	mono-and dihybrid ratios (3:1, 1:1, 9:3:3:1, 1:1:1:1, 9:7, 13:3, 15:1) by Chi-	
	square analysis and comment on the nature of inheritance.	
	3. Computer application in biostatistics - MS Excel and SPSS	
IV	Plant tissue culture	
	1.Familiarization of instruments and special equipments used in the plant	8
	tissue culture experiments	
	2.Preparation of plant tissue culture medium, and sterilization, Preparation of	
	stock solutions of nutrients for MS Media.	
	3.Surface sterilization of plant materials for inoculation (implantation in the	
	Medium)	
	4.Micropropagation of potato/tomato/ - Demonstration	
	5.Protoplast isolation and culturing – Demonstration	
v	LCOIOgy & Environment	8
	Fninhytes and Parasites	0
	2 Study of morphological adaptations of hydrophytes and verophytes	
	(four each).	
	3. Study of biotic interactions of: Stem parasite (Cuscuta), Root	
	parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).	
	4. Observation and study of different ecosystems mentioned in the	
	syllabus.	
	5. Field visit to familiarize students with ecology of different sites	
VI	Soil Formation, Properties & Conservation	8
	1. Determination of pH of various soil and water samples (pH meter,	
	universal indicator/Lovibond comparator and pH paper)	
	2. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter	
	and base deficiency from two soil samples by rapid field tests.	
	5. Determination of organic matter of different soil samples by Waltday & Plack register traction matter d	
	4 Soil Profile study	
	5. Soil types of India-Map	
	Biodiversity and Phytogeography:	
VII	1. Study of community structure by quadrat method and determination	7
	of (i) Minimal size of the quadrat, (ii) Frequency, density and	
	abundance of components (to be done during excursion/field visit).	
	2. Marking of vegetation types of India, World & Uttar Pradesh on	

	maps			
N/III	3. Phytogeographical areas of India			
VIII	Pollution & waste management	tia variablas. Sail	1	
	thermometer maximum and minimum thermom	eter anemometer		
	psychrometer/hygrometer, rain gauge and lux meter	eter, anemometer,		
	2. Estimation of chloride and dissolved oxygen content in	water sample		
	3. Comparative anatomical studies of leaves form pollute	ed and less polluted		
	areas.	-		
	4. Measurement of dissolved O2 by azide modification of	f Winkler's method.		
	5. Determination of dissolved oxygen of water samples	from polluted and		
	unpolluted sources.	N tashniqua watan		
	from well river water supply department and package	drinking water		
	7. Making kitchen waste from compost/vermicompos	st by Enzymes/Bio		
	decomposer/ Whey with dung.			
	Climate Change, Carbon Credits & Role of GIS			
	1. Conducting Waste Audit of your Institution -Demo			
	2. Green auditing of the College/University -Demo			
Suggested R	eadings: as in papers above: a <b>P</b> ooks published in <b>Uindi may be preserihed by th</b>	a Universities		
Cours	e books published in ffindi may be prescribed by in	e Universities.		
1. Pra	ctical Botany (Part III) Author: Sunil D Purohit, Anamik	a Singhvi& Kiran Tak 2	2013 Apex	
Pub	lishing House,Raj.	-	-	
2. Pra	ctical Botany (Part II) Author: N. C. Aery, Sunil D Pur	ohit &Gotam K Kukda	2013 Apex	
	plishing House, Kaj.			
	3 3.			
्रान				
4. A H	4. A Handbook Of Soil, Fertilizer And Manure (2nd Ed.) (pb) ISBN : 9788177544152Edition :			
02Year : 2017Author : Gupta PKPublisher : Agrobios (India)				
5. Gre	5. Green Technology: An Approach For Sustainable Environment ISBN : 9788177543438Edition :			
	ear : 2021Author : Dr. Purohit SSPublisher : Agrobios (In	ndia)	т	
0. Lat	8177540802Edition · 01Vear · 2011 Author · Theroux ER	Fldridge FF	N :	
Ma	llmannWLPublisher : Agrobios (India)	, Elanage Er,		
7. Me	thods In Environmental Analysis: Water Soil And Air (2n	d Ed.) ISBN :		
978	8177543087Edition: 02Year: 2021Author: Gupta PKPu	blisher : Agrobios (Indi	a)	
8. Wa	ter Treatment And Purification Technology ISBN : 97881	77540024Edition : 01Y	ear :	
200	9Author : Ryan WJPublisher : Agrobios (India			
http://vidyan	nitra.inflibnet.ac.in/index.php/home/subjects?domain=Life+So	cience&subdomain=Bota	<u>ny</u>	
http://heecor	ntent.upsdc.gov.in/Home.aspx			
(http://epath	shala.nic.in/, http://epathshala.gov.in/)	oots.		
Open to all	but special for B.Sc. Biotech, B.Sc. Forestry, B.Sc. Agricultu	re. B. Pharma. B.Sc. Foo	d Science, B.A.	
(Curators), E	B.A. Geology.	, 2. 1		
Suggested C	ontinuous Evaluation Methods: Continuous Internal Evaluation	on shall be based on allott	ed Assignment	
and Class Te	sts. The marks shall be as follows:			
	Internal Assessment	Marks		
	Class Interaction	5		
	Quiz	5		
	Seminar	7	———————————————————————————————————————	
		-		

Assignment (Charts/ Flora/ Rural Service/ Technology Dissemination)	8	
	25	

### Course pre-requisites:

**Qualification:** To study this course, a student must have qualified 10+2 with Biology/ NSQF level 3 from Sector Skill Councils / Diploma holder from ITI in (Biology/ Agriculture/ Forestry/ Biotech/ Math/Statistics/Chemistry/ Computer Science)

**Facilities: Smart and Interactive Class** 

Other Requisites: Video collection, Books, CDs, Access to On-line resources, Display Charts Lab requisites: Biotech instruments, environmental lab instruments.

Suggested equivalent online courses:

https://www.cytology-iac.org/educational-resources/virtual-slide-library

https://www.asct.com/ASCTWeb/Content/Cytopreparation\_Online\_Course.aspx

https://www.mooc-list.com/tags/genetics

https://www.coursera.org/learn/genetics-evolution

https://www.my-mooc.com/en/mooc/introduction-to-genetics-and-evolution/

Further Suggestions: Access to Statistics, Chemistry, Math and Biotechnology resources will be required

Programme/Class: Bachelor of Science	Year: III	Semester: VI /Project- II/ Paner-IV
	Subject: BOTANY	1 4001-1 4
Course Code: - <b>BOT 308</b> B040604R	Course Title: <b>Project in B</b>	otany for Graduation
B040604R         Course outcomes:         After completing this course a student will have:         Project work will supplement field experimental learning and deviations from classroom and laboratory transactions.         project work will enhance the capability to apply gained knowledge and understanding for selecting, solving and decision-making processes         It will promote creativity and the spirit of enquiry in learners.         They will learn to consult Scientists, libraries, laboratories and herbariums and learn importance of discussions, Botanical & field trips, print and electronic media, internet etc. along with data documentation, compilation, analysis & representation in form of dissertation writing         It will enhance their abilities, enthusiasm, and interest.		
Credits: 04	Core: Compul	sory
Max. Marks: 25+75	Min. Passing N	Marks:
Total No. of Lectures-Tutorials-Practical (in hours per week): 0-0-4.		

SUGGESTIVE LIST OF PROJECTS			
Prepare beds for growing nursery for herbs, shrubs and trees.			
Develop Green house facility in college and grow plants	Develop Green house facility in college and grow plants		
Develop hydroponics facility in college and grow plants.			
Develop botanical garden in the college with labelling			
Vertical gardens, roof gardens.			
Culture & art of making bonsai.			
Computer Aided Designing (CAD) for outdoor and indoor sca	oing Exposure to CAD (Computer		
Aided Designing)			
Phytochemical Analysis of Medicinal plants			
Bio composting and Vermicomposting.			
Performing Aromatherapy by essential Oils			
Refer: libraries, journals, Memoirs, encyclopaedias, herbaria, Museu	ıms, etc.		
This course can be opted as an elective by the students of following sub	piects:		
This course can be opted as an elective by the students of following	subjects: Open to all		
Suggested Continuous Evolution Matheday			
Suggested Continuous Evaluation Methods:	Marka		
internal Assessment	IVIAI KS		
Class Interaction	5		
Seminar	10		
Thesis/dissertation	10		
	25		
Course prerequisites:			
<b>Oualification:</b> To study this course, a student must have qualified 10+2	2 with Biology/ NSOF level 3 from		
Sector Skill Councils / Diploma holder from ITI in (Biology/ Agricultu	re/Biotech/Forestrv/		
Microbiology/Gardening /biomedical Science.	ie, Diesend i elesay,		
Facilities: Smart and Interactive Class			
<b>Other Requisites:</b> All listed under all papers of the course.			
Suggested equivalent online courses:			
https://ndl.jitkgp.ac.in/			
http://heecontent.upsdc.gov.in/Home.aspx			
(http://epathshala_nic_in/_http://epathshala_gov_in/)			
nntel iitm ac in			
https://asiafoundation.org/what-we-do/books-for-asia?gclid=CiwKCAi	A7939BRBMEiwA-hX5I-		
$\frac{110}{100} = \frac{100}{100} = $			
UIDIISYTIIYJSISYEIO-LYISUIYIAOOEOALULAYEOUUPYZSSSYQZXOUSWKQAVD_BWE			
http://www.un.enet.n/, http://www.uno.org/ http://www.tkdl.res.in/ http://www.vigyanprasar.gov.in/digilib			
Directory of Open Access Repositories (DOAR) http://www.opendoar.c	<u>nttp://www.tkdl.res.in/, http://www.vigyanprasar.gov.in/digilib</u>		
Registry of Open Access Repositories (BOAR)http://www.opendoar.e	<u>ح</u>		
http://www.iscnagnur.ac.in/knowledge_learning_files/5.7_General_On	en Access e-Resources ndf		
http://www.isonagpur.uo.ii/kitowiougo_fourning_ines/5.7_0010101_00	<u></u>		

### B. Sc. I Paper I Physical Chemistry

#### 1. Mathematical Concepts and Computers

### (A) Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like f(x),  $e^x$ ,  $x^n$ , sin x, log x; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations, Factorials and Probability.

### (B) Computers

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems.

### 2. Gaseous States

Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of state. **Critical Phenomena** : PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state.

**Molecular Velocities :** Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases.

### 3. Liquid State

Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases.

**Liquid crystals:** Difference between liquid crystal, solid and liquid. Classification, structure of nematic, smectic and cholesteric phases and applications.

### 4. Solid State

Definition of space lattice and unit cell.

#### Laws of crystallography:

- (i) Law of constancy of interfacial angles
- (ii) Law of rationality of indices
- (iii) Law of symmetry Symmetry elements in crystals.

**X-ray diffraction:** Derivation of Bragg's equation. Determination of crystal structure of NaCl and KCl. A brief introduction to point defects in crystals, semiconductors, superconductors and nanomaterials (only qualitative idea).

#### 5. Colloidal State and Macromolecules

Definition of colloids and classification of colloids.

**Solids in liquids (sols):** properties - kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.

**Liquids in liquids (emulsions**): types of emulsions, preparation, Emulsifier. Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.

**Macromolecules :** Determination of molecular weight of macromolecules by osmotic pressure and viscosity methods. Concepts of micelles and critical micelle concentrations. A brief introduction to conducting and light emitting polymers.

### 6. Chemical Kinetics and Catalysis

Rate of a reaction- factors influencing the rate of a reaction such as concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction - differential method, method of integration, method of half life period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods for the studies of chemical kinetics.

**Theories of chemical kinetics**: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy, Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.

**Catalysis:** Characteristics of catalysed reactions, classification of catalysis, Industrial catalysts and enzyme kinetics.

Books Recommended:

### B.Sc. I Paper II Inorganic Chemistry

#### 1. Atomic Structure and Periodic Table

Quantum numbers. shapes of s, p and d orbitals. Pauli's exclusion principle. Hund's rule Aufbau principle. Variation of orbital energies with atomic number and energy level diagram. Long form of periodic table based on electronic configuration.

#### 2. Periodic properties of elements :

- (i) Types of radii (Covalent, Crystal and Van der Waal)
- (ii) Electron affinity and its variation
- (iii) Ionisation potential, Factors affecting the magniutude of I.P., Concept of effective nuclear charge and shielding effect (Calculation of Screening constant with Slater's rules.)
- (iv) Electronegativity (Pauling, Mulliken and Allred Rochow scale) and its variation.

### 3. Chemical Bonding :

(i) Ionic: Conditions favouring the ionic bond, radius ratio in ionic solids.
 Concept of lattice energy and Born-Haber cycle, Polarisation of ions and Fajan's rules.

### (ii) Covalent and brief idea of other bonds:

Concept of directed valence and hybrid orbital description (sp, sp<sup>2</sup>, sp<sup>3</sup>, sp<sup>3</sup>d and sp<sup>3</sup>d<sup>2</sup>) using simple illustrations, determination of the shapes of molecules and ions viz. NH<sub>3</sub>, H<sub>2</sub>O, H<sub>3</sub>O<sup>+</sup>, SF<sub>4</sub>, CIF<sub>3</sub>, ICl<sub>2</sub><sup>-</sup> and I<sub>3</sub><sup>-</sup> by VSEPR concept, Concept of maximum covalency. Odd electron bond, Hydrogen bond, Three centre bond and Metallic bond.

#### 4. General studies of s and p block elements :

Group wise discussion with respect to electronic configuration, ionisation potential, electron affinity, electronegativity, atomic and ionic radii, oxidation states, catenation and inert pair effect (wherever applicable). Trends in their hydrides, oxides and halides.

#### 5. Occurrence, extraction and isolation of Li, Be and F<sub>2</sub>

- **6.** (a) Preparation, properties and structures of diborane, borazine, hydrazine, interhalogens and polyhalides and fluorides of xenon.
  - (b) Structure and basicities of oxyacids of B, P and S.

#### Books Recommended:

### B.Sc.-1 Paper- III Organic Chemistry

### 1. Structure and Reactivity

Bond orbitals of carbon (sp, sp<sup>2</sup> and sp<sup>3</sup> Hybridization). Polarity of co-valent bonds; types of electronic displacements (Inductive, Electromeric, Resonance and Hyperconjugation); Hydrogen-bonding; Homolysis and Heterolysis; Concept of Carbocation, Carbanion and Free radicals.

### 2. Alkenes, Alkynes Alkadienes and cycloalkanes

- (i) Elementary treatment of mechanism of addition of hydrogen, halogens, halogen acids, water and sulphuric acid.
- (ii) Hydroboration, epoxidation, ozonolysis and hydroxylation.
- (iii) Acetylene as carbon acid (replacement by Na,Cu and Ag).
- (iv) Hydration, halogenation, addition of HCl and organic acids.
- (v) Stability and addition reactions of 1,3-butadiene.
- (vi) General methods of preparation and properties of small ring cycloalkanes. Treatment of optical and geometrical isomerism.

### 3. Stereochemistry:

#### (i) Optical isomerism

- (a) Concept of chirality, elements of symmetry.
- (b) Optical isomerism of compounds containing one (lactic acid) and two asymmetric carbons tartaric acid).
- (ii) Methods of racemization and resolution, relative and absolute configuration.
- (iii) Geometrical isomerism: Maleic and fumaric acid, and methods for their configurations.
- (iv) Sawhorse and Newman's projection formula; R-S, D-L and E-Z nomenclatures.
- (v) Conformations of ethane and n-butane

### 4. Alkyl halides and Grignard's Reagent

Mechanisms of nucleophilic substitution reactions of alkyl halides. Preparation and synthetic applications of Grignard Reagent.

### 5. Alcohols and Ethers

- (a) Classification, distinctions and mechanism of dehydration of primary, secondary and tertiary alcohols.
- (b) Isomerism of propanols, butanols and pentanols.
- (c) Industrial preparation, reactions and structures of glycerol.
- (d) **Ethers:** Williamson's synthesis, formation and cleavage of oxonium salts, elementary idea about crown ethers.
- 6. General reactions of carbonyl compounds

- (i) Oxidation-Reduction(Catalytic,LiAlH<sub>4</sub>,Clemmensen's,Meerwein-Ponndorf-Verley reduction.
- (ii) Mechanism of addition of alcohol, sodium bisulphite and HCN.
- (iii) Mechanism of Aldol & Cannizzaro reactions, and Wolff-Kishner reduction.

### 7. Carboxylic acids:

- (i) Structure of carboxylic group.
- (ii) Acid strength with special reference to formic, acetic, propionic and chloroacetic acids.
- (iii) Mechanism of esterification & ester hydrolysis ( $B_{AC}^2$  and  $A_{AC}^2$  mechanism.).
- (iv) Mechanism of acetylation with Acetic anhydride and acetyl chloride.
- 8. Example of compounds containing reactive methylene group: Preparation and synthetic uses of acetoacetic ester and malonic esters only, keto-enol tautomerism.

### 9. Nitrogen containing compounds:

(i) Preparation and distinction between

- (a) alkyl nitrites & nitroalkanes, and
- (b) alkyl cyanides & alkylisocyanides.
- (ii) Amines
  - (a) Classification, distinction and separation of Primary, Secondary & tertiary amines.
  - (b) General methods of preparation and general reactions.
  - (c) Relative basicities of methyl, ethyl, dimethyl, diethyl, trimethyl and triethylamines.
- **10.** Numerical questions based on determination of structural formula.

Books Recommended:

### B.Sc. I PRACTICALS

The duration of practical examination will be of six hours and will comprise of the following exercises:

### 1. General - calibration of thermometer and fractional weights

#### 2 Inorganic Chemistry:

Qualitative analysis of an inorganic mixture containing five radicals out of the following preferably by semimicro technque (including insoluble substances):-

 $NH_4^+$ ,  $Na^+$ ,  $K^+$ ,  $Mg^{++}$ ,  $Ca^{++}$ ,  $Sr^{++}$ ,  $Ba^{++}$ ,  $Zn^{++}$ ,  $Mn^{++}$ ,  $Ni^{++}$ ,  $Co^{++}$ ,  $Al^{+++}$ ,  $Cr^{+++}$ ,  $Cr^{+++}$ ,  $Cu^{++}$ ,  $Bi^{++}$ ,  $Hg^+$ ,  $Hg^{++}$ ,  $Cd^{++}$ ,  $As^{+++}$ ,  $Sb^{+++}$ ,  $Sn^{++}$ ,  $Pb^+$ ,  $Pb^{++}$ ,  $Ag^+$ .  $CO_3^{-2}$ ,  $NO_2^{-2}$ ,  $S^{-2}$ ,  $SO_4^{-2}$ ,  $F^-$ ,  $Cl^-$ ,  $Br^-$ ,  $NO_3^{-}$ ,  $CH_3COO^-$ , Borate, Oxalate, and Phosphate.

### 3. Physical Chemistry

- 1. Determination of molecular weight of sulphur by Rast Method.
- 2. Kinetics of precipitation of sulphur from sodium thiosulphate by mineral acid.
- 3. Kinetics of dissolution of Mg-ribbon in HCl.
- 4. To determine the percentage composition of a given binary mixture (non-interacting systems) by viscosity methods.
- 5. To determine the percentage composition of a given binary mixture (non interacting) by surface tension method.

### 4. Organic Chemistry

- (a) Preparation of organic compounds:
  - 1. Acetanilide
  - 2. p-bromoacetanilide
  - 3. picrates

#### (b) Crystallization and determination of melting point.

- 1. Phthalic acid from hot water (using fluted filter paper and stemless funnel)
- 2. Acetanilide from boiling water
- 3. Naphthalene from ethanol
- 4. Benzoic acid from water

The distribution of marks will be as follows:

- 1. Mixture Analysis (3 marks for each correct radical) 15
- 2 Organic preparation 10
- 3. Crystallization 05
- 4. Physical Chemistry 15

5. Viva Voce	10
6. Record	10
Total	65

**Note :** The number of candidates to be examined in the practical per batch should not exceed 50. At least one experiment is to be given from each section in the examination.

### B.Sc. II Paper I Physical Chemistry

#### 1. Thermodynamics - I

Definition of terms: system, surroundings, open system, isolated system, intensive and extensive properties, State and path functions and their differentials, reversible and irreversible processes, Concept of heat and work.

*First Law of Thermodynamics* :concepts of internal energy and enthalpy, heat capacities at constant volume and constant pressure and their relationship. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for a reversible process.

*Thermochemistry :* standard state, standard enthalpy of formation- Hess's Law of constant heat summation and its applications, heat of reaction at constant pressure and at constant volume, Bond dissociation energy and its calculation from thermo-chemical data, Kirchhoff's equation.

#### 2. Thermodynamics –II

Second law of thermodynamics: concept of entropy, entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical process. Gibbs and Helmholtz functions; Criteria for thermodynamic equilibrium and spontaneity in term of changes in entropy, Gibbs and Helmholtz functions. Concept of chemical potential.

#### 3. Chemical Equilibrium

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chattelier's principle.

#### 4. Phase Equilibrium

Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system - water, Sulpher and Hellium. First and second order phase transitions.

Phase equilibria of two component systems - solid-liquid equilibria, simple eutectic - Pb-Ag system, desilverisation of lead, Systems involving compound formation with a congruent melting point (Mg-Zn) and an incongruent melting point (CuSO<sub>4</sub>-H<sub>2</sub>O).

Nernst distribution law and its thermodynamic derivation.

#### 5. Electrochemistry – I

Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution.

Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Activity and activity coefficient. Transport number, definition and determination by Hittorf method and moving boundary method.

Applications of conductivity measurements: determination of degree of dissociation, determination of K<sub>a</sub> of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

#### 6. Electrochemistry - II

Types of reversible electrodes - gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference electrodes- standard electrode potential, sign conventions, electrochemical series and its significance.

Electrolytic and Galvanic cells - reversible and irreversible cells, conventional representation of electrochemical cells.

EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (  $\Delta$ G,  $\Delta$ H and K).

Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.

Definition of pH and  $pK_a$  determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.

Buffers - mechanism of buffer action, Henderson-Hazel equation. Hydrolysis of salts. Electrochemical corrosion and its prevention.

### B.Sc. II Paper-II Inorganic Chemistry

### **1. Concept of electrode potential** : EMF diagrams and their utility.

2. Transition Elements: Position in periodic table, electronic configuration, General Characteristics, viz., atomic and ionic radii, variable oxidation states, ability to form complexes, formation of coloured ions, magnetic ( $\mu_{so}$  and  $\mu_{eff}$ ) and catalytic behaviour. General comparative treatment of 4d and 5d elements with their 3d analogues with respect to ionic radii, oxidation states and magnetic properties.

### 3. Coordination Compounds :

- (i) Definition of ligand : Classification with respect to denticity. (Examples of mono-to hexadentate ligands).
- Werner's postulates, Sidgwick's effective atomic number concept and limitations, Valence Bond Theory of coordination compounds, Stereochemistry of coordination numbers two, four and six with examples of hybrid orbital participation in the following :

 $[Ag(NH_3)_2]^+$ ,  $[Ag(CN)_2]^-$ ,  $[Ni(CN)_4]^{n-}$  (n=2 and 4),  $[Cu(NH_3)_4]^{2+}$ ,  $[Zn(NH_3)_4]^{2+}$ ,  $[MnO_4]^-$ ,  $[Fe(CN)_6]^{n-}$  (n=3 and 4),  $[FeF_6]^{3-}$ ,  $[Fe(H_2O)_6]^{3+}$ ,  $[Fe(C_2O_4)_3]^{3-}$ ,  $[Co(NH_3)_6]^{3+}$ ,  $[Co(en)_3]^{3+}$ ,  $[Ni(NH_3)_6]^{2+}$ ,  $[PbCl_6]^{2-}$ 

- (iii) Chelate effect
- (iv) Nomenclature for only mono- and di-nuclear complexes.
- (v) Various types of isomerism, viz., hydrate, ionisation, linkage, polymerization and coordination position. Stereoisomerism in C.N.4 and C.N.6 (only ML<sub>4</sub>L'<sub>2</sub> and ML<sub>3</sub>L'<sub>3</sub> complexes).

#### 4. Non-aqueous solvents:

Classification and characteristic properties of solvents. Types of chemical reactions occurring in liquid ammonia and liquid sulphur dioxide.

#### 5. Acid - Base concept :

Lewis concept, Concept and classification of hard and soft acids and bases. Applications of HSAB principle.

### B.Sc. II Paper III Organic Chemistry

- 1. **Carbohydrates:** Classification, ring structure and configuration of glucose and fructose. Interconversions in the carbohydrate series (Ruff degradation and Killiani-Fischer synthesis ).
- 2. Aromatic hydrocarbons: General methods of preparation, aromaticity and molecular orbital representation of benzene.
- **3.** Mechanism of aromatic electrophilic substitutions (nitration, halogenation, sulphonation, alkylation and acylation). Orientation in aromatic substitution and ortho/para ratio.
- 4. Aromatic Halogen Compounds: Different types of halogen compounds, study of chlorobenzene and benzylchloride.
- 5. Aromatic nitro compounds: Nitrobenzene, dinitrobenzene and trinitrotoluene(TNT), reduction of nitrobenzene.
- 6. Aromatic amino compounds and diazonium salts: Study of aniline, benzylamine and toluidines (o, m, & p). Relative basicity of aniline, toluidines. Preparation, reactions and structure of benzenediazonium chloride.
- 7. Aromatic sulphonic acids: Benzene sulphonic acid, sulphalinic acid, chloramine-T, and saccharine.
- 8. Phenols: Acid character, reaction of phenol, preparation and uses of picric acid.
- **9.** Aromatic alcohols, aldehydes and ketones: Preparation and reactions of benzyl alcohol, benzaldehyde, salicylaldehyde, acetophenone and benzophenone.
- **10.** Aromatic acids: Preparation and properties of cinnamic, phthalic and salicylic acids . Acid strength of benzoic, p-toluic, p-nitrobenzoic and p-chlorobenzoic acids.

#### 11. Polynuclear Hydrocarbons:

- (i) Non-condensed system : Biphenyl
- (ii) Condensed system: Naphthalene and its derivatives, 1- and 2-naphthols and naphthylamines, tetraline and decaline)
- **12.** Heterocyclic compounds: Preparation & reactions of furan, pyrrole, thiophene & pyridine.
- **13.** Numerical problems for the determination of structures based on chemical reactions of above mentioned compounds.

### B.Sc. II PRACTICALS

The duration of practical examination will be of six and a half hours and will comprise of the following exercises:

- 1. General Calibration of pipettes and burettes, preparation of standard solutions, dilution-0.1 M to 0.001 M solutions.
- 2. Inorganic Chemistry

### Volumetric Exercises :

- (i) Estimation of silver ions by volhard's and Mohr's method.
- (ii) Redox titrations e.g. titration of ferrous ion with permanganate and dichromate using internal and external indicators.
- (iii) Iodometric Estimation of Copper Sulphate and Potassium dichromate.
- (iv) Estimation of  $Ca^{2+}$  ions using KMnO<sub>4</sub> solutions.
- (v) Determination of acetic acid in commercial vinegar using NaOH.

### 3. Physical Chemistry

- (i) Determination of heat of neutralization of
  - (a) Strong acid-strong base
  - (b) Strong acid-weak base
  - (c) Weak acid strong base
- (ii) Determination of enthalpy of solution of solid calcium chloride and calculation of lattice energy of CaCl<sub>2</sub> by using BORN-HABER cycle.
- (iii) Determination of the transition temperature of the given substance by thermometric method (e.g. MnCl<sub>2</sub>.4H<sub>2</sub>O)
- (iv) To construct the phase diagram of two component system (diphenyl amine + benzophenone) by Thaw-melt method.

### 4. Organic Practical

Identification of organic compounds containing any one of the following groups:

aldehyde, carbohydrate, acid, phenol, ketone, ester, alcohol, amine, amide, nitro, hydrocarbon.

This would include - determination of melting or boiling point, element detection, test for solubility and unsaturation test for functional groups, specific test if any and preparation of suitable derivatives wherever possible.

Each centre is expected to provide sufficient number of organic compounds representing almost all the groups.

Distribution of marks will be as follows :

1.	Inorganic Practical	15 marks.
	(3 marks for manipulation and 12 marks for result)	
	up to 1.0% of error there is no deduction of marks but after that 1 mark will be deducted for each 0.1% of error)	
2.	Physical Chemistry experiment	15 marks.
3.	Organic Practical	15 marks.
4.	Viva-Voce	10 marks.
5.	Record	10 marks.
	Total	65 marks.

*Note :* The number of candidates to be examined in the practical per batch should not exceed 50. At least one experiment is to be given from each section in the examination .

# B.Sc. III Paper– I Physical Chemistry

#### 1. Elementary Quantum Mechanics

Black-body radiation, Planck's radiation law, photoelectric effect, Compton effect, concept of wave motion.

De Broglie hypothesis, the Heisenberg's uncertainty principle, Difference between classical and auantum mechanism, Hamiltonian operator, Schrodinger wave equation and its importance, physical interpretation of the wave function.

Schrodinger wave equation for H-atom, separation into three variables (without derivation), quantum numbers and their importance, hydrogen like wave functions, radial wave functions, angular wave functions.

Molecular orbital theory, basic ideas - criteria for forming M.O from A.O, construction of M.O's by LCAO -  $H_2^+$  ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave functions, concept of  $\sigma$ ,  $\sigma^*$ ,  $\pi$ ,  $\pi^*$  orbitals and their characteristics.

Introduction to valence bond model of H<sub>2</sub>, comparison of M.O. and V.B. models.

### 2. Nuclear Chemistry

Fundamental particles and their classification. Nuclear forces. Liquid drop and shell models of atomic nucleus. Nuclear stability. Energy changes in nuclear reactions. Fission, The atom bomb, spallation and fusion reactions, Hydrogen bomb. Concept of nuclear cross–sections. Radioactive equilibrium, kinetics of radioactive decay, Applications of radioactivity- radioactive dating, radioactive tracer technique, radioactivity in medicines, radioactivity in agriculture and research.

### 3. Statistical/ Molecular Thermodynamics

Energy levels. Microstates. The Boltzmann factor. Partition function. Relation between partition functions and thermodynamic functions. Translational, rotational and vibrational partition function.

### 4. Spectroscopy

Introduction: Electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

#### **Rotational Spectrum**

Diatomic molecules. Energy levels of a rigid rotor (semi-classical principles), selection rules

#### Spectral intensity :

distribution using population distribution (Maxwell-Boltzmann distribution), determination of bond length, qualitative description of non-rigid rotor, isotope effect.

### **Vibrational Spectrum**

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of anharmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups.
Raman Spectrum: concept of polarizability, condition for Raman active vibrations, mutual exclusion principle pure rotational and pure vibrational Raman spectra of diatomic molecules.

#### **Electronic Spectrum**

Concept of potential energy curves for bonding and antibonding molecular orbtials, qualitative description of selection rules and Franck-Condon principle.

Qualitative description of  $\sigma$ ,  $\pi$  and n M.O., their energy levels and the respective transitions.

#### 5. Photochemistry

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grotthus - Draper law, Stark - Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions - energy transfer processes (simple examples).

#### 6. Surface Chemistry

Adsorption, difference between Physical adsorption and chemisorption, Adsorption isotherms - Langmuir adsorption isotherm and Freundlich adsorption isotherm, BET equation, Determination of surface area.

#### 7. Solutions, Dilute Solutions and Colligative Properties

Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

## B.Sc. III Paper-II Inorganic Chemistry

#### 1. Chemistry of Lanthanides and Actinides

- i. Electronic Configuration,
- ii. Atomic and Ionic radii,
- iii. Ionisation energy,
- iv. Calculation of magnetic moments and correlation with experimental data (specially for lanthanides),
- v. Colour and spectral behaviour,
- vi. Oxidation states and their stability,
- vii. Ability to form complexes and examples of complexes of different coordination numbers.
- viii. Occurrence and principle of separation of lanthanides.
- ix. Chemistry of separation of Np, Pu and Am from U and
- x. One synthesis each of Np to Lr.

#### 2. Coordination Chemistry:

- (i). Crystal field theory : Definition of Crystal field, d-orbital splitting in octahedral, tetrahedral and square planar fields, Explanation of weak and strong field ligands, Dq and factors influencing its magnitude, Calculation of crystal field stabilisation energy for d<sup>1</sup>-d<sup>9</sup> weak and strong field complexes. Interpretation of magnetic properties on the basis of crystal field theory.
- (ii). Electronic spectra of transition metal complexes :Types of electronic transitions, Selection rules for d-d transitions, Charge-transfer, Spectroscopic ground terms for d<sup>1</sup> to d<sup>10</sup> systems. Spectrochemical series, Discussion of the electronic spectra of only [Ti(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> and [Cu(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup>
- **3.** (a) Metal Carbonyls : Ligand behaviour of CO,General methods of preparation, Representation of structures of the binary carbonyls of all nuclearities of V, Cr, Mn, Fe, Co and Ni.

**(b)** Metal Nitrosyls : Ligand behaviour of NO (NO<sup>+</sup>, NO<sup>-</sup> and bridging NO), preparation and structures of nitrosyls of Cr, Fe and Ru; carbonyl nitrosyls and cyano nitrosyls

#### 4. Environmental Chemistry

The earth's atmosphere and its components, Types of pollutants and their sources. Green house effect and global warming. Acid rains, Ozone layer (Importance and its protection)

#### B.Sc. III Paper –III Organic Chemistry

- 1. **Reaction intermediates**: Generation, structure, stability and synthetic applications of carbenes, nitrene, benzyne, carbocations (classical and non classical), carbanions and free radicals.
- **2.** Treatment of E1, E2 and E1<sub>CB</sub> mechanisms. Labelling experiments to distinguish E2 and E1<sub>CB</sub> mechanism.
- **3.** Molecular rearrangements and name reactions: Pinacol-pinacolone, Benzil-benzilic acid, Beckmann, Fries rearrangements, Claisen-Smith and Dieckmann's reactions.
- 4. **Polymers**: Types and mechanism of polymerisation, stereocontrol polymerisation. Preparation and uses of Teflon, Terylene, Nylons and Dynel. Natural and Synthetic rubbers.
- 5. Dyes: Colour and constitution (electronic concept), Classification of dyes, Chemistry and synthesis of methylorange, Congo red, Malachite green, Crystal violet, Phenolphthalein and fluorescene.
- 6. Polynuclear hydrocarbons: Chemistry of Anthracene and Phenanthrene. A general idea about carcinogenic hydrocarbons.
- 7. Heterocycles: Chemistry of quinoline, isoquinoline and indole.
- 8. Amino acids, peptides and proteins:
  - a. Classification, synthesis and properties of amino acids (acid-base behaviour, isoelectric point and electrophoresis).
  - b. Synthesis of polypeptides and methods of determining their structure (end group analysis and selective hydrolysis of peptides).
  - c. Classification, properties and Structure (primary, secondary and tertiary) of proteins. Protein denaturation/renaturation.

## B.Sc. III Paper IV Analytical and Biological Chemistry

## Section A Analytical Chemistry

#### 1. Errors and Evaluation

Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, types of error in experimental data, determinate (systematic), indeterminate (or random) and gross, sources of errors and effects upon the analytical results, methods for reporting analytical data, statistical evaluation of data, indeterminate errors, uses of statistics.

#### 2. Volumetric analysis

General principles of acid – base titration, precipitation titration, oxidation-reduction titration, iodimetry and iodometry, complexometric titrations, use of EDTA for the determination of Ca<sup>2+</sup> and Mg<sup>2+</sup> and hardness of water, types of EDTA titrations, metal ion indicators.

#### 3. Gravimetric analysis

Precipitation from homogeneous medium, purity of precipitates, co-precipitation, post-precipitation, washing and ignition of precipitates, contamination and their removal.

#### 4. Separation techniques

Principle, technique and aanalytical applications of the following:

- (a). Solvent extraction
- (b). Chromatography (Paper, Thin Layer, Column and HPLC)
- (c). Ion exchange

#### Books

- 1. Fundamentals of Analytical Chemistry, DA Skoog, DM West FJ Holler, and WB Sauders.
- 2. Quantitative Inorganic Analysis, Al Vogel.
- 3. Instrumental Methods of Chemical Analysis, BK Sharma.
- 4. Instrumental Methods of Chemical Analysis, H. Kaur
- 5. Analytical Chemistry, Gary D Christian

## SectionB Biological Chemistry

#### 1. Biological Membranes

General features of the biological membrane and its fluid mosaic model. Diffusion, facilitated diffusion aand active transport through a biological membrane, Donnan membrane equilibria.

#### 2. Nucleic acids

A general description of constituents of DNA and RNA, Salient features of structures of DNA and RNA, DNA denaturation and renaturation, Effect of UV radiation on DNA. Elementary idea of genetic code and recombinant DNA technology.

#### 3. Enzymes and Coenzymes

General features of enzymes and their active sites, Ribozymes and Abzymes, Enzyme nomenclature, units of enzyme activity, Derivation of Michaelis–Menten equation, Experimental determination and physical significance of  $K_m$  and  $v_{max}$ , significance of  $k_{cat}/K_m$  in enzymatic catalysis, Brief description of competitive, uncompetitive, non–competitive and suicidal inhibitors of enzymes. A brief description of coenzymes and function of thiamine pyrophosphate.

#### 4. Role of Metals in Biological systems

- (a). Fe in myoglobin and hemoglobin
- (b). Cu in plastocyanin and hemocyanin
- (c). Zn in carboxypeptidase and carbonic anhydrase
- (d). Mg in chlorophyll

#### Books

- 1. Outlines of Biochemistry by E. E. Conn and P. K. Stumpf, Wiley Eastern Ltd. New Delhi.
- 2. Biochemistry by Lubert Stryer , Freeman and company New York (Indian print also available) CBS Publishers and Distributors, Delhi)
- 3. Biochemistry by Lehninger, Nelson and Cox, Worth Publishers Inc.U.S.A., Indian Print CBS publishers and Distributors, Delhi)
- 4. Bio inorganic chemistry by Bertini, Gray, Lipard and Valentene, Viva Books Pvt. Ltd. New Delhi.

**Note:** Question No. 1 is compulsory and it would be of 10 marks. It contains **Six** short answer questions (three from each section) out of which only **Five** should be answered. A total of **Eight** questions (**Four** from each section) will be asked out of which four questions may be attempted with the condition that a maximum of only two questions may be answered from each section

## B.Sc. III PRACTICAL

The duration of practical examination will be of eight hours in one day. The total number of marks will be 100. Each candidate will have to carry out one experiment, from each section.

#### **Section A**

Estimate the following metals gravimetrically

- 1. Barium as Barium sulphate
- 2. Zinc as Zinc Oxide
- 3. Iron as Iron Oxide
- 4. Chromium as Chromium Oxide
- 5. Lead as lead sulphate
- 6. Nickel as bis (dimethylglyoximato) nickel (II)

#### **Section B**

- 1. To study the kinetics of reaction between acetone and iodine.
- 2. To determine the velocity constant for the hydrolysis of methyl acetate catalyzed by hydrogen ions.
- 3. To determine the solubility of simple salt by evaporation method and to draw the solubility curve.
- 4. To determine the solubility of benzoic acid by titration method.
- 5. To determination of amino acid by paper chromatography and thin layer chromatography.

#### **Section** C

1. Separation of two component organic mixture (Water separable). Systematic analysis of each component leading to their final identification laying emphasis on solubility, element detection, melting points. Boiling point determination, ignition test, and unsaturation and functional group test and preparation of suitable derivatives.

#### 2. Preparation of the following compounds :

- a. Soap from line seed oil or mahua oil or neem oil or coconut oil.
- b. Phenyl benzoate from phenol
- c. Aspirin from salicylic acid
- d. Picric acid from phenol.
- e. Oxalic acid from cane sugar.
- f. Benzoic Acid from ethyl or methyl benzene.

Tota	1	100 marks.
6.	Record	10 marks.
5.	Viva Voce	15 marks.
3.	Section C	25 marks
2.	Section B	25 marks.
1.	Section	25 marks

Note: The number of candidates to be examined in the practical per batch should not exceed 50.

\*\*\*\*

## Department of Physics DDU Gorakhpur University, Gorakhpur

## SYLLABUS FOR 3 Yr B.Sc. Degree

#### B.Sc. I

#### Total Marks: 200

(A)	Theory Papers	Max. Marks
	Paper I: Mechanics	45
	Paper II: Oscillations and Waves	45
	Paper III: Electricity and Magnetism	45
(B)	Practical Work	65

#### B.Sc. II

#### Total Marks: 200

(A)	Theory Papers	Max. Marks
	Paper I : Thermal Physics	45
	Paper II : Optics	45
	Paper III: Electronics	45
(B)	Practical Work	65

#### B.Sc. III

#### Total Marks : 300

(A)	Theory Papers	<u>Max. Marks</u>
	Paper I : Mathematical Physics and	50
	Classical Mechanics	
	Paper II : Quantum Mechanics	50
	Paper III: Statistical Mechanics and Modern Physics	50
	Paper IV: Spectra of atoms and molecules	50
(B)	Practical Work	100

# B.Sc. Part I PHYSICS

#### Paper I : Mechanics

- 1. Newtonian Mechanics : Inertial frame of reference, Galilean transformation, Velocity and acceleration in rotating coordinate system, Coriolis force, effect of rotation of earth on g, Foucault Pendulum.
- Special Theory of Relativity : Michelson-Morley experiment, Principle of simultaneity, postulates of special theory of relativity, Lorentz transformation, length contraction, time dilation, addition of velocities, Doppler effect, Aberration of light.
- 3. Relativistic Dynamics : Relativistic momentum, variation of mass with velocity, relativistic energy, mass energy equivalence, transformations of momentum and energy.
- 4. Central Forces : Inverse square law, potential and field due to (i) spherical shell and (ii) sphere, gravitational self energy, two body problem and reduced mass, Kepler's laws, motion of a satellite, geostationary satellite.
- 5. Dynamics of rigid bodies : Equation of motion of a rigid body, moment of inertia, products of moment of inertia, radius of gyration, theorems of parallel and perpendicular axes, moments of inertia of a ring, disc, rectangular beam, hollow and solid cylinders, spherical shell, solid and hollow spheres, moment of inertia of fly wheel, compound pendulum.
- 6. Elasticity: Elastic constants and their mutual relations, theory of bending of beams, torsion of cylinder.
- Properties of Liquids : Stream line motion, Reynold number, Poiseuille's equation, Stoke's law and terminal velocity, Surface tension and surface energy, molecular interpretation of surface tension, Pressure over curved surfaces, capillarity, Jager's method.

3-year B.Sc. Physics Syllabus

#### Paper II : Oscillations and Waves

- Free Oscillations : Concept of potential well, small oscillation approximation, differential equation of SHM and its solution, examples of mechanical and electrical systems, Addition of SHM, Lissajous figures with frequency ratio 1:1 and 2:1.
- 2. Damped Harmonic Oscillation : Mechanical and electrical systems, logarithmic decrement, relaxation time, LCR circuit, Moving coil galvanometer.
- Forced Oscillations : Forced Oscillation of mechanical and electrical systems, transient and steady state behaviour, sharpness of resonance, quality factor (Q), energy dissipation, Mechanical and electrical impedances, LCR series and parallel resonance.
- 4. Oscillation of Coupled Systems : Normal modes of vibration of mechanical and electrical systems with two degrees of freedom, Vibrations of string and rectangular membrane, Forced oscillation of coupled system.
- 5. Wave Motion : Wave motion and its parameters, stationary waves, Wave velocity and group velocity.
- 6. Ultrasonics : Production, properties and uses of ultrasonic waves, Acoustic grating.
- Fourier Analysis : Fourier theorem, evaluation of Fourier coefficients, analysis of (i) square wave, (ii) sawtooth wave, (iii) half and full wave rectifiers output.
- 8. Acoustics : The acoustics of Halls, Reverberation time, Sabine's formula.

#### Paper III : Electricity and Magnetism

- Electrostatics : Field due to a charge distribution, Multipole expansion, Electric field due to uniform distribution of line charge, sheet charge and spherical charge, Gauss' law and its application for finding E for symmetric charge distribution. Electrostatic pressure, electrostatic field energy, force on a point charge in front of an infinite conducting sheet (method of images).
- Electric field inside matter : Dielectrics, parallel plate capacitor with a dielectric, polarization; Concept of electronic, ionic and orientational polarization, polarizability, polarization vector P, displacement vector D, Electric susceptibility, Clausius-Mossotti equation.
- 3. Magnetostatics : Lorentz force, Definition of B , Biot-Savart's law, Ampere's law, Magnetic field due to a straight wire, circular coil, Helmholtz's coils, solenoid, toroid, Lorentz force; Magnetisation, magnetisation current, Magnetic permeability and susceptibility. Electromagnetic induction, Induced electric field, Faraday's law; integral and differential forms, Series and parallel combination of inductances, mutual induction, coupled circuits and ideal transformer.
- Electromagnetic waves : Displacement current, Maxwell's equations, E.M. field energy density, EM waves in vacuum, Poynting vector.
- 5. A.C. Bridges : J operator, Anderson, Schering, Robinson and Wein's bridge.
- 6. Network analysis : T and  $\Pi$  networks and their equivalence, Thevenin's, Norton's and Maximum Power Transfer Theorems, Low and high pass filters.

#### PRACTICALS

#### List of Experiments

Students are required to do any eight experiments from each group.

#### Group A : General Physics

- 1. Moment of inertia of fly wheel.
- 2. Compound pendulum; Acceleration due to gravity and radius of gyration.
- 3. Modulus of rigidity by Maxwell's needle.
- 4. Young's modulus of rectangular bar by cathetometer or optical lever method.
- 5. Sextant
- 6. Elastic constants by Searle's apparatus.
- 7. Surface tension of water by Jaeger's method.
- 8. Coefficient of viscosity of water by Poiseuille's method.
- 9. Thermal conductivity of rubber.
- 10. Spectrometer
- 11. Frequency of electrically maintained tuning fork.
- 12. Frequency of A.C. mains using sonometer.

#### Group B : Electricity and Electronics

- 1. Verification of Child's law.
- 2. Characteristics of triode valve and determination of its parameters.
- 3. Characteristics of Tetrode/ Pentode.
- Temperature co-efficient for platinum resistance thermometer using Carey Foster's bridge (M.P. of wax)
- 5. Thermocouple calibration and melting point of wax.
- 6. Current sensitivity of a dead beat moving coil galvanometer.
- 7. Charge sensitivity of a ballistic galvanometer by capacity discharge method.
- 8. Characteristics of P-N junction and Zener diode.
- 9. Reduction factor of Helmholtz galvanometer.
- 10. Calibration of energy meter using ammeter and voltmeter.
- 11. Potentiometer: Calibration of voltmeter and ammeter,
- 12. Determination of low resistance by potentiometer.

#### Practical Examination

There will be one practical examination. Duration of the examination shall be four hours. Candidates will be required to perform two experiments, one from group A and other from group B. The distribution of marks will be as follows :

	Student appearing as	
	Regular student	Ex - student
Experiment 1	20	20
Experiment 2	20	20
Viva - Voce	15	25
Record	10	00
Total	65	65

# B.Sc. Part II PHYSICS

#### **Paper I: Thermal Physics**

- Kinetic Theory of Gases : Maxwell's law of distribution of molecular speeds, Law of equipartition of energy, specific heat of ideal gas; Mean free path, Transport phenomena: conduction, viscosity and diffusion.
- 2. Equation of state : Andrew's experiment and discussion of results, Specific heat of saturated vapour, Van der Waal's equation of state, Boyle's temperature, Critical constants.
- Thermodynamics and Entropy : Reversible and irreversible processes, Carnot's theorem, Absolute scale of temperature; second law of thermodynamics; Entropy and its physical significance, Entropy of simple reversible and irreversible processes.
- Maxwell Thermodynamical Relations : Maxwell thermodynamical relations and their applications to, Clausius-Calpeyron latent heat equations, TdS equations, Joule-Thomson effect, internal energy equation, Specific heat equations, Magneto-caloric effect, Reversible electrolytic cell.
- Cryogenics : Principle of refrigeration, Porus-plug experiment, Principle of Regenerative cooling, Liquefaction of air, hydrogen and helium, Solidification of helium, Adiabatic demagnetisation of paramagnetic salt.
- 6. Conduction : Mathematical analysis of rectilinear flow of heat, acceretion of ice at the surface of ponds, Conductivity of bad conductors.
- 7. Radiation : Black body radiation, Kirchoff's law and its application, Pressure and energy density of diffuse radiation, Stefan-Boltzmann's law, Spectral distribution, Solar constant and temperature of sun, Wien's displacement law, Rayleigh-Jean's law, Planck's hypothesis and its application to black body radiation.

3-year B.Sc. Physics Syllabus

#### Paper II : Optics

- 1. Fermat's principle, Principle of extremum path, the aplanatic points of a sphere and other applications.
- 2. General theory of image formation: Cardinal points of an optical system; general relationships, thick lens and lens combinations, telephoto lenses.
- Aberration in images: Chromatic aberrations; achromatic combination of lenses in contact and separated lenses, Monochromatic aberration and their reduction, aspherical mirrors and Schmidt corrector plates, oil immersion objectives.
- 4. Optical instruments: Entrance and exit pupils, need for a multiple lens eyepiece, common type of eyepieces.
- 5. Interference of light: The principle of superposition; two-slit interference, coherence requirements for the sources, Fresnel biprism localised fringes in thin films, transition from fringes of equal thickness to those of equal inclination. Newton's ring, Michelson interferometer; its uses for determination of wavelength, Wavelength difference and standardisation of meter. Intensity distribution in multiple beam. Interference: Tolansky fringes, Fabry Perot interferometer and etalon.
- 6. Fresnel diffraction: Half-period zones, zone plate, circular apertures and obstacles, straight edge, explanation of rectilinear propagation.
- 7. Fraunhofer diffraction: Diffraction at a slit, circular aperture and a circular disc. Resolution; Rayleigh criterion, Resolving power of human eye, telescope, microscope, grating and prism.
- 8. Diffraction grating: Diffraction due to two slits, Diffraction at N parallel slits; plane diffraction grating, concave grating.
- 9. Polarisation: Linearly polarised light, its production and detection, Brewster's law, law of Malus, Double refraction, Nicol prism, double image prism, Huygen's theory of double refraction in uniaxial crystals, circularly and elliptically polarised light; its production and detection, optical rotation, polarimeters.

3-year B.Sc. Physics Syllabus

#### Paper III : Electronics

- Basic Semiconductor Physics: Basic features of energy band theory of solids; energy band pictures of semiconductors, electron-hole densities, electrical conductivity of intrinsic and extrinsic semiconductors, minority and majority charge carriers, drift and diffusion currents, concept of continuity equation for minority charge carrier.
- P-N Junction: Built in potential, width and capacitance of depletion region; Current flow in biased p-n junction, Varactor diode; Zener breakdown mechanism, Zener diode and its characteristics, Photo diode and Solar cell.
- Transistors: n-p-n and p-n-p transistors, current flow in transistors, potential divider biasing of transistors, characteristics in all three configurations; α, β and hybrid parameters and their relationship, FET and MOSFET, Principle of operation, characteristics and parameters.
- 4. Amplifiers and Oscillators: Small signal hybrid equivalent circuit of BJT, RC coupled CE amplifiers, frequency and phase response. Amplifier circuit using FET, Oscillator as positive feed back amplifier, Barkhausen criteria of sustained oscillation, LC tuned collector oscillator, Hartley and Colpitts transistor oscillator (derivation of formule not needed).
- 5. Modulation and Demodulation: Definition of three kinds of modulations, expression for AM, FM and PM waves, Vander-Brijl modulator, Linear diode detector.
- Radio Transmitter and Receiver: AM transmitter (block diagram and function of different blocks); Principle of simple and super heterodyne radio receiver, Qualities of radio receiver (selectivity, sensitivity, fidelity), Standard broadcast radio receiver, Image frequency, AVC and tuning indicator.
- 7. Digital Electronics: Binary system, Boolean algebra, De Morgan's theorem. OR, AND, NOT, NAND, NOR and XOR gates. Universality of NOR and NAND gates.

## PRACTICALS

#### List of Experiments

Candidates are required to do any eight experiments from each group.

#### **GROUP A: Optics**

- 1. Focal length of thin lenses and their combination by Nodal slide.
- 2. Wavelength of light by grating using spectrometer.
- 3. Wavelength of light using bi-prism.
- 4. Wavelength of light by Newton's rings method.
- 5. Breadth of single slit by diffraction of light using spectrometer.
- 6. Resolving power of plane transmission grating.
- 7. Resolving power of telescope.
- 8. Specific rotation of cane sugar using polarimeter.
- 9. Refractive index using Brewster's law.
- 10. Characteristics of photocell or photodiode.
- 11. Wavelength of light by Young's double slit experiment (using spectrometer)
- 12. Thickness of mica sheet by biprism.

#### **GROUP B: Electricity and Electronics**

- 1. Determination of high resistance by method of leakage.
- 2. Measurement of inductance of a coil using Anderson's bridge.
- 3. Measurement of capacity and power factor of a capacitor using Schering's Bridge.
- 4. Study the behaviour of LCR circuit.
- 5. Measurement of magnetic field of an electromagnet at different current using search coil.
- 6. H and angle of dip by earth inductor.
- 7. Characteristics curves of Beam power tube and determination of tube parameters.
- 8. Characteristics of p-n-p transistor in common-emitter configuraton and determination of current gain β.
- 9. Characteristics of p-n-p transistor in common-base configuration and determination of current transfer ratio.
- 10. Determination of electronic charge by Millikan's oil drop method.
- 11. Measurement of dc and ac voltages and frequency using cathod ray oscilloscope.
- 12. Verification of truth table of OR, AND and NOT gates.

#### PRACTICAL EXAMINATION

There will be one practical examination. Duration of examination shall be FOUR hours. Candidates will be required to perform two experiments one from group A and other from group B. The distribution of marks shall be as follows:

	Student appearing as		
	Regular	student	Ex - student
Experiment 1		20	20
Experiment 2		20	20
Viva - voce		15	25
Record		10	-
-	Total	65	65

## **SYLLABUS**

B.Sc. Part III PHYSICS

#### Paper I: Mathematical Physics and Classical Mechanics

#### **Mathematical Physics**

- 1. Orthogonal transformations, transformation matrix, proper and improper rotations, Euler angles (notation of Goldstein)
- Curvilinear coordinates: tangent basis vectors, scale factors, spherical, polar and cylindrical coordinate systems, gradient of a scalar, Divergence and curl of a vector, Laplace equation in spherical, polar and cylindrical coordinate systems and its solution.
- 3. Special Functions: Legendre, Hermite, Laguerre differential equations; their generating functions, recurrence relations, Rodrigue's formula and orthogonality properties. Associated Legendre polynomial.

#### **Classical Mechanics**

- Mechanics of a system of particles: Conservation Theorems, Constraints, Generalised coordinates, D' Alembert's principle, Lagrange's Equation, Generalised Momentum, Principle of least action, cyclic coordinates, Lagrangian for a free particle
- 2. Two Body Problem: Reduction to one-body problem, centre of mass, Kepler's problem
- Canonical Formulation: Hamilton's equations, canonical transformations, Poisson's bracket, Angular momentum Poisson's brackets, Hamilton Principal function, Hamilton-Jacobi equation, Harmonic Oscillator Problem, Hamilton characteristic Function, separation of variables, Central Force problem.
- 4. Motion of rigid bodies: Angular Momentum, Inertia Tensor, Torque free motion of a rigid body, Symmetrical top, Precession.

#### Paper II: Quantum Mechanics

- Matter and Radiation; Photoelectric effect, Compton effect. de Broglie's hypothesis; Davison-Germer experiment, wave packet. Uncertainity principle:, Complementarity principle. Angular momentum and magnetic moment of an electron due to orbital motion: Bohr magneton, electron spin, Stern-Gerlach experiment.
- 2. Schrödinger equation: time independent and time dependent formulations. Postulatory approach to wave mechanics, physical interpretation of □, conditions to be satisfied by the Schrödinger equation as an operator equation, observables and measurements, eigen values and eigen functions. Classical limit and Correspondence principle. Normalization and Orthogonality of wave function, degeneracy and parity of wave function. Probability current density and its interpretation, expectation value of an observable, Ehrenfest's theorem.
- 3. Operators: linear operators, product of two operators, commuting and non commuting operator, simultaneous eigen functions, Hermitian operators and their properties.
- 4. Simple one dimentional problems: Particle in a box, concept of potential well; Wave function and energies for ground and excited states. Step potential, penetration through rectangular barrier, transmission coefficients, quantum mechanical tunneling.
- 5. One dimensional harmonic oscillator, eigen value and eigen functions of ground and excited states, zero point energy.
- 6. Hydrogen atom : Schrödinger equation and its solution, angular momentum operators and their commutative relation, its eigen values of L2 and Lz and their degeneracy. Rigid rotator.

#### Paper III : Statistical Mechanics and Modern Physics

#### Statistical Mechanics:

- Statistical basis of thermodynamics, principle of equal a priori probability, probability distribution, average properties. Phase space representation, the mu and gamma space, density of states, ergodic surface, Liouville's theorem, Idea of statistical equilibrium, Microcanonical, Canonical and Grand-Canonical ensambles.
- 2. Thermodynamic equilibrium, Probability and entropy, Boltzman entropy relation, statistical interpretation of the second law of thermodynamics, Maxwell-Boltzman distribution, Maxwell distribution of speeds in an ideal gas.
- Quantum statistics; Cell size, as nature's constant, indistinguishability and symmetry considerations. Fermi-Dirac and Bose-Einstein Distributions, Planck's law, Saha's theory of Thermal Ionisation, Richardson-Dushman Equation.

#### Modern Physics:

- 1. Magnetism, Diamagnetism, Paramagnetism due to free ions and conduction electrons; Curie's law, ferromagnetism, domains, hysteresis loops.
- Lasers and Masers : Stimulated and Spontaneous emission of radiation, Einstein's coefficients, population inversion by pumping and cavity, Working principle of three level laser, Ruby and Helium-Neon laser, elementary idea of masers.
- 3. Nucleus and Nuclear models: Rutherford-Particle scattering and concept of nucleus, Static properties (size, spin, magnetic moment, parity and quadruple moment) of nucleus. Liquid drop model, Semiempirical mass and binding energy formula and Bohr-Wheeler theory of nuclear fission; Nuclear fusion, Bethe's theory of nuclear energy; Shell model, Explanation of magic numbers.
- 4. Nuclear instruments : Cyclotron, Synchrotron, Betatron and Geiger-Muller counter.
- 5. Elementary particles : Classification, Elementary ideas of strong, electromagnetic, weak and gravitational interactions, Basic idea of Quark model.

#### Paper IV : Spectra of atoms and molecules

- 1. Atomic model: Summerfield model and fine structure of  $H\alpha$  line, Vector atom model, Paulie's exclusion principle and electronic configuration of atom.
- 2. Atomic Spectra of one valence electron system: Optical spectra of Alkali atoms, electron spin and fine structure, spin orbit interaction; Zeeman and Paschen-Back effects, Stark effect.
- Atomic spectra of two valence electrons system: Spectra of helium and alkali earth elements, different types of coupling schemes and interaction energies, Zeeman effect, Paschen-Back effect, Intensity of spectral lines.
- 4. Molecular spectra of diatomic molecules: Quantum mechanical interpretation of near and far infra-red spectra of diatomic molecules, Rotation, vibration and rotation-vibration spectra, P, Q, R branches; Classification of moleculer electronic status of a diatomic molecules, symmetry properties of electronic eigen functions, coupling of rotation and electronic motion. Electronic band systems, sequences and progressions, Franck-Condon principle
- 5. Fluorescence and Raman spectra.

## PRACTICALS

Candidates are required to do any eight experiments from each group listed below.

#### List of Experiments

#### **GROUP A : Optics**

- 1. To determine the wavelength and separation between D1 and D2 line with the help of Michelson Interferometer.
- 2. To study the characteristics of photocell and to determine Planck's constant using photocell.
- 3. To determine the Young's modulus by Cornue's Fringes or Newton's rngs.
- 4. To determine the velocity of ultrasonic wave by diffraction method.
- 5. To determine the refractive index of a liquid by total internal reflection method.
- 6. To determine the wavelength of sodium light by interference due to three/ four slits.
- 7. To determine the wavelength of sodium light by interference due to four slits.
- 8. To determine the wavelength of a given diode laser by interference method (Young's double slit).
- To determine the radius of curvature of a cylindrical and plano convex lens by Interference method.
- 10. To determine the diameter of a thin wire by interference in a wedge shape air film.
- 11. To determine the dimensions (open and closed portion) of a double slit from the Fraunhofer diffraction pattern produced using a monochromatic source.
- 12. To determine the dimensions of a rectangular aperture by its Fraunhofer diffraction pattern.

#### **GROUP B: Electricity and Electronics**

- 1. To determine the specific charge (e/m) of the electron by kenotron/helical method.
- Verification of Richardson-Dushman equation and evaluation of work function of cathode material.
- 3. To draw the charecteristics and to determine the parameters of a field effect transistor.
- 4. To study the charecteristics of low/high pass filter.
- 5. To determine the magnetic susceptibility of a liquid by Quincke's Capillary rise method.
- 6. To study the characteristics of an audio frequency transistor amplifier.
- 7. To study the characteristics of R-C network.
- 8. To study the characteristics of interstage audio transformer.
- 9. To study the characteristics of a rectifier circuit.
- 10. To study the characteristics of of an unregulated power supply.
- 11. To study Zener diode voltage ragulating characteristics.
- 12. To study the universality of NOR and NAND gates.

## PRACTICAL EXAMINATION

There will be one practical examination. Duration of examination shall be six hours. Candidates will have to perform two experiments: one from Group A and other from Group B. The distribution of marks shall be as below:

		Student appearing as	
		Regular student	Ex - student
Experiment		50	50
Viva		30	50
Record		20	00
	Total	100	100

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course

## **B.Sc. Part –I (Theory)**

The examination shall comprise three theory papers and a practical test:

## Theory

Paper – I: Lower Non-Chordata	45 Marks
Paper – II: Higher Non-Chordata	45 Marks
Paper – III: Elements of cell biology, evolution and ecology	45 Marks
Practical	<u>65 Marks</u>
Total:	200 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

## Paper –I: LOWER NON-CHORDATA (PROTOZOA-HELMINTHES)

General survey and outline classification (up to orders only) of Protozoa, Porifera Coelenterata, Platyhelminthes and Nemathelminthes and the classification, habits, structure and life-history of the representatives mentioned below.

 PORTOZOA: Entamoeba; Euglena; Paramecium; Monocystis. Protozoa and diseases.
PORIFORA: Sycon.
COELENTERATA: Obelia and Aurelia.
PLATYHELMINTHES: Planaria, Fasciola and Taenia.
NEMATHELMINTHES: Wuchereria bancrofti. Helminthes and diseases.

## PAPER – II : HIGHER NON-CHORDATA (ANNELIDA-ECHINODERMATA)

General survey and outline classification (upto orders only) of Annelida, Arthropoda, Mollusca and Echinodermata and the classification, habits and life-history of the representatives mentioned below.

 ANNELIDA: Neries, and Hirudinaria
ARTHROPODA: Palaemon, Scorpion and Grasshopper Useful and harmful insects
MOLLUSCA: Lamellidens and Pila
ECHINODERMATA: Sea Star

## PAPER - III: ELEMENTS OF CELL BIOLOGY, EVOLUTION AND ECOLOGY,

#### **SECTION-A**

#### CELL BIOLOGY

Ultrastructure and molecular organization of cell-components in relation to basic functions; Structure and types of chromosomes; Mitosis and meiosis; Mendel's Laws of inheritance; Linkage and crossing over; Principles of chromosomal mapping.

#### **SECTION-B**

#### **EVOLUTION**

Theories and evidences of evolution; Lamarckism, Neolamarckism, Darwinism, Neo-Darwinism, Mutation theory, Modern Synthetic theory and evidences of evolution.

## SECTION-C

#### ECOLOGY

Concept of ecosystem; Energy flow, abiotic ecofactor (temperature, light and moisture) and biotic (food-web as in fresh water lakes and ponds) primary ecological divisions and their fauna.

Zoogeographicals realms and their characteristics vertebrate fauna.

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course

## **B.Sc. Part –I (Practical)**

Candidates shall be required to show knowledge of classification, dissections and micro preparations of the types mentioned above, in addition to those prescribed for intermediate examination of U. P. Board. Note books containing a complete record of the laboratory work done during the session must be produced at the practical examination. The duration of the practical examination shall be  $3\frac{1}{2}$  hours.

The distribution of marks shall be as follows:

Exercise		
Major dissection		15 Marks
Minor dissection		05 Marks
Preparation		08 Marks
Spots (10)		25 Marks
Viva-voce		05 Marks
Class records		<u>07 Marks</u>
	Total	65 Marks

The scope of practical work is indicated from the exercises given below:

## Protozoa:

Feeding experiment with congo-red; Prepared slides of structure, binary fission and conjunction.

## Gregarine and Verticella:

Examination of ciliates (Opalina, Balantidium and Nyctotherus) from the rectum of frog.

### **Porifera:**

Permanent preparation of spicules and gemmules.

Study of prepared slides of transverse and longitudinal sections of *Sycon*, Spongin fibres of *Euspongia*, different kinds of spicules and gemmules of *Spongilla*.

Meseum specimens: Euplectella skeleton; Spongilla; Euspongia; Cliona.

### **Coelenterata:**

Permanent preparation of Obelia colony.

Study of prepared slides of *Obelia* colony and medusa.

**Meseum specimens:** *Physalia; Porpita; Vellala; Corallium; Fungia; Tubipora; Pennatula; Gorgonia; Sea-anemone.* 

### **Plathyehelminthes:**

*Planaria:* Examination of living flat worms; Study of prepared slides of entire specimens and transverse sections.

*Fasciola*: Examination of specimens insitu; Study of prepared slides of entire specimen, transverse sections and larval forms.

*Teania*: Study of prepared slides of scolex, mature and gravid proglottids and transverse sections of mature proglottid.

Study of prepared slides of Polystomum, Paramphistomum, Schistosoma and Echinococcus.

Museum specimens: Tapeworm; Cysticercus larva.

## Nemathelminthes:

Ascaris: External characters; Study of prepared slides of transverse sections of male and female.

## Annelida:

*Neries*: External characters; Study of prepared slides of transverse sections; Permnent preparation of parapodium.

*Hirudinaria*: External characters; Dissections; Preparation of Jaws, nephridium and salivary glands; study of prepared slides salivary glands, nephridium and transverse sections through different regions.

**Meseum specimens:** *Heteronereis; Arenicola; Chaetopterus; Aphrodite; Pheretima; Branchllion; Bonnelia* female.

### Arthropoda:

Palaemon: External characters; Permanent preparation of statocyst.

Scorpion: External characters; Dissections; Permanent preparation of book-lung and pectin.

Periplanata: Dissection; Permanent preparation of salivary apparatus and trachea.

## Grasshopper: Dissections.

Study of prepared slides of mouth-parts of male and female *Anopheles* and *Culex*, life-history of *Anopheles* and *Culex*, Nauplius and Zoea larva, *Daphnia*, *Cyclops* and *Xenopsylla*.

**Museum specimens:** *Peripatus; Thyroglutus; Scolopendra; Balanus; Pagurus; Scylla; Sacculina* on crab; *Limulus; Schistocerca; Bombyx mori; Apis; Polistes;* Life-history of termite.

### Mollusca:

*Pila*: External characters; Dissections; Permanent preparation of radula and gill filaments; Study of prepared slides of gill lamella and osphradium.

**Lamellidens:** External characters; Dissections; Permanent preparation of gill lamella; Sections of gill lamella and glochidium larva; Study of prepared slides of glochidium and transverse sections through ctenidium, shell and different regions of the body.

**Museum specimens:** *Chiton; Turbinella; Doris; Aplysia; Vaginula; Mytilus; Teredo; Dentalium; Octopus; Loligo; Sepia; Nautilus; Pearl oyster.* 

### **Echinodermata:**

*Asterias*: External characters; Study of prepared slides of transverse and longitudinal sections of the arms.

Museum specimens: Echinus; Ophiothrix; Holothuria; Antedon.

### **Cytogenetics:**

Grasshopper testis and onion root-tip squash preparation to study mitosis and meiosis. Study of prepared slides of cell division.

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course

## **B.Sc. Part – II (Theory)**

The examination shall comprise three theory papers and a practical test:

## Theory

Paper – I: Protochordata, histology and embryology		45 Marks
Paper – II: Vertebrate Zoology		45 Marks
Paper – III: Elements of physiology and biochemistry		45 Marks
Practical		65 Marks
	Total:	200 Marks
	1 /*	1 •

Candidate must obtain minimum pass marks in theory and practical examination separately.

## Paper – I: PROTOCHORDATA, HISTOLOGY AND EMBRYOLOGY

## PROTOCHORDATA:

General survey and outline classification (up to orders only) of Protochordata, and the classification, habits, structure and life-history of the representatives mentioned below.

## Urochordata : Amphioxus.

## HISTOLOGY:

Histology of stomach, intestine, liver, pancreas, bone, pituitary, kidney and gonads of frog and a mammal.

## EMBRYOLOGY:

Outlines of development of an Ascidian, *Amphioxus*, frog and chick. Development of placenta in rabbit.

## PAPER – II: VERTEBRATE ZOOLOGY

General survey and outline classification (up to orders only) of Craniata, and the classification, habits, structure and life-history of the representatives mentioned below.

 CYCLOSTOMATA: External features only.
PISCES: Scoliodon.
AMPHIBIA: Parental care and neoteny.
REPTILIA: Uromastrix or any other Lizard. Identification of poisonous and non-poisonous snakes Biting mechanism of snakes, Snakes venom and antivenin
AVES: Columba
MAMMALIA: Octoology of robbit. Adaptive rediction Concernl characteristics of

**MAMMALIA:** Osteology of rabbit, Adaptive radiation,General characteristics and affinities of Prototheria, Metatheria and Eutheria.

Page 5 of 13

## PAPER – III: ELEMENTS OF PHYSIOLOGY AND BIOCHEMISTRY

### Section – A

### **ELEMENTARY MAMMALIAN PHYSIOLOGY:**

Elementary knowledge of digestion and absorption, respiration, circulation, excretion, nerve conduction, muscles, endocrines and pheromones.

#### Section – B

### **BIOCHEMISTRY:**

Elementary knowledge of functional groups (alcohols, thio-alcohols, acids aldehydes, ketones, and amines) and their reaction; Hydrogen ion concentration and buffering mechanism; classification of carbohydrates; Characteristics of monosaccharides; chemical classification of amino acids; Peptide Linkage; Types of Lipids; Hydrolysis of fats; Types of enzymes; Conditions for enzymatic activity; types of vitamins and micronutrients.

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course B.Sc. Part –II (Practical)

Candidates shall be required to show knowledge of classification, dissections and micro preparations of the types mentioned below. Note books containing a complete record of the laboratory work done during the session must be produced at the practical examination. The duration of the practical examination shall be  $4^{1}/_{2}$  hours.

The distribution of marks shall be as follows:

## Exercise

Dissection		18 Marks
Preparation		05 Marks
Physiology experiment		05 Marks
Spots (10)		25 Marks
Viva-voce		05 Marks
Class records		07 Marks
	Total	65 Marks

The scope of practical work is indicated from the exercises given below.

### Hemichordata:

Balanoglossus: External charatcters; Study of prepared slides.

### Urochordata:

*Herdmania*: External characters; Glycerine and permanent preparation of spicules and branchial wall; Study of prepared slides of larva and metamorphosis.

Museum specimen: Herdmania; Pyrosoma; Doliolum Oikopleura.

### **Cephalochordate:**

*Amphioxux*: External characters; Study of prepared slides of oral hood, velum and sections through various regions of the body.

### **Cyclostomata:**

Petromyzon: Larva: External characters.

#### **Pisces:**

*Scoliodon*: External characters; Dissections; Permanent preparation of placoid scales and ampulla of Lorenzini; Study of prepared slides of different kinds of scales and development of placoid scales.

### **Museum specimens:**

Elasmobranchii: Heptranches; Sphyrna; Pristis; Toredo; Sting-ray.

Holocephall: Chimaera.

**Teleostomi:** Acipencer; Lepidosteus; Hippocampus; Anguilla; Pleuronecles; Exocoetus; Clarias; Anabas; Amia; Arius; Polyodon.

**Dipnoi:** Any lung-fish.

### Amphibia:

**Frog:** Dissections; Permanent preparation of blood film and chromatophores; Study of prepared slides of histology and development; Study of articulated and disarticulated skeleton.

**Museum specimens:** Salamender; Proteus; Amphiuma; Amblyostama; Axolotal larva; Cryptobranchus; Siren.

Anura: Rhacophorus; Alytes ; Hyla.

**Reptilia:** 

*Uromastrix* or any other lizard: external characters; Dissections; Permanent preparation of blood film.

Study of articulated and disarticulated skeleton of Varanus.

#### **Museum specimens:**

Chelonia: Turtles and Tortoises.

Lacertilia: Varanus; Heloderma; Hemidactylus; Chamelion; Draco; Calotes; Lygosoma; Ophiosaurus or Anguis.

**Ophidia:** *Naja; Vipera; Crotalus; Bungarus; Ptyas*; Biting mechanism of poisonous snakes (Models).

Crocodilia: Alligator; Crocodileus; Gavialis.

**Extinct reptiles (models):** *Rhamphorhyncus; Brontosaurus; Iguanodon; Stegosaurus.* 

Aves:

*Columba livia intermedia:* External characters; Dissections; Permanent preparation of pecten, filoplume and blood film; Structure of feathers.

Study of prepared slides of chick embryo.

Study of articulated and disarticulated skeleton of fowl.

## Museum specimen:

Archaeornithes: Archaeopteryx. (cast and model).

Neornithes: Gallus; Anser; Corvus; Psittacula.

#### Mammalia:

**Rat or any other mammal**: External characters; Dissection of vascular and urinogenital systems.

Study of prepared slides of histology.

Study of articulated and disarticulated skeleton of rabbit.

### Museum specimens:

Prototheria: Tachyglossus and Ornithorhynchus, if available.

Metatheria: Macropus, if available.

**Eutheria:** *Manis; Platinasta; Felis domestica* or any other cat; *Mus; Hystrix; Lepus; Erinaceous;* Crocidura; Pteropus or any other bat; lemur or a monkey.

### **Physiology Experiment:**

Action of salivary amylase, pepsin and trypsin.

Oxygen consumption of a rat.

Total count of R.B.C. and W.B.C.

Differential count of W.B.C.

Bleeding and clotting time.

Formation of hemin crystals.

Estimation of haemoglobin.

Effect of asmolarity of salt solutions and hemolytic agents on R.B.C., Clinical tests of sugar, ketone and urea in urine.

Kymographic recording of muscle contraction in nerve-muscle preparation of frog.

Kymographic recording of muscle heart beat of frog and effect of drugs on it.

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course

## **B.Sc. Part – III (Theory)**

The examination shall comprise three theory papers and a practical test:**Theory**Paper – I : Environmental biology and toxicology50 MarksPaper – II : Economic Zoology and elementary biostatistics50 MarksPaper – III : Regulatory mechanism in vertebrates50 MarksPaper – IV : Cell physiology and elements of Biotechnology50 MarksPractical :100 MarksTotal :300 Marks

Candidates must obtain minimum pass marks in theory and practical examination separately.

## PAPER – I: ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

## Section – A

## **ENVIRONMENTAL BIOLOGY :**

Ecosystem : General organization; Trophic structure; Energy flow; Ecological pyramids; Basic types of biogeochemical cycles (chiefly nitrogen, phosphorus and sulphur).

Community : Basic structure; Species diversity, dominance, distribution and succession.

Population : Interspecific and intraspecific relations.

Population in relation to public health.

Conservation of natural resources with particular reference to wild life conservation in India (chief endangered species and concept of wild life reserves).

## Section – B

## **ENVIRONMENAL TOXICOLOGY**:

Introduction and scope of toxicology. Survey of environmental toxicants and their biology and ecological ill-effects.

Dose-response relationship: Graded, quantal and cumulative responses. Outline of toxicological testing methods : Mortality tests ( $LC_{50}/LD_{50}$  and safety margins/Limits); Acute, subacute and chronic testing of local and systemic effects (Skin; Eye; Behavioural; Biochemical; Physiological; Histopathological; Heamatological; Reproductive; Teratogenic; Carcinogenic).

## **Translocation of chemicals :**

Membrane barriers; Storage depots; Biotransformation sites; Mixed multifunction oxidases. Selective toxicity in relation to translocation and biotransformation factors. Outline of antidotal procedures.

## PAPER – II: ECONOMIC ZOOLOGY AND ELEMENTARY BIOSTATISTICS

## Section –A

## **ECONOMIC ZOOLOGY:**

General survey of economically important Phytoparasitic nematodes and insects. Pathology/Damage caused, Prevention and control of *Leishmania, Trypanosoma, Heterodera* and *Tribolium*. Diseases transmitted and control of mosquitoes and housefly. General features, Life-History and useful products of *Apis, Bombyx* and *Tachardia*. Brief outline of fish-culture, poultry and dairy-farming. Economic importance of fishes. General survey of important food-fishes and their diseases. Rat menace and its control.

## Section – B

## **BIOSTATISTICS:**

General representation of frequency distribution: Histograms; Frequency polygon; Cumulative frequency graph/ogive. Measurement of central tendency: Mean; Median; Mode. Measures of variability: Standard deviation. Normal probability curve: Basic features.

## PAPER – III: REGULATORY MECHANISMS IN VERTEBRATES

### **Nutritional Physiology:**

Nutritive requirements (concept of balanced diet); Regulation of hunger; Satiety; Food movement; Secretion of digestive juices.

### **Respiration:**

Regulation of breathing and transport of gases. Automobile industrial emissions, food additives, Pesticides (Insecticides & Rodenticides), Heavy metals, radioactive substances.

## **Blood and circulation:**

Regulation of heart beat; Vasomotor control; Hemodynamics (Physical characteristics of blood with reference to haematocrit and viscocity; Blood flow and resistance; Fluid energies; Blood pressure; Blood volume; Cardiac output).

## **Excretion and Osomoregulation:**

Regulation of kidney function; Cellular Permeability, diffusion and active transport; Salt and Water balance.

### Muscular system:

Innervation of muscles, excitation and contraction coupling; Chemical basis of muscle contraction.

### Nervous system:

Role of autonomic nervous system in regulatory mechanism.

### **Endocrines:**

Hypothalamo-hypophysial system; Regulatory action of hormones at cellular level; Thermoregulation in homeotherms.

## Paper IV: <u>CELL PHYSIOLOGY AND ELEMENTS OF BIOTECHNOLOGY</u>

## Section – A

## **CELL PHYSIOLOGY:**

Glycolysis; Kreb's cycle; Electron transport system; Synthesis of nucleic acids; Protein synthesis and its regulation; Immune responses.

## Section – B

## **BIOTECHNOLOGY:**

Basics of recombinant D.N.A. technology.

**Biotechnological Processes:** 

Cellular interaction and production of hybrids; Nuclear cloning.

Elementary knowledge of genetic engineering and its application towards human welfare.

## Department of Zoology DDU Gorakhpur University, Gorakhpur Syllabus for Three Year Degree Course B.Sc. Part –III (Practical)

The practical examination shall comprise two sittings of 3 hours each. The distribution of marks shall be as follows:

Exercise			
Paper –I:			
Ecology exercise			08 Marks
Toxicology exercise			08 Marks
Spots (5)			10 Marks
Paper – II and III:			
Dissection			08 Marks
Exercise			08 Marks
Spots (9)			18 Marks
Paper – IV:			
Major exercise			15 Marks
Minor exercise			05 Marks
Paper I – IV:			
Viva-voce			10 Marks
Class records			<u>10 Marks</u>
	Total	:	100 Marks

Note-books containing a complete record of the laboratory work done during the session must be produced at the practical examination.

The scope of the practical work is indicated from the exercises given below.

## Paper – I:

Recording of physical eco factors: Atmospheric pressure, temperature and humidity. Estimation of dissolved oxygen content of freshwater samples by Winkler's method. Estimation of free carbon dioxide in freshwater samples. Estimation of alkalinity of freshwater samples. Study (qualitative and quantitative) of freshwater plankton. Effect of light on colour changes in frog. Animal associations: Mutualism; Commensalism; Parasitism. Particular effect of organo phosphorus insecticide in rat. Precipitation of protoplasm of buccal epithelium cells by mercuric chloride in rat. Study of signs and symptom of ammonia poisoning in rat. Behaviorural rat responses of fish/insect to different doses of pesticide exposure. Determination of  $LC_{50}$  values from provided data. Study of prepared skeleton of toxicology related histopathology. Comparative study of chemical characteristics of polluted and non-polluted freshwater samples.
# Paper II:

Study of prepared slides and/or museum specimens of the following from the view point of their economic importance with respect to man:

Entamoeba; Leishmania; Trypanosoma; Plasmodium; Giardia; Trichomonas; Schistosoma; Miracidia; Redia and Cercaria; Taenia; Echinococcus; Hymenolepis; Dipylidium; Bladderworm; Hydatid cyst; Ascaris; Enterobius; Ancylostoma; Wuchereria; Dracunculus; Trichinella larva; Microfilariae; Cimex, Pedicules, Xenopsylla, Culex, Anopheles, Musca, Tribolium, Corcyra, Pyrilla; Chilo; Leptocorisa; Hieroglyphus; Dysdercus; Earias; Aulacophora; Termite (all castes); Apis and Bombyx life-history; Tachardia; Palaeomon; Microbrachium; Ostrea; Hilsa; Notopterus; Catla; Cirrhinus; Labeo; Wallago; Mystus; Rita; Hetropneustes; Clarias; Anabas.

Selected larvivorous fishes; Rattus.

Study of specimens of plant material damaged by nematodes and insects.

Study of fish by-products.

Study of devices/equipment used for the administration of pesticides to control phytoparasites and pests (sprayers; dusters; blowers); for netting of juvenile and adult fishes and for feeding chicks at poultry farms.

### Paper III:

Kymographic recording of muscle twitch.

Study of the effect of drugs on heart.

Dissections for the display of various endocrine glands.

Osmolarity of salt solutions on R.B.C.

Study of the effect of salivary amylase on digestion of starch.

Dissection of autonomic nervous system.

## Paper IV:

### Major exercise:

Separation of amino acids by chromatography.

### Minor exercise:

Giant chromosomes of chioronomus larva.

Demonstration of nerve cells by methylene blue.

Demonstration of mitosis in bone marrow/onion root-tip.

Mounting of bone marrow for mitosis.

Quantitative estimation of haemoglobin.

Demonstration of mitochondria in human buccal epithelium by supravital staining.

Preparation of Lactobacillus or any other useful microbe.