Curriculum Framework
M.Sc.-M.Ed.

3-YEAR POSTGRADUATE INNOVATIVE INTEGRATED TEACHER EDUCATION PROGRAMME

Academic Year 2020-21

COURSE FOR SEMESTER I to VI

॥ न हि ज्ञानेन सदृशं पवित्रमिह विद्यते ॥

Indian Institute of Teacher Education

(State Public University established by Govt. of Gujarat)

Curriculum Framework M.Sc.-M.Ed. 2020

Published by

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Registrar

Indian Institute of Teacher Education

Ramkrushna Paramhans Vidya Sankul, Near KH-5, Sector - 15, Gandhinagar - 382016

From the Desk of Vice-Chancellor....

Dear All,

Any curricula at any level should be based on what objectives or goals the educator or educational institution is trying to achieve in regard to students. A course of study for a class that teaches a student how to touch-type should be very different from one that teaches students to write a novel or a poem or even the results of a science experiment.

Therefore, a curriculum is of the utmost importance, as it mandates, among other things, how teachers and students will spend their time—in a lab? in clinical practice? in creating? in listening to lectures? It also clearly shows what a class, a department, a school, or an institution values, what these entities see as their mission, and what each expects its graduates to achieve. A curriculum should be the map to the essentials in any course of study, from the classroom level to the institutional level.

The success of any curriculum, then, should be judged on the basis of whether it achieves its objective. It's a test of how well an educational institution (or an individual teacher) defines and understands those objectives. It's a measure of how well an educational institution (or individual teacher) maps out a way for a student to find his or her way to success as defined by those objectives.

Curriculum consists of continuous chain of activities needed to translate educational goals into concrete activities, materials and observable change in behaviour. A lesson plan for example is a curriculum used by the teacher in the classroom. It answers the questions, "What do I want my students to know? How can I engage them in a series of activities that will maximize their chances of knowing? How can I measure what they have learned from the activities?"

Hence, for a society to achieve its educational goals, it needs a curriculum that is functional and relevant to its needs. Through the management of the curriculum, making use of the given resources in the best possible way. Developing policies to bring improvements in the whole system one can move towards a more promising future.

The curriculum sets the basis of any academic institution, without it, the institution would be a lost cause. As the syllabus would be commonly applied to the affiliated institutes across the state of Gujarat, we have concrete objectives of the system to apply. We have a defined set of aims and objectives for the syllabus that we have planned for our students. That's how we aim to move toward a better academic future for our nation.

It is a matter of great privilege and happiness writing to confirm the unveil of the latest curriculum of one and only university in the state of Gujarat dedicated to teacher education, Indian Institute of Teacher Education, Gandhinagar. We are glad to acknowledge that the latest curriculum has taken due care of the objectives and goals as set by NCFTE 2009 and guiding principles of NEP 2020. I also take the opportunity of appreciating the efforts put in by the teaching faculty of Centre of Education, IITE, Gandhinagar, Members of Board of Studies and Members of Acedemic Council for bringing a concrete neo-curriculum to the effect and application.

Date: 15th Sept., 2020

Gandhinagar

Dr. Harshad A. Patel

Contents:

Curriculum Framework for
M.Sc.-M.Ed.

3-YEAR POSTGRADUATE INNOVATIVE INTEGRATED TEACHER EDUCATION PROGRAMME

in force from Academic Year 2020-21

M.Sc.-M.Ed. Curriculum Framework

		Sem 1			Sem 2			Sem 3			Sem 4			Sem 5			Sem 6			Total		
	M.Sc.	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr
	Principal	5	4	20	5	4	20	3	4	12	3	4	12	3	4	12	3	4	12	22	24	88
	Total	5	4	20	5	4	20	3	4	12	3	4	12	3	4	12	3	4	12	22	24	88
	Frame Work of M.Ed. In integrated Course																					
	Total At par	*7*	*12*	*28*	*8*	*14*	*30*	*9*	*22*	*30*	*9*	*22*	*30*	*8*	*20*	*28*	*8*	*22*	*30*	*49*	*112*	*176*
	Title of the Papers/ Subject	Sem 1			Sem 2			Sem 3			Sem 4			Sem 5			Sem 6			Total		
	M.Ed.	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr	Papers	Credit	Total Cr
	Area A: Foundations of Education																					
LS	Psychological Foundations of Education-1			0	1	4	4			0			0			0			0	1	4	4
	Psychological Foundation of Education-2			0			0			0			0			0	1	4	4	1	4	4
	Psychological Testing (O3)			0			0			0			0	1	4	4			0	1	4	4
	Guidance & Counselling (O2)			0			0			0	1	4	4			0			0	1	4	4
CS	Teacher Education			0	1	4	4			0			0			0			0	1	4	4
ES	Sociological Foundations of Education			0			0			0			0	1	4	4			0	1	4	4
	Philosophical Foundations of Education			0			0			0	1	4	4			0			0	1	4	4
	Educational Studies			0			0			0	1	4	4			0			0	1	4	4
	Primary and Early Childhood Care Education (O1)			0			0	1	4	4			0			0			0	1	4	4
	Secondary and Higher Secondary Education (O1)			0			0	1	4	4			0			0			0	1	4	4
	Higher Education (O4)			0			0			0			0			0	1	4	4	1	4	4
	Total Area A	0	0	0	2	8	8	2	8	8	3	12	12	2	8	8	2	8	8	11	44	44
	Area B: Curriculum and Pedagogy																					
CS	Curriculum Development			0			0			0			0			0	1	4	4	1	4	4
	Inclusion: Concept & Policy Framework			0			0			0			0	1	4	4			0	1	4	4
	ICT in Education	1	4	4			0			0			0			0			0	1	4	4
	Instructional Technology (O3)			0			0			0			0	1	4	4			0	1	4	4
A	Measurement and Evaluation (O2)			0			0			0	1	4	4			0			0	1	4	4
EPC	Preparation of Theme Paper and its Presentation			0			0	1	2	2			0			0			0	1	2	2
	Preparation & Presentation of TLM/ e content development			0			0			0			0	1	2	2			0	1	2	2
	Yoga Studies			0	1	2	2			0			0			0			0	1	2	2
	Environment Studies (O4)			0			0			0			0			0	1	4	4	1	4	4
	Management & Administration			0			0	1	4	4			0			0			0	1	4	4
	Value Education (O1)			0			0	1	4	4			0			0			0	1	4	4
	Communication & Compository Writing			0			0	1	2	2			0			0			0	1	2	2
	Academic Writing			0			0			0	1	2	2			0			0	1	2	2
	Preparations and Administration of Psychological Test			0			0			0			0	1	2	2			0	1	2	2
	Total Area B	1	4	4	1	2	2	4	12	12	2	6	6	4	12	12	2	8	8	14	44	44
	Area C: Internship for TE																					
TE	Internship M.Ed.			0			0			0	1	2	2			0	1	2	2	2	4	4
	Area C: School Internship	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	1	2	2	2	4	4
	Research and PG Dissertation																					
R&D	Methods of Research in Education:1	1	4	4			0			0			0			0			0	1	4	4
	Methods of Research in Education-2			0			0	1	4	4			0			0			0	1	4	4
	Educational Statistics-1 (O2)			0			0			0	1	4	4			0			0	1	4	4
	Educational Statistics-2 (O3)			0			0			0			0	1	4	4			0	1	4	4
	Preparation and Presentation of Research Proposal			0			0	1	2	2			0			0			0	1	2	2
	Dissertation (Tool Development)			0			0			0	1	2	2			0			0	1	2	2
	Dissertation			0			0			0			0			0	1	4	4	1	4	4
	Total	1	4	4	0	0	0	2	6	6	2	6	6	1	4	4	1	4	4	7	24	24
		2	*8*	*8*	*3*	*10*	*10*	*6*	*18*	*18*	*6*	*18*	*18*	*5*	*16*	*16*	*5*	*18*	*18*	*27*	*88*	*88*

Semesterwise Distribution of Credits and Marks (Education)

SEMESTERWISE DISTRIBUTION OF MARKS FOR EPC Papers

Subject Name	Semester	T/P	Hours	Credit	Internal	External	Total
Yoga Studies	II	T+P	45	2	30	70	100
Value Education (O1)	III	T	60	4	30	70	100
Management & Administration	III	T	60	4	30	70	100
Communication & Compository Writing	III	T+P	45	2	30	70	100
Preparation of Theme Paper and its presentation	III	P	60	2	50	0	50
Preparations and administration of psychological test	III	P	60	2	50	0	50
Academic Writing	IV	T+P	45	2	50	0	0
Preparation & Presentation of TLM/ e content development	V	P	60	2	50	0	50
Environment Studies (O4)	VI	T	60	4	30	70	100
	-	-	**495**	**24**	**350**	**350**	**650**

SEMESTERWISE DISTRIBUTION OF MARKS FOR RESEARCH AND PG DISSERTATION

Subject Name	Semester	T/P	Hours	Credit	Internal	External	Total
	I	-	-	-	-	-	-
	II	-	-	-	-	-	-
Preparation and Presentation of Research Proposal	III	P	60	2	100	00	100
Dissertation : Tool Development	IV	P	60	2	50	00	50
	V	-	-	-	-	-	-
Dissertation	VI	P	120	4	60	140	200
			240	**8**	**210**	**140**	**350**

SEMESTERWISE DISTRIBUTION OF MARKS FOR INTERNSHIP

Subject Name	Semester	T/P	Hours	Credit	Internal	External	Total
-	I	-	-	-	-	-	-
Internship M.Ed. I	II	P	60	2	100	00	100
-	III	-	-	-	-	-	-
-	IV	-	-	-	-	-	-
-	V	-	-	-	-	-	-
Internship M.Ed. II	VI	P	60	2	100	00	100
			120	**4**	**200**	**00**	**200**

M.Sc. - M.Ed. Curriculum Framework (Educatrion)

Sem.	Nature of Paper	Type	Paper Code	Title of the Paper	Credit	Hours
1	Compulsory	Theory	292130	ICT in Education	4	60
1	Compulsory	Theory	294110	Methods of Research in Education:1	4	60
2	Compulsory	Theory	291110	Psychological Foundations in Education-1	4	60
2	Compulsory	Theory	291210	Teacher Education	4	60
2	Compulsory	T+P	292630	Yoga Studies	2	45
3	Compulsory	Theory	292740	Management and Administration	4	60
3	Compulsory	Theory	294120	Methods of Research in Education:2	4	60
3	Optional	Theory	291011	Primary and Early Childhood Care Education	4	60
3	Optional	Theory	291012	Secondary and Higher Secondary Education	4	60
3	Optional	Theory	292023	Value Education	4	60
3	Compulsory	T+P	292650	Communication and Compository Writing	2	45
3	Compulsory	Practical	292510	Preparation of Theme Paper and its Presentation	2	60
3	Compulsory	Practical	294130	Preparation and Presentation of Research Proposal	2	60
4	Compulsory	Theory	291330	Educational Studies	4	60
4	Compulsory	Theory	291320	Philosophical Foundations in Education	4	60
4	Optional	Theory	291021	Guidance & Counselling	4	60
4	Optional	Theory	292522	Measurement and Evaluation	4	60
4	Optional	Theory	294120	Educational Statistics-1	4	60
4	Compulsory	T+P	292660	Academic Writing	2	45
4	Compulsory	Practical	293110	Internship I	2	60
4	Compulsory	Practical	294140	Dissertation (Tool Development)	2	60
5	Compulsory	Theory	291310	Sociological Foundations of Education	4	60
5	Compulsory	Theory	292120	Inclusion: Concept and Policy Framework	4	60
5	Optional	Theory	291031	Psychological Testing	4	60
5	Optional	Theory	294033	Educational Statistics-2	4	60
5	Optional	Theory	292032	Instructional Technology	4	60
5	Compulsory	Practical	292520	Preparation and Presentation of TLM/e content development	2	60
5	Compulsory	Practical	292670	Preparation and administration of Psychological Test	2	60
6	Compulsory	Theory	291120	Psychological Foundation in Education-2	4	60
6	Compulsory	Theory	292110	Curriculum Development	4	60
6	Optional	Theory	292022	Environment Studies	4	60
6	Optional	Theory	291041	Higher Education	4	60
6	Compulsory	Practical	293120	Internship II	2	60
6	Compulsory	Practical	294150	Dissertation	4	120

M.Sc. - M.Ed. Curriculum Framework (Mathematics)

Sem	Nature	Type	Paper Code	Title of Course	Credit	Hours/ Week
1	Core Course	Theory	211010	Abstract Algebra 1	4	4
1	Core Course	Theory	211020	Real Analysis 1	4	4
1	Core Course	Theory	211030	Complex Analysis 1	4	4
1	Core Course	Pra/Tut	211040	Practical: Real Analysis 1 and Complex Analysis1	3	6
1	Core Course	Pra/Tut	211050	Practical: Abstract Algebra 1	3	6
1	Core Course	Submission	211060	Foundation course on Research in Mathematical Science- I	2	4
2	Core Course	Theory	211070	Abstract Algebra 2	4	4
2	Core Course	Theory	211080	Real Analysis 2	4	4
2	Core Course	Theory	211090	Complex Analysis2	4	4
2	Core Course	Pra/Tut	211100	Practical: Real Analysis 2 and Complex Analysis2	3	6
2	Core Course	Pra/Tut	211110	Practical: Abstract Algebra 2	3	6
2	Core Course	Submission	211120	Foundation Course on Research in Mathematical Sciences- II	2	4
3	Core Course	Theory	211130	Topology	4	4
3	Core Course	Pra/Tut	211140	Practical: Topology	3	6
3	Optional Course	Theory	211151	Number Theory	4	4
3	Optional Course	Theory	211152	Operations Research	4	4
3	Core Course	Submission	211160	Dissertation in Mathematical Sciences- 1	1	2
4	Core Course	Theory	211170	Functional Analysis	4	4

M.Sc. - M.Ed. Curriculum Framework (Mathematics)

4	Core Course	Pra/Tut	211180	Practical: Functional Analysis	3	6
4	Optional Course	Theory	211191	Computer Programming in 'C'	4	4
4	Optional Course	Theory	211192	Mathematical Statistics	4	4
4	Core Course	Submission	211200	Dissertation in Mathematical Sciences- 2	1	2
5	Core Course	Theory	211210	Ordinary Differential Equations	4	4
5	Core Course	Pra/Tut	211220	Practical: Ordinary Differential Equations	4	8
5	Optional Course	Theory	211231	Differential Geometry	4	4
5	Optional Course	Theory	211232	Mathematical Methods	4	4
6	Core Course	Theory	211240	Partial Differential Equations	4	4
6	Core Course	Pra/Tut	211250	Practical: Partial Differential Equations	4	8
6	Optional Course	Theory	211261	Advance Linear Algebra	4	4
6	Optional Course	Theory	211262	Classical Mechanics	4	4

M.Sc.-M.Ed. Curriculum Framework For Research and Dissertation (Mathematics)

Sem	Course	Nature	Type	Paper Code	Title of Course	Credit	Hours/ Week
1	M.Sc. M.Ed.	Core Course	Submission	211060	Foundation course on Research in Mathematical Science- I	2	4
2	M.Sc. M.Ed.	Core Course	Submission	211120	Foundation Course on Research in Mathematical Sciences- II	2	4
3	M.Sc. M.Ed.	Core Course	Submission	211160	Dissertation in Mathematical Sciences- 1	1	2
4	M.Sc. M.Ed.	Core Course	Submission	211200	Dissertation in Mathematical Sciences- 2	1	2

M.Sc.-M.Ed. Curriculum Framework For Practicals (Mathematics)

Sem	Course	Nature	Type	Paper Code	Title of Course	Credit	Hours/ Week
5	M.Sc. M.Ed.	Core Course	Pra/Tut	211220	Practical: Ordinary Differential Equations	4	8
6	M.Sc. M.Ed.	Core Course	Pra/Tut	211250	Practical: Partial Differential Equations	4	8

M.Sc. - M.Ed. Curriculum Framework (Physics)

M.Sc. M.Ed. Physics Theory and Practical Framework						
Sem.	**Nature of Paper**	**Type**	**Paper Code**	**Title of the Paper**	**Credit**	**Hours**
1	Core Compulsory	Theory	223010	Advanced Quantum Mechanics	4	4
1	Core Compulsory	Theory	223020	Advanced Mathematical Physics	4	4
1	Core Compulsory	Theory	223030	Electronics and instrumentation	4	4
1	Core Compulsory	Practical	223040	Laboratory Experiments in Physical Sciences-1	3	6
1	Core Compulsory	Practical	223050	Laboratory Experiments in Physical Sciences-2	3	6
1	Core Compulsory	Theory	223060	Foundation Course of Research in Physical Science-I	2	4
2	Core Compulsory	Theory	223070	Classical and statistical mechanics	4	4
2	Core Compulsory	Theory	223080	Solid State Physics	4	4
2	Core Compulsory	Theory	223090	Electrodynamics and plasma physics	4	4
2	Core Compulsory	Practical	223100	Laboratory Experiments in Physical Sciences-3	3	6
2	Core Compulsory	Practical	223110	Laboratory Experiments in Physical Sciences-4	3	6
2	Core Compulsory	Theory	223120	Foundation Course of Research in Physical Science-II	2	4
3	Core Compulsory	Theory	223130	Introduction to Computer Programing	4	4
3	Core Compulsory	Practical	223140	Laboratory experiments in Physical Science-V	3	6
3	Core Optional	Theory	223151	Laser physics and nonlinear optics	4	4
3	Core Optional	Theory	223152	Nanotechnology	4	4
3	Core Compulsory	Submission	223160	Dissertation in Physical Science-I	1	2
4	Core Compulsory	Theory	223170	Condensed matter Physics	4	4
4	Core Compulsory	Practical	223180	Laboratory experiments in Physical Science-VI	3	6
4	Core optional	Theory	223191	Solid State Electronics and devices	4	4
4	Core optional	Theory	223192	Cosmology and Astrophysics	4	4
4	Core Compulsory	Submission	223200	Dissertation in Physical Science-II	1	2
5	Core Compulsory	Theory	223210	Nuclear and Particle Physics	4	4
5	Core Compulsory	Practical	223220	Laboratory experiments in Physical Science-VII	4	8
5	Core Optional	Theory	223231	Atmospheric and Space Physics	4	4
5	Core Optional	Theory	223232	Pulse and microwave electronics	4	4
6	Core Compulsory	Theory	223240	Spectroscopic Techniques	4	4
6	Core Compulsory	Practical	223250	Laboratory experiments in Physical Science-VIII	4	8
6	Core Optional	Theory	223261	High energy Physics	4	4
6	Core Optional	Theory	223262	Electronic Communication	4	4

RESEARCH AND PG DISSERTATION FRAMEWORK (PHYSICS)

Sr No.	Subject Name	Semester	Hours	Credit	Internal	External	Total
1	**Foundation Course on Research in Physical Science-I**	1	30	2	50	-	50
2	**Foundation Course on Research in Physical Science-II**	2	30	2	50	-	50
3	**Dissertation in Physical Sciences – I**	3	30	1	25	-	25
4	**Dissertation in Physical Sciences – II**	4	30	1	25	-	25
5	**Dissertation Submission**	4	-	-	60	140	200
	Total				210	140	350

M.Sc. - M.Ed. Curriculum Framework (Chemistry)

Semester	Nature of Paper	Type	Paper Code	Title of the Paper	Credit	Hours
1	Core Compulsory	Theory	222010	Organic Chemistry-I	4	4
1	Core Compulsory	Theory	222020	Inorganic Chemistry-I	4	4
1	Core Compulsory	Theory	222030	Physical Chemistry-I	4	4
1	Core Compulsory	Practical	222040	Laboratory Experiments in Chemistry-1	3	6
1	Core Compulsory	Practical	222050	Laboratory Experiments in Chemistry-2	3	6
1	Core Compulsory	Theory	222060	Foundation Course on Research in Chemical Sciences-1	2	4
2	Core Compulsory	Theory	222070	Organic Chemistry-II	4	4
2	Core Compulsory	Theory	222080	Inorganic Chemistry-II	4	4
2	Core Compulsory	Theory	222090	Analytical Chemistry	4	4
2	Core Compulsory	Practical	222100	Laboratory Experiments in Chemistry-3	3	6
2	Core Compulsory	Practical	222110	Laboratory Experiments in Chemistry-4	3	6
2	Core Compulsory	Theory	222120	Foundation Course on Research in Chemical Sciences-2	2	4
3	Core Compulsory	Theory	222130	Molecular Spectroscopy	4	4
3	Core Compulsory	Practical	222140	Laboratory Experiments in Chemistry-5	3	6
3	Core Optional	Theory	222151	Polymer Chemistry	4	4
3	Core Optional	Theory	222152	Natural Products	4	4
3	Core Compulsory	Submission	222160	Dissertation in Chemical Sciences-1	1	2
4	Core Compulsory	Theory	222170	Heterocyclic Chemistry	4	4
4	Core Compulsory	Practical	222180	Laboratory Experiments in Chemistry-6	3	6
4	Core optional	Theory	222191	Inorganic Chemistry-III	4	4
4	Core optional	Theory	222192	Physical Chemistry-II	4	4
4	Core Compulsory	Submission	222200	Dissertation in Chemical Sciences-2	1	2
5	Core Compulsory	Theory	222210	Medicinal Chemistry	4	4
5	Core Compulsory	Practical	222220	Laboratory Experiments in Chemistry-7	4	8
5	Core Optional	Theory	222231	Disconnection Approach	4	4
5	Core Optional	Theory	222232	Dyes	4	4
6	Core Compulsory	Theory	222240	Drugs	4	4
6	Core Compulsory	Practical	222250	Laboratory Experiments in Chemistry-8	4	8
6	Core Optional	Theory	222261	Physical Chemistry-III	4	4
6	Core Optional	Theory	222262	Environmental Chemistry	4	4

M.Sc.-M.Ed. Theory and Practical Framework (Chemistry)

Semester	Nature of Paper	Type	Paper Code	Title of the Paper	Credit	Hours
1	Core Compulsory	Theory	222010	Organic Chemistry-I	4	4
1	Core Compulsory	Theory	222020	Inorganic Chemistry-I	4	4
1	Core Compulsory	Theory	222030	Physical Chemistry-I	4	4
1	Core Compulsory	Practical	222040	Laboratory Experiments in Chemistry-1	3	6
1	Core Compulsory	Practical	222050	Laboratory Experiments in Chemistry-2	3	6
2	Core Compulsory	Theory	222070	Organic Chemistry-II	4	4
2	Core Compulsory	Theory	222080	Inorganic Chemistry-II	4	4
2	Core Compulsory	Theory	222090	Analytical Chemistry	4	4
2	Core Compulsory	Practical	222100	Laboratory Experiments in Chemistry-3	3	6
2	Core Compulsory	Practical	222110	Laboratory Experiments in Chemistry-4	3	6
3	Core Compulsory	Theory	222130	Molecular Spectroscopy	4	4
3	Core Compulsory	Practical	222140	Laboratory Experiments in Chemistry-5	3	6
3	Core Optional	Theory	222151	Polymer Chemistry	4	4
3	Core Optional	Theory	222152	Natural Products	4	4
4	Core Compulsory	Theory	222170	Heterocyclic Chemistry	4	4
4	Core Compulsory	Practical	222180	Laboratory Experiments in Chemistry-6	3	6
4	Core optional	Theory	222191	Inorganic Chemistry-III	4	4
4	Core optional	Theory	222192	Physical Chemistry-II	4	4
5	Core Compulsory	Theory	222210	Medicinal Chemistry	4	4
5	Core Compulsory	Practical	222220	Laboratory Experiments in Chemistry-7	4	8
5	Core Optional	Theory	222231	Disconnection Approach	4	4
5	Core Optional	Theory	222232	Dyes	4	4
6	Core Compulsory	Theory	222240	Drugs	4	4
6	Core Compulsory	Practical	222250	Laboratory Experiments in Chemistry-8	4	8
6	Core Optional	Theory	222261	Physical Chemistry-III	4	4
6	Core Optional	Theory	222262	Environmental Chemistry	4	4

RESEARCH AND PG DISSERTATION FRAMEWORK (CHEMISTRY)

Semester	Nature of Paper	Type	Paper Code	Title of the Paper	Credit	Hours
1	Core Compulsory	Theory	222060	Foundation Course on Research in Chemical Sciences-1	2	60
2	Core Compulsory	Theory	222120	Foundation Course on Research in Chemical Sciences-2	2	60
3	Core Compulsory	Submission	222160	Dissertation in Chemical Sciences-1	1	30
4	Core Compulsory	Submission	222200	Dissertation in Chemical Sciences-2	1	30
				Total	6	180

M.Sc. M.Ed. Theory and Practical Framework (Botany)

Sem.	Nature of Paper	Type	Paper Code	Title of the Paper	Credit	Hours
1	Core Compulsory	Theory	221010	Principles of Plant Sciences	4	4
1	Core Compulsory	Theory	221020	Anatomy of Higher Plants	4	4
1	Core Compulsory	Theory	221030	Concepts of Ecology	4	4
1	Core Compulsory	Practical	221040	Laboratory Experiments in Plant Sciences-1	3	6
1	Core Compulsory	Practical	221050	Laboratory Experiments in Plant Sciences-2	3	6
2	Core Compulsory	Theory	221070	Principles of Genetics	4	4
2	Core Compulsory	Theory	221080	Molecular Cell Biology	4	4
2	Core Compulsory	Theory	221090	Developmental Biology	4	4
2	Core Compulsory	Practical	221100	Laboratory Experiments in Plant Sciences-3	3	6
2	Core Compulsory	Practical	221110	Laboratory Experiments in Plant Sciences-4	3	6
3	Core Compulsory	Theory	221130	Advanced Plant Physiology	4	4
3	Core Compulsory	Practical	221140	Laboratory Experiments in Plant Sciences-5	3	6
3	Core Optional	Theory	221151	Biological Chemistry	4	4
3	Core Optional	Theory	221152	Applied Plant Sciences	4	4
4	Core Compulsory	Theory	221170	Pteridophytes and Gymnosperms	4	4
4	Core Compulsory	Practical	221180	Laboratory Experiments in Plant Sciences -6	3	6
4	Core optional	Theory	221191	Microbiology	4	4
4	Core optional	Theory	221192	Principles of Horticulture	4	4
5	Core Compulsory	Theory	221210	Molecular Biology and Gene Regulation	4	4
5	Core Compulsory	Practical	221220	Laboratory Experiments in Plant Sciences -7	4	8
5	Core Optional	Theory	221231	Biostatistics and Bioinformatics	4	4
5	Core Optional	Theory	221232	Environmental Biology	4	4
6	Core Compulsory	Theory	221240	Analytical and Separation Techniques	4	4
6	Core Compulsory	Practical	221250	Laboratory Experiments in Plant Sciences -8	4	8
6	Core Optional	Theory	221261	Plant Biotechnology: Scope and Principles	4	4
6	Core Optional	Theory	221262	Phytoresources- Utilization and Manage-ment	4	4

RESEARCH AND PG DISSERTATION FRAMEWORK (BOTANY)

Sr. No.	Title of the Paper	Semester	Hours	Credit	Internal	External	Total
1	Foundation Course 1 : Research in Life Sciences	1	30	2	50	-	50
2	Foundation Course 2 :Academic and Research Organizations in Life Sciences	2	30	2	50	-	50
3	Dissertation in Plant Sciences - 1	3	25	1	25	-	25
4	Dissertation in Plant Sciences - 2	4	25	1	25	-	25
5	Dissertation Submission	4			60	140	200
	Total				210	140	350

EDUCATION

M.Ed. Semester I

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	ICT in Education	T	60	4	30	70	100
2	Methods of Research in Education:1	T	60	4	30	70	100
	Total		**120**	**8**	**60**	**140**	**200**

Semester II

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Psychological Foundations of Education:1	T	60	4	30	70	100
2	Teacher Education	T	60	4	30	70	100
3	Yoga Studies	T+P	45	2	30	70	100
	Total		**165**	**10**	**90**	**210**	**300**

Semester III

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Management and Administration	T	60	4	30	70	100
2	Methods of Research in Education:2	T	60	4	30	70	100
3	Optional Paper (01) Any One	T	60	4	30	70	100
	Primary and Early Childhood Care Education						
	Secondary and Higher Secondary Education						
	Value Education						
4	Communication and Compository Writing	T+P	45	2	30	70	100
5	Preparation of Theme Paper and its Presentation	P	60	2	50	0	50
6	Preparation and Presentation of Research Proposal	P	60	2	100	0	100
	Total		**345**	**18**	**270**	**280**	**550**

Semester IV

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Educational Studies	T	60	4	30	70	100
2	Philosophical Foundations in Education	T	60	4	30	70	100
3	Optional Paper (02) Any One	T	60	4	30	70	100
	Guidance and Counselling						
	Measurement and Evaluation						
	Educational Statistics:1						
4	Academic Writing	T+P	45	2	30	70	100
5	Internship M.Ed. I	P	60	2	100	00	100
6	Dissertation (Tool Development)	P	60	2	50	00	50
	Total		**345**	**18**	**270**	**280**	**550**

Semester V

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Sociological Foundations of Education	T	60	4	30	70	100
2	Inclusion: Concept and Policy Framework	T	60	4	30	70	100
3	Optional Paper (03) Any One	T	60	4	30	70	100
	Psychological Testing						
	Educational Statistics-2						
	Instructional Technology						
4	Preparation & Presentation of TLM/ econtent development	P	60	2	50	0	50
5	Preparations and Administration of Psychological test	P	60	2	50	0	50
	Total		**300**	**16**	**190**	**210**	**400**

Semester VI

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Psychological Foundation of Education-2	T	60	4	30	70	100
2	Curriculum Development	T	60	4	30	70	100
3	Optional Paper (04) Any One	T	60	4	30	70	100
	Environment Studies						
	Higher Education						
4	Internship M.Ed. II	P	60	2	100	00	100
5	Dissertation	P	120	4	60	140	200
	Total		**360**	**18**	**250**	**350**	**600**

Semester I

Semester wise Distribution of Credits and Marks

Semester I

Education

	Hours	Credit	Internal	External	Total
Theory	120	8	60	140	200
EPC	-	-	-	-	-
Research	-	-	-	-	-
Internship	-	-	-	-	-
Total	120	8	60	120	200

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	ICT in Education	T	60	4	30	70	100
2	Methods of Research in Education:1	T	60	4	30	70	100
	Total		**120**	**8**	**60**	**140**	**200**

Sem
I

ICT in Education

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand meaning and application of information and communication technology.
- understand the process of communication.
- understand the application of multimedia and process of e content development
- apply knowledge of ICT for academic and research writings

Unit 1 Information and Communication Technology (ICT) and internet

1.1 Meaning of ICT , Difference between ICT and Educational Technology

1.2 Application of ICT in context of education – classroom, professional development and school management

1.3 Information Literacy : Meaning, purpose and standards

1.4 Internet: Meaning and application in education Internet Security – Virus

Unit 2 Understanding Communication Process

2.1 Communication: concept and need Elements – context, sender, message, receiver, feedback and noise

2.2 Types of communication: Target related, Process related, message related, Direction related

2.3 Barriers to effective classroom communication ,

2.4 Models of Communication : Linear, Interactive and Transactional Model

Unit 3 Multimedia and e-content

3.1 Multimedia: meaning of text, graphics, animation, audio and video; integration of multimedia in education

3.2 Approaches to IT Based Teaching Learning Process: Computer Assisted Instruction, Computer Managed Instruction, Computer Aided Instruction, Web Based Instruction, Web Enhanced Instruction

3.3 E-Content: Design, standards and development (ADDIE Model)

3.4 E-Content Tools: Concept and Examples - Freeware, Open Source Software, Proprietary Software and Public Domain Software

Unit 4 Academic and research content on web

4.1 Online Journals and abstraction services, Meaning of Database, Indexing and impact factor

4.2 Web services for review, bibliography, references and citation: INFLIBNET, Open Journal Access System (OJAS)

4.3 Plagiarism – Meaning and identification Plagiarism Software : URKUND,

4.4 Report writing : Use of Microsoft office and google suit services in report writing

Sem I

Methods of Research in Education I

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand the basics of educational research.
- develop the skill of reviewing related literature and previous research.
- understand the meaning of variables, objectives and hypotheses of research.
- acquire skills for conducting review of related literature and develop research proposal.

Unit 1 Basics of Educational Research

1.1 Educational Research: Definitions, Meaning and characteristics

1.2 Types of Research: Basic / Fundamental Research, Applied research, Action Research, Types of Research According to the type of Data: Quantitative Research, Qualitative Research,

1.3 Areas of Educational Research

1.4 Steps of research process

Unit -2 Review of Related Literature

2.1 Criteria for Selecting Research Problem:

2.2 Review of Related Literature: Meaning and Need
Sources: Preliminary, Primary, Secondary and Tertiary: Biographies, Dictionaries, Electronic Sources.

2.3 Conceptual and theoretical Framework; Operationalisation of terms used

2.4 Analysis of Review: Meta-Analysis

Unit -3 Variables, Objectives and Hypotheses of Research

3.1 Research Questions: Characteristics, Points to be kept in mind while forming Research Questions

3.2 Objectives of Research: Points to be kept in mind and Importance

3.3 Variable: Meaning and Types- Independent, Dependent, Moderator, Controlled and Intervening Variable

3.4 Hypothesis: Concept and Characteristics
Types: Declarative, Directional, Non-directional, Question Form, Null and Research Hypothesis

Unit 4 Population, Sample and Sampling Technique

4.1 Universe and Population: Concept

4.2 Sample: Concept, Characteristics and Importance

4.3 Sampling: Meaning, Need and Characteristics

4.4 Types of Sampling: Probability: Random, Stratified, Systematic and Cluster
Non Probability: Incidental, Purposive, Convenient, Quota and snowball
Special: Multiphase, Multistage, Double and Match Pair Sampling

Semester II

Education

	Hours	Credit	Internal	External	Total
Theory	120	8	60	140	200
EPC	45	2	30	70	100
Research	-	-	-	-	-
Internship	-	-	-	-	-
Total	165	10	90	210	300

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Psychological Foundations of Education:1	T	60	4	30	70	100
2	Teacher Education	T	60	4	30	70	100
3	Yoga Studies	T+P	45	2	30	70	100
	Total		**165**	**10**	**90**	**210**	**300**

Sem **II**

Psychological Foundations of Education-1

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand concept of learning and association and field theories of learning.
- to understand theories of learning with reference to Cognitivism, Behaviorism, Constructivism and Humanism.
- understand the concept of Learning Curve and Transfer of Learning.
- acquaint with the concepts of Constructivism, Motivation, Thinking and Reasoning.

Unit -1 Learning and Learning Theories – Association and Field Theory

1.1 Learning
- Meaning, Characteristics of learning
- Factors affecting learning
- Schools of Thoughts related to Education: Cognitive, Behavioristic, Constructive, Humanistic

1.2 Hull's Drive Reduction Theory of learning- Association Theory
- Four Level Learning Theory
- Postulates for Learning
- Educational Implications

1.3 Kurt Lewin's Field Theory of Learning-Behaviorism – Field Theory
- Meaning and basic elements
- Experiment
- Educational Implication

1.4 Tolman's Sign Gestalt Theory of learning- Field Theory
- Meaning of Sign – Gestalt Theory
- Types of learning
- Laws of Learning
- Educational Implications

Unit -2 Learning Theory – Cognitivism, Behaviorism, Constructivism and Humanism

2.1 Gagne's Hierarchy of Learning - Cognitivism
- Meaning and conditions
- Events of Instructions
- Educational Implications

2.2 Bandura's Theory of Social Learning - Behaviorism
- Meaning and Essentials of Social Learning
- Bobo Doll Experiment
- Social Learning Process
- Educational Implications

2.3 Bruner's Theory of Discovery Learning - Constructivism
- Meaning and types of Concept
- Meaning of Discovery Learning
- Steps and educational implication

2.4 Rogers's Learning theory (Experiential Learning)- Humanism
- Meaning and elements of experiential learning
- Educational Implication

Unit -3 Learning Curve and Transfer of Learning

3.1 Learning Curve
- Meaning, Types, Characteristics & Educational Implications
- Plateaus and Causes of Plateaus in Learning Curve;
- Suggestions to Remove Plateaus of Learning Curve

3.2 Transfer of Learning
- Meaning and types of transfer
- Role of environment in transfer of learning
- Educational Implication

3.3 Theories of Transfer of Learning-1
- Mental Discipline (Faculty Theory)
- Identical Elements
- Theory of Generalization

3.4 Theories of Transfer of Learning-2
- Theory of Apperception
- Theory of Transposition

Unit -4 Constructivism, Motivation, Thinking and Reasoning

4.1 Constructivism
- Concept, Characteristics and types
- Role of teacher in constructivist learning and Educational Implications
- Vygotsky's theory of social constructivism: concept of ZOP

4.2 Theories of Motivation
- Concept and Types of motivation
- McClelland's Motivation Theory
- Educational Implication

4.3 Thinking
- Meaning, Definition & Characteristics of Thinking
- Types, Methods & Tools of Thinking
- Essentials of Effective Thinking

4.4 Reasoning
- Meaning, Definition & Characteristics of Reasoning
- Kinds & Steps of Reasoning
- Role of teacher in developing reasoning of students

Sem

II

Teacher Education

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand historical perspective of Teacher Education.
- get acquaint themselves with teaching as profession and roles of organizations in Teacher Education.
- understand organizational pattern and broad organisation of Teacher Education.
- get acquaint with Research, Problems, Innovations and Issues in Teacher Education

Unit 1 Concept of Teacher Education & Teacher Education in India : Historical Perspective

1.1 Meaning of Teacher Education, Purpose and Objectives of Teacher Education at various stages (Pre - School , Primary , Secondary and Higher Secondary)

1.2 Types of Teacher Education: Pre-Service and In Service

1.3 Teacher Education in Ancient India and Teacher Education in Pre-Independence Period

1.4 Teacher Education in Post-Independence Period

Unit 2 Teaching as a Profession & Various organizations related to Teacher Education

2.1 Teaching as a Profession, Role and Responsibilities of a teacher

2.2 Teacher Education as perceived in NEP 1986 , NCFTE 2009 and NEP 2020

2.3 Role of Organizations like: 1:UGC, 2:NCERT, 3:NCTE, 4: IASE

2.4 Role of Organizations like: 1:IITE, 2:CASE, 3:SCERT, 4:CTEs,5:DIETs

Unit 3 Teacher Education in India

3.1 Organizational Patterns:D.El.Ed.,B.El.Ed., Diploma in Special Education

3.2 Organizational Patterns:(Physical Education): D.P.Ed.,B.P.Ed., M.P.Ed.

3.3 Organizational Patterns:(Two Year): B.Ed.,M.Ed., B.Ed Special Education

3.4 Integrated Programme: B.Sc.B.Ed., B.A.B.Ed. M.Sc.M.Ed., M.A.M.Ed, B.Ed.M.Ed

Unit 4 Research, Innovations and Issues in Teacher Education

4.1 Research Trends in Teacher Education

4.2 Competency Based Teacher Education: Curriculum, Teaching learning Process and Evaluation

4.3 Issues: Quality v/s Quantity, Privatization and Employability

4.4 Innovations in Teacher Education

Sem

II

Yoga Studies

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- develop an understandung of yoga and its philosophy.
- to familiarize with the theories of first four limbs and methods of Astang yoga.
- to familiarize with the theories of second four limbs and methods of Astang yoga.
- realize the importance of Astang yoga for Self development.

Unit 1Yoga-It's Philosophy

1.1 Introduction and Meaning of yoga

1.2 Brief History of yoga

1.3 Importance of yoga

1.4 Effect of yoga on body and Daily routine of a healthy person.

Unit 2Astang yoga: First four limbs

2.1 Yama (The five "abstentions"): Ahimsa (non-violence), Satya (Truth, non-lying), Asteya (non-covetousness), Brahmacharya (non-sensuality, celibacy), and Aparigraha (non-possessiveness).

2.2 Niyama (The five "observances"): Shaucha(purity), Santosha(contentment), Tapas (austerity), Svadhyaya (study of the Vedic scriptures to know about God and the soul), and Ishvara-Pranidhana (surrender to God).

2.3 Asana: Literally means "seat", and in Patanjali's Sutras refers to the seated position used for meditation.

2.4 Pranayama ("Suspending Breath"): Prāna, breath, "āyāma", to restrain or stop. Also interpreted as control of the life force.

Unit 3Astang yoga: Second four limbs

3.1 Pratyahara ("Abstraction"): Withdrawal of the sense organs from external objects

3.2 Dharana ("Concentration"): Fixing the attention on a single object.

3.3 Dhyana ("Meditation"): Intense contemplation of the nature of the object of meditation.

3.4 Samadhi ("Liberation"): merging consciousness with the object of meditation

Unit 4Yog Practicies (Practical)

4.1 Pranayams:Bhastrika, anulom-vilom, kapalbhati, bahya, agnisar, bramri, udgit, ujjai shitli, sitkari, nadisodhan, karnrogantak, suryabhedi, chandra bhedi etc .)

4.2 Asanas;
Standing postures : garudasan, trikonasan, dhruvasan, natrajasan.
Sittingpostures : yogmudrasan, baudhpadmasan, vakrasan, ardhmasendrasan, vajrasan, kukutasan, sidhasan, kapotasan, marjarasan and Surya namaskar

4.3 Prone Posture : Naukasan(viprit), Bhekasan, Dhanurasan, Salbhasan, Bhujangasan
Spine Posture:Naukasan, Sarvangasan, Halasan, Matsyasan, Vipritkarni

4.4 Relaxation exercises and Savasan

Semester-III

Education

	Hours	Credit	Internal	External	Total
Theory	180	12	90	210	300
EPC	105	4	80	70	150
Research	60	2	100	0	100
Internship	-				
Total	345	18	270	280	550

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Management and Administration	T	60	4	30	70	100
2	Methods of Research in Education:2	T	60	4	30	70	100
3	Optional Paper (01) Any One	T	60	4	30	70	100
	Primary and Early Childhood Care Education						
	Secondary and Higher Secondary Education						
	Value Education						
4	Communication and Compository Writing	T+P	45	2	30	70	100
5	Preparation of Theme Paper and its Presentation	P	60	2	50	0	50
6	Preparation and Presentation of Research Proposal	P	60	2	100	0	100
	Total		**345**	**18**	**270**	**280**	**550**

Sem
III

Management and Administration

Compulsory

Marks : 70+30

Objectives

To enable the prospective teacher Educators to :

- understand concepts of educational management.
- apply appropriate educational management theory and approach in school management.
- identify appropriate leadership model as per educational institute requirement.
- gain understanding regarding various quality monitoring agencies in India.

Unit 1 Introduction of Educational Management

1.1 Educational Management: Meaning, Nature and Characteristics
1.2 Importance and Scope of Educational Management
1.3 Functions of Educational Management
1.4 Structure of Educational Management in India (with reference to Higher Education, Technical Education, Vocational Education, School Education)

Unit 2 Theories and Approach of Educational Management

2.1 Scientific Management Theory
2.2 Fayol's Theory of Management
2.3 Human Relation Approach
2.4 Human Behavior Approach

Unit 3 Models of Leadership

3.1 Leadership: Meaning and nature, quality of good leader
3.2 Blake and Mouton's Managerial Grid Model
3.3 Fiedler's Contingency Model
3.4 Tri-dimensional Model, Hersey and Blanchard's Model

Unit 4 Quality in Education

4.1 Total Quality Management and Six Sigma
4.2 Cost of Quality: Appraisal Costs, Cost Benefit Analysis
4.3 NAAC
4.4 Quality Council of India

Sem III

Methods of Research in Education - 2

Compulsory

Marks : 70+30

Objectives

To enable the prospective teacher Educators to :

- understand characteristics of tools of research and their types.
- understand methods of research in education.
- develop abilities of data handling.
- develop skill for writing a research report.

Unit 1 Tools And Techniques Of Research

1.1 Tools of Research: Concept and Overview of Types of tools of research Construction and Standardization of Tool: Steps, Reliability, Validity and Norms

1.2 Interview: Meaning, Advantages, Limitation and Types Rating Scale: Concept and Types – Likert, Thurston & Q-Sort Check-List: Points to be kept in Mind while Constructing Check-list

1.3 Questionnaire, Schedule and Inventory: Meaning and Steps of Construction

1.4 Observation: Meaning, Types, Advantages and limitations

Unit 2 Methods Of Research

2.1 Historical Research: Meaning, Purposes, Sources and Steps

2.2 Descriptive Research: Meaning and characteristics

- Survey: Meaning and Types
- Interrelationship studies: Co-relational Research and Casual Comparative Research, Case Study
- Developmental studies: Longitudinal: Cross sectional studies.

2.3 Experimental Research: Meaning; Characteristics -control, manipulation, observation, replication Experimental Designs: Pre, true and quasi experimental designs Validity of experimentation: Internal and External Validity, Factors affecting validity

2.4 Qualitative Research: Meaning and Purpose Ethnographical, Phenomenological and Anthropological Research: Concept

Unit 3 Data Handling

3.1 Scales of Measurement: Meaning; Types –nominal, ordinal, interval, ratio,

3.2 Descriptive Statistics: Concept and types- Measures of central tendency and graphical presentations

3.3 Inferential Statistics: Parametric and Non Parametric Test: Introduction and Conditions (No Computations), Level of Significance: Concept , Type – 1 Error, Type – 2 Error,

3.4 Meaning of treatment of data, editing coding classification tabulation

Unit 4 Writing Research Report

4.1 Research report: meaning and types (thesis, dissertation, journal article, paper) Parts of Research: Preliminary, content and supplementary

4.2 Format, style, typing, quotations, footnotes, Referencing(APA Latest Edition), pagination, tables, figures, graphs, plates

4.3 Criteria for evaluating research report

4.4 Ethics and Plagiarism in research

Sem III

Primary and Early Childhood Care Education (O1)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understands the concepts pertaining to ECCE.
- understand goals of development and learning in ECCE curriculum.
- critically reflect on the policies of Primary Education.
- familiarize with diverse aspects of organization and administration of Primary Schools.

Unit 1 Early Childhood Care and Education

1.1 ECCE- Concept & Objectives
1.2 Principles of early learning and development and its implications
1.3 Children Learning methods- Play & Activity
1.4 Care Stimulation and Interaction at ECCE Centre and role parents

Unit 2 Goals of Development and Learning in Early Childhood Care and Education

2.1 Physical, Health, Motor, Sensory and perceptual Development
2.2 Language & Cognitive Development
2.3 Development of Creative and Aesthetic Appreciation
2.4 Pedagogical approaches to ECCE

Unit 3 Primary Education: Concept and Policies

3.1 Concept, objectives and aims of Primary Education.
3.2 Critical Reflection on the policies of Primary Education;
  - Kothari Commission (1964-66) with reference to development of Primary Education.
  - NPE-1986 with reference to Primary Education.
  - NCF- 2005 National Curriculum Frame Work (Meaning; Curriculum at Primary School Level and its features).

3.3 Critical Reflection on RTE-2009 : Rights of Children and Teachers
3.4 Critical Reflection on NEP-2020 with reference to Primary Education

Unit 4 Structure of Primary Education

4.1 Structure of Primary Education
4.2 Hierarchy of officials of Primary Education Organization; their roles and responsibilities
4.3 Navoday Vidhyalay, Ashram Shala, Eklavya Model School, Kendriya Vidyalaya, KGBV: Objectives, Functions and Facilities
4.4 Role of Ministry of Education, NCERT, GCERT and DIET in Primary Education

Sem
III

Secondary and Higher Secondary Education (O1)

Optional
Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand the concept of secondary and higher secondary Education.
- know and analyze the Structures of Secondary and Higher Secondary Education in India.
- understand the problem and challenges related to secondary and higher secondary education.
- know the New Trends and Innovation in Secondary and Higher Secondary Education.

Unit 1 Perspective and Context of Secondary and Higher Secondary Education

1.1 Concept of Secondary and Higher Secondary Education: General Aims and Objectives, Nature and Characteristics, Scope and Functions

1.2 Historical Perspectives of Secondary and Higher Secondary Education in Pre - Independent India

1.3 Recommendations of Commissions and Policies on Secondary and Higher secondary Education: Mudaliar commission, Kothari commission, Yashpal Committee, NPE 1986, NKC-2005, NEP-2020

1.4 Recommendations of Delor's commission in terms of four pillars of Education

Unit 2 Stucture of Secondary and Higher Secondary Education

2.1 Structure and Status of Secondary and higher secondary Education in India: with context to different Boards, types of Schools, different streams, different levels, Open schooling, Nature and forms of inequality.

2.2 Management system of secondary education - role of Department of Education, Directorate, Inspectorate and NGO's.

2.3 Vocational Education at higher secondary school level

2.4 Global Perspectives: Secondary and Higher Secondary Education in England, USA, Australia, Russia.

Unit 3 Problems And Challenges of Secondary And Higher Secondary Education

3.1 Universalisation of Secondary Education: objective, implementation, fund, achievement.

3.2 Alternative Schooling at Secondary Stage

3.3 Problems and their remedies in relation to access, enrolment, wastage and stagnation, achievement and equality of Educational opportunities

3.4 Education of girls, disadvantaged and differently able children and slow learners and interventions to solve the problems

Unit 4 New Trends And Innovation In Secondary And Higher Secondary Education

4.1 Rashtriya Madhamik Shiksha Abhiyan (RMSA)-Objectives and Functioning

4.2 Innovations in Teaching learning at Secondary and Higher Secondary Education- Blend of ICT, Competency Based teaching, Project based learning, online Learning.

4.3 Innovation in examinations: Innovations in Board Examinations, CCE, Use of ICT in Examination, Semester System, Grading, Open Book Examination, On-line Examination

4.4 Quality assessment and accreditation as suggested by NEP-2020

Sem III

Value Education (O1)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- develop the theoretical understanding of values.
- to familiarize with the theories and methods of value development.
- realize the importance of value education for national and global development.
- value and different procedures of solution about the conflict.

Unit -1 Concept of Value and Value Education

1.1 Meaning, definition, nature and characteristics of Values

1.2 Classification of values: Personal, social, moral, human, constitutional, Gandhian, universal values; Extrinsic and intrinsic values; Hierarchy of values

1.3 Value Education: Meaning, objectives and need; Philosophical and Sociological Basis of Value Education

1.4 Indian concept of Values

Unit -2 Theories, Models of Value Development

2.1 Theories of Value Development: Social learning theory, Psychoanalytic theory and Cognitive Development Theory.

2.2 Process of Value Development: Knowledge, Perception and Actualization.

2.3 Models of Value Development: Value Analysis model, Value discussion model, Value clarification model, rational building model, Role playing model,

2.4 Value Crisis and Value Conflict; Role of Family, Peer Group, Mass Media and Technology.

Unit -3 Approaches and Methods of Value Education

3.1 Curricular Approaches to Value Education: Direct approach of teaching of values as a subject, Indirect and Integrated approach of teaching values through curricular subjects.

3.2 Co-curricular Approaches to Value Education: Morning Assembly, Extramural Talks, Celebrations, Game and sports, Dance, Drama and songs, NCC and NSS.

3.3 Evaluation of values: Need for evaluating values, Methods of Evaluation of values- Value Tests, Value Perception Scale, Observation and anecdotes.

3.4 Teachers as a Role model for Value Development.

Unit -4 Value Education and National Development

4.1 Constitutional values reflected in the Preamble of the Constitution of India: Liberty, Integrity, Unity, Equality, Fraternity, Sovereignty, Socialism and Democracy

4.2 Constitutional values reflected in the Fundamental rights and duties: Patriotism, Nationalism, Humanism, Environmentalism, Harmonious living, Gender equality, National Integration and International Understanding, Scientific temper and inquiry, Individual and collective excellence.

4.3 Strategies to foster constitutional values among youth.

4.4 Value orientation of Teacher Education Curricula.

Sem
III

Communication and Compository Writing

Compulsory
Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- gain insight and reflect on the concept and process of communication.
- develop an insight for academic listening and note taking.
- acquaint with academic communication and its importance.
- develop skills of writing and identification of different styles.

Unit -1 Communication Skills

1.1 Meaning, concept and components of effective communication
1.2 Strategies of effective communication
1.3 Role and usage of ICT in effective communication
1.4 Development of pre-academic skills (pre-reading, pre-writing and pre-presentation)

Unit -2: Academic Listening and Note taking- Informational, Critical and Therapeutic listening

2.1 Meaning, concept and importance of Informational listening, Critical Listening and Therapeutic listening
2.2 Academic Listening- Listening to Lectures, observing tone and taking notes.
2.3 Skills for a good listener – Listening to educational film
2.4 Developing and Presenting the notes

Unit -3: Academic Communication- classroom communication, seminar and workshops

3.1 Meaning, concept and importance
3.2 Seminar – skills for presenting research paper and article
3.4 Academic Workshops - Developing and Participating in workshop
3.5 Communicating with publishers for publication of articles and research paper

Unit -4: Types of Writing – Expository, Narrative, Descriptive, Argumentative

4.1 Meaning and concept of Expository, Narrative, Descriptive, Argumentative writings
4.2 Development or writing of Expository, Narrative, Descriptive, Argumentative paragraphs
4.3 Identification of different type of writing from the given sample
4.4 Writing of Expository, Narrative, Descriptive, Argumentative paragraphs

Sem III

Preparation of Theme Paper and its Presentation

Compulsory

Marks : 00 + 50

Objective of the course:

To enable the prospective teacher educators to :

- think about topics on which they can prepare theme papers.
- prepare presentations on theme papers.
- present theme papers to seminar or workshop.
- work in group for identifying topics on education.
- refer the material from various sources.
- write papers in different styles.
- present the paper in seminar or workshop arranged for the purpose.

Suggested Framework

According to the title of the dissertation students are allotted the topic for the theme paper. The format for the theme paper is discussed in the class based on various theme paper as well as good articles. After that there is deliberation and discussion with the students on the given topic. As per the need of the students, they refer library and access computer lab for the reference and conceptualize and put it in writing. One-month time is provided to the students for the preparation of the theme paper. After the completion of the paper they submit it online, and after that according to schedule they present the paper within 15-20 min.

Evaluation is done on the basis of presentation, content of the paper according to Topic and way of presentation.

Sem

III

Preparation and Presentation of Research Proposal

Compulsory

Marks : 00+ 100

Objectives

To enable the prospective teacher educators to :

- develop skills of literature review and develop and analytical skills.
- write a detailed research proposal.
- present the research proposal.

Details and Submissions

- Research Reviews (at least 10)
- Preparation of Research Proposal and submission
- Presentation of Research Proposal and approval

Suggested Framework for developing Research Proposal

- Introduction
- Title of research and statement of the problem
- Review of related literature, conceptual framework
- Rationale and need for the study
- Objectives of Research
- Hypothesis and or Research questions
- Variables of Research
- Operational and conceptual definitions and or explanation of terms
- Scope, limitations and delimitations of Research
- Area of Research
- Type of Research
- Method of Research
- Population and sample
- Tool of Research
- Intervention Program (in case of experimental research)
- Data Collection
- Technique of data analysis
- Chapterization
- Time frame and Budget
- References

(The framework can be changed or modified depending upon the type and need of research problem)

Semester- IV

Semester IV

Education

	Hours	Credit	Internal	External	Total
Theory	180	12	90	210	300
EPC	45	2	30	70	100
Research	60	2	50	00	50
Internship	60	2	100	00	100
Total	345	18	270	280	550

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Educational Studies	T	60	4	30	70	100
2	Philosophical Foundations in Education	T	60	4	30	70	100
3	Optional Paper (02) Any One	T	60	4	30	70	100
	Guidance and Counselling						
	Measurement and Evaluation						
	Educational Statistics:1						
4	Academic Writing	T+P	45	2	30	70	100
5	Internship M.Ed. I	P	60	2	100	00	100
6	Dissertation (Tool Development)	P	60	2	50	00	50
	Total		**345**	**18**	**270**	**280**	**550**

Sem IV | **Educational Studies** | Compulsory | Marks : 70 + 30

Educational Studies

Sem IV

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand education as a phenomenon and concept related with education studies.
- comprehend theoretical perspectives of education.
- identify and appreciate vision of school education and develop abilities to foresee and re-solve challenges.
- understand and apply knowledge with institutions, systems and structures of education and flagging the contemporary concerns of education policy and practice.

Unit 1 Educational Studies

1.1 Meaning, Concept and Scope of Educational studies
1.2 Disciplinary and Interdisciplinary nature of education
1.3 History of Educational Studies
1.4 Future of Education in relation to ICT and Artificial Intelligence

Unit 2 Theoretical Perspectives of Education

2.1 Educational ideologies for Education studies.
2.2 Meaning, characteristics and importance of
 a. Schoolling
 b. Pedagogy & Andragogy
 c. Knowledge generation
 d. Sustainable education
2.3 Education as a socially contrived system influenced by Social, cultural, political, economic and technological factors.
2.4 Prioritizing the aims of Indian education in context of a democratic, secular, egalitarian and a human society.

Unit 3 Vision of School Education

3.1 Development of relationship between child and environment: school practices with life outside the school: ICT and Teaching-Learning.
3.2 Role Perception: Teacher as role model, as a facilitator, as a autonomous individual, and as a co-learner.
3.3 Quality and Excellence in Education and Millennium Developmental Goals
3.4 Contemporary challenges to School Education.

Unit 4 Various Issues and Concerns of Educational Studies

4.1 LPG, Localization, Globalization of Education
4.2 Nationalization and internationalization of education
4.3 ODL, Blended Learning, Home Schooling
4.4 Researches in Educational Studies

Sem

IV

Philosophical Foundations of Education

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- introduce to Philosophy and Philosophy of Education.
- identify Indian schools of philosophy and educational thinkers.
- know Schools of Philosophy and Educational Thinkers around the World.
- develop competence in analyzing philosophical texts and review the researches in the areas of pure philosophy and educational philosophy and to draw implications thereof.

Unit 1 : Introduction to Philosophy and Philosophy of Education

1.1 Definitions, Concept and Nature of Philosophy from Bhartiya and Western Perspectives
1.2 Relation between Philosophy and Education
1.3 Branches of Philosophy; Metaphysics, Epistemology and Axiology; their Educational Implications
1.4 Philosophical attitude and its implications in educational practices.

Unit 2 : Indian Schools of Philosophy and Educational Thinkers

2.1 Samkhya Darshan, Yog Darshan and Uttar Mimamsa Darshan
2.2 Buddhism, Jainism
2.3 Gandhiji, Tagore, Swami Vivekananda
2.4 Sri Aurobindo, J. Krishnamurty, Pandit Deendayal Upadhyay

Unit 3 : Schools of Philosophy and Educational Thinkers around the World

3.1 Idealism, Realism, Naturalism, Pragmatism and Existentialism, Post-modernism
3.2 Islamic and Christian philosophies of education
3.3 Herbert Spencer, Rousseau, John Dewey
3.4 Michel Foucault, Paulo Freire, Martin Buber

Unit 4 : Philosophical analysis and implications of Educational Text and Researches in Educational

4.1 Analysis of Selected Philosophical Texts from Educational Perspectives
4.2 Analysis of Selected Educational and Literary Texts from Educational Perspectives
4.3 Analysis of Selected Movies / Documentaries from Educational Perspectives
4.4 Nature of Research in Educational Philosophy with illustrations of at least 3 research studies.

Unit 3 Introduction to Counselling

3.1 Counseling:
- Concept, Nature and Characteristics
- Principles of counseling.

3.2 Counseling approaches:
- Directive, Nondirective and Eclectic

3.3 Types of Counseling:
- Group counseling vs. individual counseling.

3.4 Difference between Guidance and Counseling

Unit 4 Counseling Process and Issues in Counselling

4.1 Counseling Process:
- Preparation for Counseling
- Counseling skills
- Factors affecting Counseling process.
- Case study and Case conference: Purpose, Plan, Procedures, and Precautions

4.2 Group Counseling:
- Introduction and assumptions in group Counseling
- The process of group Counseling
- Values of group Counseling
- Limitations of group Counseling

4.3 Preparation and Training for Counseling
- Academic preparation
- Qualities of a good Counselor
- Professional Ethics for Counselor

4.4 Problems and Issues
- Organization and Administration of Guidance and Services
- Guidance services for Special Groups
- Changing roles of functionaries

Sem

IV

Educational Statistics-1 (02)

Optinal

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- learns the various statistical method used in analysis of data.
- understands the basic concepts of educational statistics.
- develop the ability to select proper statistics with various data.
- develop the ability to evaluate critically the result of analysis of data.

Unit 1 Meaning of Educational Statistics

1.1 Meaning of statistics
1.2 Meaning of statistics in Education
1.3 Scale of Measurement
1.4. Tabulation of data and different forms of graphic presentation and their uses of in educational research

Unit 2 Descriptive statistics

2.1. The frequency distribution, measures of central tendency and variability, their calculation and use
2.2. The normal distribution-the normal probability curve-its important properties and applications
2.3. Scaling of test items
2.4. Scaling of judgments

Unit 3 Correlation and Regression

3.1. The coefficient of correlation-Linear, Biserial, Point Biserial, tetrachoric, phi, contingency, product-moment
3.2. Rank Difference, Partial and Multiple Correlation
3.3. Regression and Prediction; Linear regression-the regression line in prediction;
3.4. The regression equations and accuracy of prediction

Unit 4 Reliability and Validity of Test

4.1. Item analysis
4.2. Reliability: Meaning, Methods, Calculations of split half, length of test and reliability methods of rational equivalent.
4.3. Validity: Meaning, Methods, Calculations, length of test of validity.
4.4. Process of Standardization of Test

Sem IV

Measurement and Evaluation (O2)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand the process and theories of measurement and evaluation.
- understand objectives, norm referenced and criterion referenced test.
- identify, compare and contrast tools of measurement.
- understand standardized tests and acquaint them with process of standardisation.

Unit 1 Process & Theories of Measurement

1.1 Concept and need of evaluation, Inter relationship between measurement and evaluation

1.2 Functions of evaluation & Basic principles of evaluation

1.3 Classical Test Theory(CTT) : Concept, Characteristics and Importance of Item Response Theory(IRT): Concept, Characteristics and Importance

1.4 True scores and Errors of Measurement, Marks and Grades

Unit 2 Objectives & Norm-Referenced and Criterion-Referenced Test

2.1 Taxonomy of educational objectives: Cognitive Domain Affective domain, Psychomotor domain

2.2 Concepts of Norms Referenced and Criterion referenced Test Difference between NRT and CRT

2.3 Steps for constructions of Criterion-Referenced Test : Instructional intent specifying the domain, item development, item review and test development.

2.4 Types of tests: Achievement Test, Diagnostic Test, Domain-Referenced Test

Unit 3 Tools of Measurement and Evaluation

3.1 Subjective tools of Evaluation

3.2 Objective tools of Evaluation

3.3 Supply type questions: Simple question, completion question, short answer question, long answer question/essay questions (Characteristics, merits, limitations and improvement of each type).

3.4 Selection type question: constant alternative, multiple choice, matching, Re-arrangement. (Characteristics, merits, limitations and improvement of selection type item).

Unit 4 Process of Standardizing a Test

4.1 Standardized Test: Nature and use of standardized test Criteria for selecting a good standardized test: planning, reliability, validity, objectivity, Discriminating power, Adequacy, Usability and Comparability

4.2 Reliability: Concepts and types of reliability.

4.3 Validity: Concept and types of validity.

4.4 Standard Scores and Norms : Z-score, t-score, stanine, Letter Grade, Percentile Rank.

Sem
IV

Academic Writing

Compulsory-
Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand the concept of different types of writing and writing style.
- critically comment on the reports- project report, institutional report, minutes of staff meeting.
- comprehend the academics in the form of books and films and talks by academicians
- be aware about the current trends in education.
- present a seminar on various reports and policy documentation.
- self-criticize, defend on their point, counter question the opponent on the academic presentations/cross question.

Unit 1 Types of Writing and Writing Styles

1.1 Concept of Narrative, Descriptive and Persuasive Writing and Difference between narrative, descriptive and persuasive writing

1.2 Concept of Theme paper and research paper, review paper and the difference between the two

1.3 Writing of Project Reports, Field Visit Reports, Minutes of Staff Meeting

1.4 Writing of Abstract, Executive Summary, Paraphrasing and Summarizing

Unit 2 Writing a Review by Reviewing Surveys, Film and Speeches of Famous Academicians

2.1 Review of TED Talks

2.2 Review of Speech of A P J Abdul Kalam, Narendra Modi, Jawaharlal Nehru, Swami Vivekanand and M K Gandhi

2.3 Review of Films-Ek Doctor Ki Maut, Aadhar Sheela, Dead Poets Society, Short Films related to Education

2.4 Reviewing the related literature from Surveys, Shodganga, INFLIBNET, ERIC, Dissertation Abstract International

Unit 3 Critical Analysis of Various Policies and Act (Group Activities on the basis of Divergent and Convergent thinking)

3.1 National Education Policy- 2020, Teach R

3.2 NCTE Regulation 2014 Two Year integrated B.Ed., M.Ed. B.Sc Ed and MSc Ed (BSc-BEd and MSc- MEd)

3.3 RTE 2009

3.4 UGC Regulation PhD 2009 (For Doctoral Studies), 2016 and 2018

Unit 4 Writing of Research Proposal and Reporting Doctoral Thesis

4.1 Steps of writing Research Proposal

4.2 Reporting of Chart/Graphs and Tables-Explain, Compare and Narrate

4.3 APA style of Writing and APA style of Referencing

4.4 Plagiarism and Antiplagiarism Software

Sem

IV

Internship M.Ed. I

Compulsory-

Marks : 00+ 100

Objectives

To enable the prospective teacher educators to :

- develop skills of doing research on psychological attribute, social research and status surveys.
- develop skills of guiding and supervising microteaching lessons of B.Ed. trainees.
- develop an understanding of role, functions and process various agencies related with teacher education.
- develop and understanding of the role of technology in content development and research.
- develop an understanding of social roles of teachers as volunteers.
- develop skills of effectively presenting the work done.

Activities to be performed

Credit	Hrs.	Activity
2	60	Implementation of a Psychological Test/Status Survey/Social Research
		Guidance, checking and supervision of Microteaching Lessons of student teachers
		Visit to an agency of curriculum development/text book bureau/ DIET/ GCERT/ Teacher Education Institution
		Visit to Secondary Teacher Training Institute, GCERT /INFLIBNET/GIET / an institute of special education/NGO and contribute as a teacher/volunteer
		Presentation of submissions

Sem

IV

Dissertation (Conceptual Framework and Tool Delopment)

Compulsory-

Marks : 00+ 50

Objectives

To enable the prospective teacher educators to :

- develop skills of writing the introductory and conceptual framework for research report.
- develop and validate research tool.
- present their research progress.

Activities to be performed

Credit	Hrs.	Activity
2	60	Development and validation of tool
		Submission of Chapter 1, 2 and 3
		Presentation of work done

Semester - V

Semester V

Education

	Hours	Credit	Internal	External	Total
Theory	180	12	90	210	300
EPC	120	4	100	0	100
Research	-	-	-	-	-
Internship	-	-	-	-	-
Total	300	16	190	210	400

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Sociological Foundations of Education	T	60	4	30	70	100
2	Inclusion: Concept and Policy Framework	T	60	4	30	70	100
3	Optional Paper (03) Any One	T	60	4	30	70	100
	Psychological Testing						
	Educational Statistics-2						
	Instructional Technology						
4	Preparation & Presentation of TLM/ econtent development	P	60	2	50	0	50
5	Preparations and Administration of Psychological test	P	60	2	50	0	50
	Total		**300**	**16**	**190**	**210**	**400**

Sem V | Compulsory | Marks : 70 + 30

Sociological Foundations of Education

Objectives

To enable the prospective teacher educators to :

- understand concept of sociology and education.
- appreciate the socio-cultural context of education.
- understand the relation between society and education.
- understand the sociological issues and their remedies.

Unit 1 Sociology and Education

1.1 Concept, nature and definition of Sociology;
1.2 Relationship between Education & Sociology
1.3 Branches of Sociology: Sociology of knowledge, Rural Sociology, Sociology of Mass media
1.4 Concept, Nature and Scope of sociology of Education

Unit 2 Socio-cultural Context of Education

2.1 Culture: Meaning, Nature, Cultural change and Cultural Lag - Relation between education and culture
2.2 Nature of Indian Society: social and cultural changes in India
2.3 Social Change: Meaning, Nature, Pattern and Factors; Interrelationship between Education and Social Change
2.4 Modernization and Post-modernization as social movements and their educational implications

Unit 3 Society and Education

3.1 Concept of socialization, Education as a socialization process
3.2 Social Stratification: Concept, meaning & factors affected Social Stratification.
3.3 Social Mobility: Concept, Meaning, types and factors affecting
3.4 Future of Social Institutions in India: Challenges to Education

Unit 4 Sociological Issues and Remedies

4.1 Equality and Equity
4.2 Gender issues, disadvantaged section of Indian society (SC, ST and OBC)
4.3 Unemployment & Poverty
4.4 LPG, Urbanization Vs Ruralization

Sem V

Inclusion: Concept and Policy Framework

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand basic concepts of inclusive Education.
- identify and appreciate the diversities in the society.
- build barrier free environment for Students with Special Needs in Inclusive Classrooms .
- develop insight regarding Constitutional provisions and legal frameworks for facilitating inclusive education.

Unit -1 Introduction of Inclusive Education

1.1 History of inclusion –paradigm shift from segregation to inclusion

1.2 Inclusive education: Meaning, concept, definitions

1.3 Principles of Inclusive Education: Access, Equity, Relevance, Participation & Empowerment

1.4 Models of Inclusive Education

Unit -2 Understanding the Diversities

2.1 Understanding diversities: concept, types (disability as a dimension of diversity)

2.2 Disability as a social construct, classification of disability and its educational implications

2.3 Introduction to Neuro-Developmental Disabilities (SLD, ID, ASD)

2.4 Introduction to Sensory Disabilities (HI, VI, Deafblind)

Unit 3Building Inclusive Learning Environments

3.1 Definition and concept of Adaptation, Accommodation and Modification

3.2 Barriers to inclusive education

3.3 Role of teacher

3.4 Peer mediated instruction: Peer tutoring, Cooperative learning

Unit -4 Policies and Framework Facilitating Inclusive Education

4.1 Constitutional provisions: RTE (2009), NPE of Students with Disabilities (2006), RPwD (2016), NTA (1999) IEDSS (2013)

4.2 International Perspective: Salamanca 1994, UNCRPD, IEDSS (2013)

4.3 Concessions and Provisions for PwDs

4.4. Role of national Institutes (NIs) and NGOs

Sem V

Psychological Testing (O3)

Optional

Marks : 70+ 30

Objectives

To enable the prospective teacher educators to :

- develop an understanding of nature of psychological measurement and its underlying principles.
- acquaint with techniques of psychological measurement.
- develop skills in testing select psychological constructs.
- develop ability to administer, score, interpret and report psychological tests.

Unit 1 Psychological Measurement and Testing

1.1 Psychological Measurement: Meaning, Nature and Scope, Psychological and physical measurement: Difference

1.2 Need of psychological measurement in Educational Practices

1.3 Psychological testing: Meaning, nature and Characteristics of Psychological measurement

1.4 Scope and Use of psychological test in educational practices

Unit 2 Techniques of Psychological Measurement: Meaning, Steps, importance, merits and limitations

2.1 Testing Techniques: Teacher-made tests

2.2 Testing Techniques: Standardized Psychological Tests

2.3 Non Testing Techniques : Rating Scale, Questionnaires, Interview, Inventories

2.4 Non Testing Techniques: Personal Records, Sociometric and Projective techniques,

Unit 3 Testing of Psychological Constructs: Concept, need and available Standardized Tools

3.1
- Intelligence Tests
- Aptitude Test
- Achievement Test

3.2
- Attitude Scale: Thurston and Likert

3.3
- Interest Inventory
- Personality Inventory

3.4 Criteria for Test selection and Preparation
- Technical criteria: Reliability, Validity and norms
- Practical criteria: Ease of Administration, cost, time.

Unit 4 Administration, Scoring, Interpretation and Reporting Psychological Tests

4.1 Administration: Steps and precautions to be taken during administration of psychological tests

4.2 Scoring: Scoring of psychological test with reference to available standardized tests and analysis of test results

4.3 Interpretation: Interpreting test result for stakeholders (students, parents and authorities)

4.4 Reporting of test: Preparing Psychological Test Report and Reporting the test results to students, teachers and parents.

Sem
V

Educational Statistics- 2 (O3)

Optional
Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand statistical interpretations in educational research and to examine the scope of application of research.
- develop an ability to evaluate critically the results of analysis of data.
- develop the understanding of multivariate analysis techniques.
- differentiate between parametric and non parametric analysis techniques.

Unit 1 Testing Hypothesis

1.1 The hypothesis of chance-null hypothesis
1.2 The meaning of statistical inference, the significance of the mean, the median, the measures of variability, of percentages, of the coefficient of correlation
1.3 The significance of the difference between means and other statistics
1.4 Principals of sampling and the use of standard error formulas

Unit 2 Non Parametric Tests

2.1 Chi square Test, Sign Test, Median Test
2.2 Mann-Whitney U-Test
2.3 Kolmogorov- Smirnov Test
2.4 Kruskal Walis Testing, Candall Tests

Unit 3 Analysis of Variance

3.1 Analysis of Variance: Concept and Assumptions
3.2 Homogeneity test of Variance
3.3 Computation One way, Two way and factorial design
3.4 Analysis of covariance

Unit 4 Multivariate Analysis

4.1 Factor Analysis
4.2 Discriminant Analysis
4.3 Cluster Analysis
4.4 Meta-Analysis

Sem V

Instructional Technology (O3)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand Foundations of Educational, Instructional and learning Technology.
- understand concepts and models of Instructional Technology.
- understand concepts and models of Instructional Design.
- understand Planning and Procedures of Instructional Media.

Unit 1 Foundations of Educational, Instructional and Learning Technology

1.1 Concept of Educational technology, Instructional technology and learning technology Meaning of Technology of Education and Technology in Education

1.2 Forms of Education Technology: Teaching Technology, Instructional Technology and Behaviour Technology

1.3 Approaches to Media Use: Integrated, Complementary, Supplementary, Standalone (independent)

1.4 Historical Overview: Programmed learning stage, Media application stage and Computer application stage

Unit 2 Instructional Technology

2.1 Concept of Instruction and Instructional Technology
Forms of Instructional Technology: Hardware Approach, Software Approach and System Approach

2.2 Pedagogy of Technology Integration

2.3 E-learning Development Process: Preparation of Instructional Media for E-Learning and Blended Learning, Designing Learning Experiences using Open Education Resources

2.4 Instructional Strategies for Online Courses: Meaning and Types - Learning Contracts, Small Group Work Discussion, Projects, Collaborative Learning, Self-Directed Learning, Case Study, Mentorship, Forum

Unit 3 Instructional Design

3.1 Concept, need and Principles of instructional design
Difference between Instructional Design and Instructional System Design

3.2 Learning theories and their implications for instructional design – behaviorist, cognitivist, constructivist and eclectic approach

3.3 Stages of development of instructional design- Instructional goals; Need analysis- Audience and Environment Analysis, Performance objectives; Criterion referenced test items, Developing instructional strategy and material, Evaluation

3.4 Models of Instructional Design: Dick and Carrie, ADDIE Model, and ASSURE Model

Unit 4 Planning and Producing Instructional Media

4.1 Concept, characteristics and Preparation of Self Learning Material

4.2 Concept, characteristics and types of Programmed Learning Material – Linear , Branched and Mathetics

4.3 Online Course Development Process:
Team – Web developer, programmer and graphic designer
Interactive Multimedia: Concept,
Steps for Developing Multimedia- Storyboard and Prototype of multimedia, Multimedia Development Tools and Software

4.4 Emerging Trends: Learning Management System, Learning Content Management System, Creative Commons and Open Education Resources, Licensing and Copyright on Using and Sharing Resources

Sem
V

Preparation & Presentation of TLM/ E Content Development

Compulsory

Marks : 00 + 50

Objectives

To enable the prospective teacher educators to :

- review various teaching learning material.
- Identify, compare and contrast teaching learning material.
- cultivate skills for developing teaching learning material.
- develop skills for presentation of teaching learning material.

Presentation of Teaching Learning Material (Conceptual Understanding)

1.1 Understanding Teaching Learning Material and its types.
1.2 Selecting appropriate Teaching Learning Material for construction.
1.3 Preparation of teaching learning material.
1.4 Presentation of Teaching Learning Material.

Suggested Framework

Any one Teaching learning material is to be prepared based on any topic from B.Ed. Syllabus.The topic selected can be presented in any form (Physical or virtual) of TLM and any type – Video, Audio or Audio Video. Some of the suggested TLM types are

- Development of TLM 3 D Model
- Conceptual Model in the form of some report or project
- Virtual Model in the form of app or some coding program
- e learning material in 4 Quadrant

Sem V	Preparation and Administration of Psychological Tests	Compulsory Marks : 00 + 50

Objectives

To enable the prospective teacher educators to :

- review and analyze the available psychological test.
- understand the process of psychological testing.
- develop ability to construct psychological test.
- develop skills for administering psychological test.
- develop skill for scoring and interpreting psychological test.

Administration of Psychological Tests and Preparation (Conceptual Understanding)

1.1 Understanding psychological tests.
1.2 Selecting appropriate psychological tests.
1.3 Administering psychological tests.
1.4 Interpretations of data received from testing.

Suggested Framework

The objective of the paper is to develop the skills related with constructing and preparing the psychological test that is related with the measurement of a psychological attribute.The paper is to be introduced by giving basic understanding of psychological tests. This understanding can be linked with theory paper of Psychological Testing that is offered separately. The students should have motivated to select a topic related to attitude, aptitude, motivation, personality, achievement etc. The student may also select a topic related to the tool of his dissertation with the permission of his or her guide.

The student has to select an appropriate topic with the help of teacher in charge. After the selection of topic, the students have to go through the standardised procedure of developing test. Once prepared the test is to be administered and the data is to be interpreted.

Suggestive Steps for the Paper

S.No. Steps

1 Preparing Theoretical Background –
  a. Theory on which test is to be based and clarity on components
  b. selecting the type of test/scale/inventory
  c. Planning the nature, purpose of test and selecting sample
  d. Selecting the components/subcomponents and preparing test items
  e. Expert validation

2. Pilot Testing

3 Item Analysis-
  a. Fixing criterion for item validation
  b. Item Validation / difficulty index /discrimination value
  c. Reliability

4 Administration of test

5 Standardization – (optional)
  a. Fixing Norms
  b. Reliability
  c. Validity

6 Submission in the form of report

Semester VI

Semester VI

Education

	Hours	Credit	Internal	External	Total
Theory	180	12	90	210	300
EPC	-	-	-	-	-
Research	120	4	60	140	200
Internship	60	2	100	00	100
Total	360	18	250	350	600

Sr. No	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Psychological Foundation of Education-2	T	60	4	30	70	100
2	Curriculum Development	T	60	4	30	70	100
3	Optional Paper (04) Any One	T	60	4	30	70	100
	Environment Studies						
	Higher Education						
4	Internship M.Ed. II	P	60	2	100	00	100
5	Dissertation	P	120	4	60	140	200
	Total		**360**	**18**	**250**	**350**	**600**

Sem
VI

Psychological Foundations of Education-2

Compulsory

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand meaning, theories and measurement of intelligence.
- identify personality, theories and measurement of personality.
- appreciate unique qualities of individuals.
- enable the learners to accept his /her emotions.

Unit 1 Intelligence- Meaning, Theories and Measurement

1.1 Intelligence
- Meaning & definitions
- Types of Intelligence: Spiritual, Emotional, Cognitive(Mental)
- Role of intelligence in child development
- Intelligence Theories : Cattell, Vernon

1.2 Theories of Intelligence
- Cognitive Intelligence: Cattell, Vernon, Gardener
- Emotional Intelligence: Goleman, Mayer & Salovery Model

1.3 Measurement of Intelligence
- Intelligence and Intelligence Quotient: Concept
- Types of Intelligence Test
- Uses and Limitations of Intelligence Test

1.4 Intelligence Test
International: Binet Simon, Stanford Binet and Wechsler Scale
Indian : Desai K.G., Bhatt C. L, Group Tests, Shah G.B. Non-Verbal Group Intelligence Test

Unit 2 Personality and its Theories

2.1 Fraud Theory of Personality
- The Id, Ego, Super Ego
- Factors affecting Personality: Mind (Conscious, Pre Conscious, Unconscious) Oedipus Complex, Electra Complex, Sibling Rivalry
- Stages of Personality Development

2.2 Jung’s Theory of Personality
- Basic Concepts of Jung’s Theory of Personality: Racial or Collective Unconscious Mind,
- Concept of Polarity, Equivalence and Entropy
- Personality Characteristics
- Functions & Types of Personality

2.3 Rogers’ Theory of Personality
- Assumptions of Rogers’ Theory of Personality
- Development of Personality
- Fully Functioning Person

2.4 Gordon Allport’s Theory of Personality
- Concept of Personality

Unit 3 Emotional and Spiritual Development

3.1 Emotional Development
- Nature and characteristics of emotions, types
- Greenspan's stages of emotional development
- Enhancing emotional development

3.2 Theories of Emotions-1
- James-Lange Theory
- Cannon Bard Theory
- Goleman's Theory

3.3 Spiritual Intelligence: Concept and Principles
- Concept of Spiritual intelligence
- Principles of Spiritual Intelligence

3.4 Spiritual Intelligence: Components
- Components of Spiritual Intelligence: Openness, precision, generosity, Kindness, Humility, Integrity

Unit 4 Attitude, Interest and Aptitude,Group and Group Dynamic and Conflict

4.1 Attitude
- Meaning and characteristics
- Heider's Balance theory
- Factors of attitude formation

4.2 Interest and Aptitude
- Meaning and types of interest
- Meaning and definition of aptitude
- Measurement for interest and aptitude

4.3 Group and Group Dynamic
- Meaning of group, steps of group formation
- Group Dynamic: Concept and importance
- Role of communication in group dynamic
- Measurement of group dynamic

4.4 Conflict
- Nature of social conflict
- Forms of social conflict: Overt, objective and subjective
- Methods of Conflict resolution
- Two dimensional model

Sem
VI

Curriculum Development

Compulsory
Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand various concepts and foundations of curriculum.
- comprehend various models of curriculum design and evaluation.
- promote critical inquiry in curriculum studies.
- critically comment on various issues of curriculum development.

Unit 1 Concepts and Foundations

1.1 Concept of curriculum development, curriculum as process and product

1.2 Components of Curriculum and their Relationship: objectives, content, methods, learning, experiences and evaluation.

1.3 Patterns of Curriculum Organisation:
a) Psychological Principles: Known to unknown, Simple to complex, easy to difficult
b) Content Organisation: topical, spiral, organized, incidental, time period, regression

1.4 Curriculum change: concept and factors

Unit 2 Models of Curriculum Design and Evaluation

2.1 Hilda Taba :Comprehensive Evaluation Model

2.2 Ralph Tyler : Objective Model of Evaluation

2.3 Robert Stakes: Countenance Model

2.4 Mukhopadhyaya : Curriculum Evaluation Model

2.5 Stufflebean: CIPP Model

Unit 3 Inquiry in Curriculum Studies

3.1 Relevance, Flexibility, Quality, Contextually and Plurality in curriculum

3.2 Role of Narrative Inquiry and multiculturalism in developing Learning Experiences

3.3 Characteristics and role of teacher in humanistic and social reconstructionist curriculum

3.4 Research in Curriculum: Critical Studies (social justice, cultural and linguistic difference etc.), innovations and teacher education

Unit 4 Issues in curriculum Development

4.1 Role of different agencies in curriculum development (Who should design curriculum schools, university, government or professional bodies like NCERT, SCERT, UGC, NCTE etc.)

4.2 Curriculum Transaction: Concept and variation in transaction due to diversity in culture, language and competence of teacher

4.3 Curriculum Evaluation: Feedback mechanism, collecting evidences from stakeholders and steps for improving curriculum

4.4 Impact of NEP 2020 on curriculum of school education with reference to aims, objectives, methods, learning experiences and evaluation

Sem

VI

Environment Studies (O4)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand concepts of environment and environment education.
- develop awareness towards environmental concerns.
- sensitize towards environmental issues.
- acquaint with the role of various agencies in environment conservation.

Unit 1 Environment and Environment Education

1.1 Environment: Concept
1.2 Environment Education: Concept and Need
1.3 Environment Education: Objectives of Environment Education
1.4 Significance of Environment Education

Unit 2 Environment Awareness

2.1 Concept of Environment Awareness
2.2 Need of Environment Awareness
2.3 Eco - Club: Meaning and Objectives
2.4 Activities of Eco club - Related to Environment Awareness

Unit 3 Environment Issues

3.1 Pollution (Air, Water, Noise, Land): Causes and Remedies
3.2 Global warming: Concept and its Impact
3.3 Ozone Layer Depletion: Causes, Impact and Remedies
3.4 Deforestation: - Causes, Impact and Remedies

Unit:-4 Role of Various Agencies in Environment Conservation

4.1 Role of Individual: School, Teacher and Learner
4.2 Role of Community
4.3 Role of Mass Media, Print Media and Electronics Media (TV, Radio, Movie, Internet)
4.4 Role of Government and NGOS

Sem VI

Higher Education (O4)

Optional

Marks : 70 + 30

Objectives

To enable the prospective teacher educators to :

- understand perspectives and context in Higher Education.
- know and analyze the structure of Higher Education in India.
- recognize problem and face challenges related to Higher Education.
- acquaint with New Trends and Innovation in Higher Education.

Unit 1 Perspective And Context Of Higher Education

1.1 Concept of Higher Education: General Aims and Objectives, Nature and Characteristics, Scope and Functions

1.2 Historical Perspectives of Higher Education in Pre - Independent and Post-Independent India focus on nature and progress

1.3 Recommendations of Commissions and Policies on

1.4 Higher Education: University commission, National education commission (1968), NPE-1986, NEP-2020

1.5 Role of Councils: NCTE, AICTE

Unit 2 Stucture Of Higher Education

2.1 Courses, Pattern, Activities

2.2 Structure and Status of Higher Education in India: with context to different Branches, Pattern, types of Universities, GER in Various streams

2.3 Management system of Higher Education: Education Ministry, UGC, Department of Higher education, Directorate, Universities, role of Department of Education., KCG, Role and functions.

2.4 Global Perspectives: Higher Education in England, USA, Australia, Canada, Privatization, Globalization and their impact on Economy. Study at abroad Issues and benefits

Unit 3 Problems And Challenges Of Higher Education

3.1 Maximizations of Higher Education: Needs, implementation, fund, achievement.

3.2 ODL: Open Universities, Distance Learning Programme

3.3 Problems/challenges/strategies/intervention in relation to access, enrolment, wastage and stagnation, achievement and equality of Educational opportunities

3.4 Quality of Higher Education: Teaching- learning, students-teacher ratio, Mode of Curriculum transaction, wastage and stagnation, issue regarding research quality

Unit 4 New Trends And Innovation In Higher Education

4.1 NAAC: Objectives, Functioning, Issues

4.2 Rashtriya Uchchatar Shiksha Abhiyan (RUSA)-Objectives and Functioning

4.3 Innovations in Teaching learning at Higher Education- Online and Blended Methods, Use of ICT, Role of Doordarshan, MOOC, SWAYAM, CBCS

4.4 Innovation in examinations: Online Exam, Open Book Examination, CCE, Use of ICT in Examination, Introduction of NTA

Sem

VI

Internship M.ED. II

Compulsory

Marks : 00 + 100

Objectives

To enable the prospective teacher educators to :

- develop skills of imparting lessons to Student Teacher.
- develop skills of observing peer lessons.
- develop an understanding of planning various curricular, co-curricular activities.
- develop and understanding of the role of institutional head and functioning of institution.
- develop skills of reflection and writing reflective diary.
- develop skills of effectively presenting the work done.

Activities to be performed

Credit	Hrs.	Activity
2	60	Lessons in Teacher Education Institution
		Observation of Lessons
		Planning of curricular and co-curricular activities, Time Table/ unit planning Guidence
		Interview of Head/ Institutional Analysis
		Reflective Diary
		Presentation of submissions

Sem

VI

Dissertation

Compulsory

Marks : 140 + 60

Objectives

To enable the prospective teacher educators to :

- collect the data for research.
- analyses the data and compute the result.
- develop skills of writing the data analysis and result for research report.
- present their research work and its findings.

Activities to be performed

Credit	Hrs.	Activity
4	120	Data Collection
		Data Analysis and Results
		Submission of Chapter 4, 5 and/6
		Submission of Research Report
		Presentation of work done

MATHEMATICS

Semester I

Mathematics

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Abstract Algebra 1**	T	60	4	30	70	100
2	**Real Analysis 1**	T	60	4	30	70	100
3	**Complex Analysis 1**	T	60	4	30	70	100
4	**Practical: Real Analysis 1 and Complex Analysis1**	P	90	3	30	70	100
5	**Practical: Abstract Algebra 1**	P	90	3	30	70	100
6	**Foundation Course on Research in Mathematical Sciences – 1**	T	30	2	50	-	50
	Total		390	20	200	350	550

Sem I

ABSTRACT ALGEBRA- 1

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand basics of abstract algebra, including binary operations, groups, subgroups, etc.
- To develop the skills of solving problems on isomorphism and automorphisms.
- To acquire knowledge of fundamental theorems of Abstract Algebra.
- To apply the knowledge of the fundamental properties of abstract algebraic structures, their substructures, their quotient structure, and their mappings.

Learning Outcomes

On completion of this paper students will be able to:

- Increased their capacity to develop logics.
- Understand basic concepts of Abstract algebra with new ideas.
- Develop problem solving ability in the subject of Abstract algebra.
- Develop confidence level to teach the same subject.

UNIT 1

1.1 Introduction to Groups, Symmetries of a Square
1.2 The Dihedral Groups, Elementary Properties of Groups, Finite Groups
1.3 Subgroups, Subgroup Tests, Cyclic Groups
1.4 Classification of Subgroups of Cyclic Groups

UNIT 2

2.1 Permutation Groups, Cycle Notation, Properties of Permutations
2.2 Isomorphisms, Cayley's Theorem, Properties of Isomorphisms, Automorphisms
2.3 Properties of Cosets, Lagrange's Theorem and consequences and further applications
2.4 External Direct Products and their properties. The Group of Units Modulo n as an External Direct product and further applications

UNIT 3

3.1 Normal subgroups, Factor groups, Applications of Factor groups
3.2 Internal Direct products, Group homomorphisms and their properties
3.3 The First Isomorphism Theorem, Fundamental theorem of finite Abelian groups
3.4 Isomorphism classes of Abelian groups

UNIT 4

4.1 The Conjugacy classes, The Class Equation
4.2 Sylow theorems and their applications
4.3 Finite Simple groups, Non Simplicity Tests
4.4 The simplicity of the group A5

Sem

I

REAL ANALYSIS 1

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand fundamental properties of the real numbers and sequences.
- To study convergence of sequence and continuous functions.
- To acquire knowledge of measure and measurable sets.
- To apply the knowledge of measure theory and measurable functions to integration theory.

Learning Outcomes

On completion of this paper students will be able to:

- Increased their capacity to develop logics of analysis.
- Understand basic concepts of Real analysis with new ideas.
- Develop problem solving ability in the subject of Real analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Sets, Sequences, and Functions
1.2 The Field, Positivity, and Completeness Axioms
1.3 The Natural and Rational Numbers, Countable and Uncountable Sets
1.4 Open Sets, Closed Sets, and Borel Sets of Real Numbers

Unit 2

2.1 Sequences of Real Numbers, monotone convergence criterion for real sequences, the Bolzano-Weierstrass theorem
2.2 Cauchy sequence, the Cauchy convergence criterion for real sequences, linearity and monotonicity of convergence of real sequences
2.3 Continuous Real-Valued Functions of a Real Variable, definition of continuous function
2.4 Lipschitz function, the intermediate value theorem, monotone function.

Unit 3

3.1 Lebesgue measurable sets, properties of Lebesgue measure
3.2 Outer measure, counting measure, Lebesgue Outer Measure and its properties
3.3 Measurable sets, σ-Algebra of Lebesgue Measurable Sets, Borel sets
3.4 Borel σ-algebra, Outer and Inner Approximation of Lebesgue Measurable Sets

Unit 4

4.1 Lebesgue Measurable Functions- definition, Borel measurable function
4.2 Sums, Products, and Compositions of measurable function
4.3 Pointwise and uniform convergence of measurable functions
4.4 Simple function, simple approximation theorem.

Sem I

COMPLEX ANALYSIS 1

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the concept of Complex Numbers, Complex Function & Analytic Function.
- To develop the skills of calculation and construction of graphs of complex function.
- To acquire the knowledge of Complex Analysis.
- To apply the knowledge of Complex Analysis for any real-world problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics of analysis.
- Understand basic concepts of complex analysis with new ideas.
- Develop problem solving ability in the subject of complex analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Metric on C, Polar representation and nth-roots of a complex number
1.2 Limit and continuity of a complex function
1.3 Derivative of a complex function
1.4 Cauchy-Riemann equations

Unit 2

2.1 Analytic functions
2.2 Harmonic functions
2.3 Power series, power series as an analytic function
2.4 Elementary functions

Unit 3

3.1 Contours, contour integrals, Antiderivative
3.2 Cauchy's theorem, Cauchy's Integral Formula, Cauchy inequality
3.3 Liouville's theorem, Fundamental Theorem of Algebra, Morera's theorem, Cauchy- Goursat's theorem
3.4 Gauss mean value theorem, Principle of deformation of paths, maximum modulus principle

Unit 4

4.1 Taylor's theorem, Laurent series
4.2 Absolute and uniform convergence of power series
4.3 Classification of singularities, Residues, residue theorem, residues at poles,
4.4 Evaluation of improper real integrals, Definite integrals with sine and cosine function, Mobius transformation.

Sem I

PRACTICAL - REAL ANALYSIS 1 AND COMPLEX ANALYSIS 1

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand fundamental properties of the real numbers.
- To develop the skills of constructing mathematical proofs in real analysis.
- To acquire the knowledge of Complex Analysis.
- To apply the knowledge of Complex Analysis for any real-world problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of Real and complex analysis.
- Develop problem solving ability in the subject of Real and complex analysis.
- Develop confidence level to teach the same subject.

1 Practical of Real Analysis Based on:

1.1 Creating the examples for given condition.

1.2 Testing the properties Measure, sequences of functions, measurable sets.

1.3 Verification of theorems.

1.4 Check necessary and sufficient conditions.

1.5 Problem solving of Real Analysis.

2 Practical of Complex Analysis Based on:

2.1 Testing Various Properties of Complex Number, Modulus, Argument and Complex Conjugate, logarithmic, Conformal mapping.

2.2 Classify the various types of singularities by definition as well as using expansion of series.

2.3 Testing Analyticity of Complex function &Verifying the Theorems on analytic function.

2.4 Explain various theorems on complex integration & Rouche's theorem, Open Mapping Theorem & Inverse function theorem.

2.5 Examples on Contour integration.

Sem
I

PRACTICAL- ABSTRACT ALGEBRA 1

Compulsory
Marks : 70 + 30

Objectives of the course:

- To understand basics of abstract algebra, including binary operations, groups, subgroups, etc.
- To develop the skills of solving problems about the size and composition of Groups.
- To acquire knowledge of fundamental theorems of Abstract Algebra.
- To apply the knowledge of the fundamental properties of abstract algebraic structures, their substructures, their quotient structure, and their mappings.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of abstract algebra.
- Develop problem solving ability in the subject of abstract algebra.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Problem solving on groups and subgroups
1.2 Problem solving on cyclic groups and check its properties
1.3 Problem solving on permutations
1.4 Examples of isomorphisms and automorphisms
1.5 Problems on direct products and the group of modulo n

Unit 2

2.1 Problem solving on normal subgroups
2.2 Applications of conjugacy class
2.3 Applications of Sylows theorem
2.4 Examples on simple groups
2.5 Applications of abstract algebra

Sem I	Foundation Course on Research in Mathematical Sciences-1	Compulsory Marks : 70 + 30

Objectives of the course:
- Can get knowledge about literature survey in Mathematical sciences.
- Can get understanding of how to write research paper/article.
- How to find a problem for dissertation
- To carry out the research work in Mathematical sciences.
- Can study of Results and Discussion coming out from Dissertation work
- Can make summary and conclusion along with references.

Learning Outcomes:
- to get knowledge about literature survey in Mathematical sciences.
- To learn how to write research paper/article.
- to carry out the research work in Mathematical sciences.
- to study of Results and Discussion coming out from Dissertation work in Mathematical Sciences.
- to make summary and conclusion of research article/paper along with references.

Unit 1 Introduction to Research:

1.1 Meaning and concept
1.2 importance of research & objectives
1.3 methodology
1.4 types of research- descriptive and analytical approach, conceptual and empirical.
1.5 Selecting the topic & literature review - Web as resource, library reference method.

Unit 2 Introduction to Methodology:

2.1 Research Design- developing research plan & frame work
2.2 Data collection and analysis- methods of data collection & data processing and analysis
2.3 Hypothesis- meaning and importance
2.4 Reporting and Project Writing- layout and method of writing
2.5 maintain good quality research writing presentation and effective communication and linguistic skills.

Semester II

SEMSESTER 2

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Abstract Algebra 2**	T	60	4	30	70	100
2	**Real Analysis 2**	T	60	4	30	70	100
3	**Complex Analysis2**	T	60	4	30	70	100
4	**Practical: Real Analysis 2 and Complex Analysis2**	P	90	3	30	70	100
5	**Practical: Abstract Algebra 2**	P	90	3	30	70	100
6	**Foundation Course on Research in Mathematical Sciences – 2**	T	30	2	50	-	50
	Total		390	20	200	350	550

Sem

II

ABSTRACT ALGEBRA 2

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the advanced level concepts of Abstract Algebra. To develop the problem-solving skills related to rings and fields.
- To acquire knowledge of some important theorems of Abstract Algebra.
- To apply Galois theory for analysing the solvability of polynomials by radicals.

Learning Outcomes

- On completion of this paper students will be able to Increased their capacity to develop logics.
- Understand basic concepts of Abstract algebra with new ideas. Develop problem solving ability in the subject of Abstract algebra. Develop confidence level to teach the same subject.

Unit 1

1.1 A brief review of Abstract Algebra 1 course
1.2 Ideals and factor rings
1.3 Ring homomorphisms
1.4 Isomorphisms and automorphisms

Unit 2

2.1 Polynomial rings, examples and its properties
2.2 Irreducible polynomials and Irreducibility tests
2.3 Unique factorization in Z[X]
2.4 Divisibility in integral domains

Unit 3

3.1 Splitting fields, examples, properties and results on it
3.2 Finite extensions of fields
3.3 Properties of algebraic extensions
3.4 Finite fields, geometric constructions

Unit 4

4.1 Fundamental theorem of Galois theory
4.2 Solvability of polynomials by radicals
4.3 Insolvability of a quantic
4.4 Cyclotomic polynomials

Sem

II

REAL ANALYSIS 2

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the basic concepts of the measure theory.
- To develop the skills of constructing mathematical proofs in Lebesgue measure theory.
- To acquire knowledge of important theorems and results of Lebesgue measure theory.
- To apply the knowledge of measure theory to check the Riemann and Lebesgue integrability.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics of analysis.
- Understand basic concepts of Real analysis with new ideas.
- Develop problem solving ability in the subject of Real analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Review of Lebesgue measure
1.2 Algebra of Lebesgue Measurable Sets, Lebesgue Measurable Functions
1.3 Littlewood's three principles
1.4 Egoroff's theorem and Lusin's theorem

Unit 2

2.1 Riemann integration, Lebesgue integration of a bounded measurable function
2.2 Linearity and monotonicity of integration, definition- lower and upper Lebesgue integral
2.3 Bounded convergence theorem
2.4 Lebesgue integration of a measurable non-negative function, monotone convergence theorem.

Unit 3

3.1 The general Lebesgue integral
3.2 Integral comparison test, Lebesgue dominated convergence theorem
3.3 General Lebesgue dominated convergence theorem
3.4 Countable additivity of integration

Unit 4

4.1 Uniform integrable measurable function
4.2 The Vitali convergence theorem
4.3 convergence in measure
4.4 Characterizations of Riemann and Lebesgue Integrability

Sem II

COMPLEX ANALYSIS 2

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the concept of Riemann Stieltjes integral and zeroes of analytic functions.
- To develop the skills of constructing mathematical proofs of important theorems and results of complex analysis.
- To classify the singularities of complex functions.
- To check the convergence of the infinite product of holomorphic functions.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics of analysis.
- Understand basic concepts of complex analysis with new ideas.
- Develop problem solving ability in the subject of complex analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Riemann Stieltjes integral- a function of bounded variation on [a, b] and its total variation
1.2 Rectifiable curve, smooth curve, polygonal path, integral of a continuous function on [a, b] with respect to a function of bounded variation and its properties
1.3 Zeros of an analytic function, multiplicity of zero of an analytic function
1.4 The index of a closed curve and its properties

Unit 2

2.1 Cauchy's Theorem and Integral Formula, Morera's Theorem
2.2 Counting zero principle and open mapping theorem
2.3 Classification of singularities-removable singularity
2.4 Pole and essential singularity, order of a pole.

Unit 3

3.1 Argument Principle, Rouche's theorem
3.2 Schwarz's lemma and applications
3.3 The space of continuous functions C(G), the topology on C(G), normal family in C(G)
3.4 Equicontinuity of a family in C(G), Arzela Ascoli theorem in C(G).

Unit 4

4.1 The space H(G) of analytic functions, locally bounded family in H(G)
4.2 Hurwitz's theorem, Montel's theorem
4.3 Infinite product, convergence and absolute convergence of infinite product, convergence of infinite product of elements in H(G)
4.4 Elementary factors and its properties, The Weierstrass Factorization Theorem, factorization of sin, cos, sinh and cosh, Walli's formula.

Sem

II

PRACTICAL REAL ANALYSIS 2 AND COMPLEX ANALYSIS 2

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the basic concepts Real and Complex Analysis.
- To develop the skills of problem solving.
- To acquire knowledge of important theorems and results.
- To apply the knowledge of theory papers to understand the concepts of Analysis.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of Real and complex analysis.
- Develop problem solving ability in the subject of Real and complex analysis.
- Develop confidence level to teach the same subject.

Unit 1 Practical of Real Analysis Based on:

1.1 Creating the examples for given condition.
1.2 Testing the properties of measurable functions.
1.3 Verification of theorems.
1.4 Check necessary and sufficient conditions.
1.5 Problem solving of Real Analysis

Unit 2 Practical of Complex Analysis Based on:

2.1 Examples on functins of bounded variation and its total variation.
2.2 Testing various properties of functions of bounded variation and closed curve.
2.3 Aplication of Cauchy's theorem and Morera's theorem.
2.4 Examples on classification of singularities.
2.5 Applications of argument principle, Rouche's theorem and Schwartz's lemma.
2.6 Examples on equicontinuous functions.
2.7 Problem solving on complex analysis.

Sem II

PRACTICAL- ABSTRACT ALGEBRA 2

Compulsory

Marks : 70 + 30

Objective of the course

To understand the advanced level concepts of Abstract Algebra.

- To develop the problem-solving skills.
- To acquire knowledge of some important theorems of Abstract Algebra.
- To apply Galois theory for analysing the solvability of polynomials by radicals.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of abstract algebra.
- Develop problem solving ability in the subject of abstract algebra.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Problem solving on ring and subring
1.2 Examples based on fields
1.3 Examples on splitting fields and check its properties
1.4 Problem solving on finite fields
1.5 Examples by dropping some necessary and sufficient conditions

Unit 2

2.1 Problem solving on solvability of polynomials by radicals
2.2 Examples of cyclotomic polynomials
2.3 Examples of Irreducible and reducible polynomials
2.4 Testing some results on field theory
2.5 Applications of Abstract algebra

Sem
II

Foundation Course on Research in Mathematical Sciences-2

Compulsory
Marks : 70 + 30

Objectives of the course:

- To understand the fundamentals of mathematical research.
- To develop skill of reasoning.
- To acquire the knowledge of mathematical methods.
- To apply the knowledge of mathematics in real-time problems.

Learning Outcomes:

- to get knowledge about mathematics terminology used in various literature survey in Mathematical sciences.
- To learn Mathematical proofs in research paper/article in Mathematical Sciences.
- to carry out the research work in Mathematical sciences.
- to study of Results and Discussion coming out from Dissertation work in Mathematical Sciences.

Unit 1

Mathematical Grammar & Vocabulary: Theorem, Corollary, lemma, Proposition, axioms, postulates, hypothesis, conjecture, existence, uniqueness, boundedness, characteristic & property – meaning & differences. Algorithm – basic concepts,
sorting & its Complexity.

Unit 2

Various Proof methods: Direct proof, indirect proof, contrapositive method, contradiction method, proofs by cases, mathematical induction method, biconditional proof, vacuous proof, trivial proofs, disproof method by counter example, characterization. Eneralisation & Simplification Techniques, Probabilistic Techniques, optimization Techniques.

Semester III

SEMESTER 3

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Topology**	T	60	4	30	70	100
2	**Practical: Topology**	P	90	3	30	70	100
3	**Number Theory (Optional)**	T	60	4	30	70	100
4	**Operations Research (Optional)**	T	60	4	30	70	100
5	**Dissertation in Mathematical Science – 1**	T	30	1	25	-	25
	Total		240	12	115	210	325

Sem

III

TOPOLOGY

Compulsory

Marks : 70 + 30

Objectives of the course:

To understand the theory of topological spaces.

- To develop the skills of finding open sets, closed sets, limit points, etc. in topological spaces.
- To acquire knowledge of connectedness and compactness of topological spaces.
- To gain knowledge of the important theorems and results of Topology.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics.
- Understand basic concepts of Topology with new ideas.
- Develop problem solving ability in the subject of Topology.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Topological spaces, basis, subbasis

1.2 The product topology on X × Y, the subspace topology

1.3 Limit points, Closed sets, closure and interior, convergent sequence

1.4 T_1- spaces and Hausdorff spaces

Unit 2

2.1 Continuous functions, homeomorphisms,

2.2 Pasting lemma, the product topology, maps into product, metric topology,

2.3 Diameter and bounded sets, continuity in metric spaces

2.4 The sequence lemma, first countability axiom

Unit 3

3.1 Connected spaces, connected subspaces of the real line

3.2 Compact spaces, results on it

3.3 Heine-Borel theorem for real line, second countable spaces

3.4 Separable spaces, regular spaces

Unit 4

4.1 Normal spaces, Urysohn's Lemma (statement only)

4.2 Tietze's Extension Theorem (statement only), complete metric spaces

4.3 Cantor's intersection theorem

4.4 Baire's category theorem for complete metric spaces

Sem III

Practical - Topology

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the problems on topological spaces.
- To develop the skills of finding open sets, closed sets, limit points, etc.
- To acquire Knowledge of topological spaces.
- To apply the knowledge of Topology for any problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of topology.
- Develop problem solving ability in the subject of topology.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Examples on topological space, basis, subbasis
1.2 Problems on various topological spaces with product topology and subspace topology
1.3 Problems on limit point, closed sets, closure of a set, interior of a set.
1.4 Problems on continuous functions with various topology.
1.5 Problems on diameter of a set, bounded set, boundary of a set.

Unit 2

2.1 Problems on countability axioms.
2.2 Problems on connected topological spaces.
2.3 Examples of compact spaces and testing its properties.
2.4 Examples of separable spaces.
2.5 Problems on T_1- spaces, Hausdorff spaces, regular spaces, normal spaces.

Sem

III

NUMBER THEORY

Optional

Marks : 70 + 30

Objectives of the course:

To Understand the concept of Divisibility, Congruence & Arithmetic functions.

- To Develop the skills of calculation of Divisibility & Congruence and the skills of Identifying the role of Arithmetic functions.
- To acquire the Knowledge of Number Theory.
- To Apply the knowledge of Number Theory for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics.
- Understand basic concepts of Number theory with new ideas.
- Develop problem solving ability in the subject of Number theory.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Review of divisibility, Arithmetic function

1.2 Greatest integer function [x], multiplicative functions

1.3 Euler's (totient) function (n), Mobius function (n)

1.4 The function (n)and (n), Average orders, perfect number

Unit 2

2.1 Congruence-Definitions, Chinese Remainder theorem

2.2 Fermat theorem and Euler theorem

2.3 Wilson's theorem, Lagrange's theorem

2.4 Primitive roots, indices

Unit 3

3.1 Quadratic residues, Legendre's symbol

3.2 Euler criterion

3.3 Gauss's lemma, Law of quadratic reciprocity

3.4 Jacobi's symbol

Unit 4

4.1 Dirichlet theorem, Continued fraction

4.2 Rational approximations, Quadratic irrationals

4.3 Linear Diophantine equation, Pell's equation
Pythagorean triples

Sem III

OPERATIONS RESEARCH

Optional

Marks : 70 + 30

Objectives of the course:

- To Understand the concept of Linear Programming & Transportation Problem & Assignment Problem.
- To Develop the skills of calculation of Linear Programming & Transportation Problem & Assignment Problem.
- To acquire the Knowledge of Operation Research.
- To Apply the knowledge of Operation Research for any real-time problem

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics.
- Understand basic concepts of Operations research with new ideas.
- Develop problem solving ability in the subject of Operations research.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Inventory Problems-Introduction, Types of Inventory
1.2 Cost involved in inventory problems, EOQ model with infinite replenishment rate
1.3 EOQ model with finite replenishment rate, EOQ model with shortages
1.4 Order-Level lot-size model, Order-Level lot-size model with infinite replenishment rate.

Unit 2

2.1 Game Theory-Introduction, Two person zero sum game
2.2 Maxmin and min max Principles, payoff, solution of 2*2 game with mixed strategy
2.3 Method of oddments, Dominance-Principle
2.4 Solution of 2*n game, Simplex method for solving game

Unit 3

3.1 Non-linear programming, Lagrangian method
3.2 Kuhn-Tucker conditions
3.3 Quadratic programming
3.4 Wolfe's method, Beale's method

Unit 4

4.1 Dynamic programming
4.2 Fractional programming

Sem III

Dissertation in Mathematical Sciences- 1

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the particular topic from its basics.
- To acquire the knowledge of the all the subjects studied in the same semester.
- To develop ideas and reading skills for research.
- To study applications of the same.

Learning Outcomes

On completion of this paper students will be able to

- Study the particular topic independently under the guidance of faculty.
- Understand the topics deeply with their application part in various field.
- Study the topic with research level aspects.
- Develop knowledge of writing on a particular subject.

Dissertation work in Mathematical Sciences:

Students must submit a report/synopsis/thesis of dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Methodology

(c) Results and discussion

(e) Summary and conclusion along with the references.

(f) Each student has to give a midterm presentation of his or her work.

Semester IV

SEMESTER 4

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Functional Analysis**	T	60	4	30	70	100
2	**Practical: Functional Analysis**	P	90	3	30	70	100
3	**Computer Programming in 'C' (Optional)**	P	60	4	30	70	100
4	**Mathematical Statistics (Optional)**	T	60	4	30	70	100
5	**Dissertation in Mathematical Sciences – 2**	T	30	1	25	-	25
	Total		240	12	115	210	325

Sem IV

FUNCTIONAL ANALYSIS

Compulsary

Marks : 70 + 30

Objectives of the course:

- To understand the theory of linear space, Banach space.
- To develop the skills of proving various results of the theory.
- To acquire Knowledge of normed linear space and Banach space.
- To apply the knowledge of this theory to various theorems.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics in pure mathematics.
- Understand basic concepts of Functional analysis with new ideas.
- Develop problem solving ability in the subject of Functional analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Review of linear spaces, quotient linear spaces
1.2 Direct sums of linear subspaces, basis of a linear space - existence using Zorn's lemma
1.3 Linear transformations from a linear space to another
1.4 Projections on a linear space

Unit 2

2.1 Normed linear spaces, Banach spaces
2.2 Quotient of a normed linear space by a closed linear subspace
2.3 Continuous linear transformations from a normed linear space to a normed linear space
2.4 Finite dimensional normed linear spaces

Unit 3

3.1 Conjugate space of a normed linear space, Hahn-Banach theorem with consequences
3.2 The natural imbedding of a normed linear space in its second conjugate space
3.3 Reflexive spaces, open mapping theorem
3.4 Projections on a Banach space, closed graph theorem

Unit 4

4.1 The uniform boundedness theorem
4.2 Conjugate of an operator on a Banach space
4.3 Hilbert spaces, orthogonal complements
4.4 Complete orthonormal sets in a Hilbert space

Sem
IV

PRACTICAL – FUNCTIONAL ANALYSIS

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the theory of linear space, Banach space.
- To develop the skills of proving various results of the theory.
- To acquire Knowledge of normed linear space and Banach space.
- To apply the knowledge of this theory to various theorems.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand applications of Functional analysis.
- Develop problem solving ability in the subject of Functional analysis.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Examples of linear spaces and subspaces
1.2 Application of Zorn's lemma
1.3 Problems on linear transformation
1.4 Examples of projections and its properties
1.5 Testing various conditions

Unit 2

2.1 Examples of norm and normed spaces
2.2 Problems on Banach spaces
2.3 Applications of norm
2.4 Check necessary and sufficient conditions of various results
2.5 Applications of functional analysis

Sem **IV**

COMPUTER PROGRAMMING in 'C'

Optional

Marks : 70 + 30

Objectives of the course:

- To Understand the concept of 'C' Language.
- To Develop the skills of obtaining various output through 'C' Programming.
- To acquire Knowledge of 'C' Language.
- To Apply the knowledge of 'C' Language for any type setting problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand a programming language.
- Develop problem solving ability with programing language.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Structure of a C program, the concept of function, preprocessors in C, include statement

1.2 Function prototype error, comments in C, data types in C, integer family, float family, character family

1.3 Type casting of variables, arithmetic and relational operators in C, input – output func tions, I/O format string, precision of numbers, field width, assignment operators

1.4 Mathematical expressions, logical expressions, precedence and associativity of operators, standard library functions, define statement, common programming errors. Arrays in C.

Unit 2

2.1 Branches in C - if, if-else, else-if statements, goto statement, switch statement

2.2 Loops: while, do–while, for, break and continue statements, nesting of loops. Statement function definitions.

2.3 Structures and unions: declaration of structures, accessing structure members, structure initialization

2.4 Nested structure, array of structures, structure assignment, structure as a function arguments, unions. typedef declaration

Unit 3

List of programs-

3.1 Conversion of units: like mile to km. To convert Cartesian coordinates to polar coordinates and vice versa, to convert degree to radian and vice versa, to find simple interest.

3.2 To interchange the content of two variables, to find maximum of given 4 numbers, to check given no is odd or even, to check given year is a leap year or not, to find real roots of a quadratic equation, to find all roots of a quadratic equation, to prepare the result of a student.

3.3 To find , to find , to print character table with their ASCII values, to print multiplication table, to find average height of male and female students, to find numbers of students getting first class second class, pass class and fail.

3.4 To print numbers for 1 to n such that each line contains m numbers, to check whether given number is prime or not, to check whether given number is perfect or not, to print first k prime numbers, to print all prime numbers ≤ k, to print first k perfect numbers, to print all perfect numbers ≤ k, to print Floyd's triangle.

3.5 To find sum of digits of a number, to print a given number in to reverse order of its digits, to check whether given number is palindrome or not, to list first k palindrome numbers, to list all palindrome numbers which are ≤ k, to find the factors of a natural number.

Unit 4

4.1 To find the GCD of two numbers, to find the LCM of two numbers, To find sum of positive divisors of n < n, number of positive divisors of n < n, number of relatively prime numbers to n, To find .

4.2 To write programs to count the number of students getting distinction, first class, second class, pass class and fail by using switch statement.

4.3 Write programs to prepare a frequency distribution table, to prepare a menu generation.

4.4 To compute approximate solutions of the equation f(x) = 0 by using bisection method, regula-falsi method, modified regula-falsi method, secant method, Newton's method.

4.5 Write programs to generate figures like (by using a character):

Sem
IV

MATHEMATICAL STATISTICS

Optional

Marks : 70 + 30

Objectives of the course:

- To understand the concept of Descriptive Statistics, Probability and Probability Distributions, Correlation and Regression.
- To develop the skills of calculation and construction of various charts used in Statistical Methods.
- To acquire knowledge of Statistical Methods.
- To Apply the knowledge of Statistical Methods for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics of statistics.
- Understand basic concepts of Mathematical statics with new ideas.
- Develop problem solving ability in the subject of Mathematical statistics.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Introduction to Random sampling, Point estimation: Some general concepts of point estimation and methods of point estimation

1.2 Confidence intervals, Basic properties of confidence intervals

1.3 Large sample confidence intervals for a population mean and proportion, Intervals based on a normal population distribution

1.4 Confidence intervals for the variance and standard deviation of a normal population.

Unit 2

2.1 Hypothesis and test procedures, z-tests for hypothesis about a population mean

2.2 The one sample t-test, Tests concerning a population proportion, z-tests and confidence intervals for a difference between two population means,

2.3 The two sample t-test and confidence interval,

2.4 Inferences concerning a difference between population proportions, Inferences concerning two population variances.

Unit 3

3.1 Introduction-The Chi square test, The Chi Square Distribution, Goodness of Fit Test

3.2 Chi Square Test for Independence, Statistical Relationships and Association

3.3 A Test for Independence, Notation for the Test of Independence

3.4 Reporting Chi Square Tests for Independence. F-test: F-Test for 1=0 vs. 1≠0, The Likelihood Ratio Test.

Unit 4

4.1 Multiple Linear Regression- Introduction, Least square estimations of the parameters

4.2 Matrix approach to multiple linear regression, Properties of the least squares estimators

4.3 Hypothesis tests in multiple linear regression

4.4 Confidence intervals in multiple linear regression.

Sem **IV**

Dissertation in Mathematical Sciences -2

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the particular topic from its basics.
- To acquire the knowledge of the all the subjects studied in the same semester.
- To develop ideas and reading skills for research.
- To study applications of the same.

Learning Outcomes

On completion of this paper students will be able to

- Study the particular topic independently under the guidance of faculty.
- Understand the topics deeply with their application part in various field.
- Study the topic with research level aspects.
- Develop knowledge of writing on a particular subject.

Dissertation work in Mathematical Sciences:

Students must submit a report/synopsis/thesis of dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Methodology

(c) Results and discussion

(e) Summary and conclusion along with the references.

(f) Each student has to give a midterm presentation of his or her work.

Semester V

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Ordinary Differential Equations**	T	60	4	30	70	100
2	**Practical: Ordinary Differential Equations**	P	120	4	30	70	100
3	**Differential Geometry (Optional)**	T	60	4	30	70	100
4	**Mathematical Methods (Optional)**	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem
V

ORDINARY DIFFERENTIAL EQUATIONS

Compulsory

Marks : 70 + 30

Objectives of the course:

- To Understand the concept of Ordinary Differential Equations.
- To Develop the skills of obtaining solutions of Various Ordinary Differential Equations.
- To acquire Knowledge of Various Ordinary Differential Equations.
- To Apply the knowledge of Various Ordinary Differential Equations for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to understand applications of mathematics.
- Understand basic concepts of Ordinary Differential Equations with new ideas.
- Develop problem solving ability in the subject of Ordinary Differential Equations.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Review of second order linear equations
1.2 Series solutions of first order equations
1.3 Second order linear equations
1.4 Ordinary points

Unit 2

2.1 Second order linear equations
2.2 Regular singular points
2.3 Gauss's hypergeometric equation
2.4 The point at infinity

Unit 3

3.1 Hermite polynomials
3.2 Chebyshev polynomials and the minimax property
3.3 Legendre polynomials
3.4 Properties of Legendre polynomials 1

Unit 4

4.1 Bessel functions, properties of Bessel functions
4.2 Bessel's integral formula
4.3 Existence and uniqueness of solutions: the method of successive approximations
4.4 Picard's theorem; systems of equations

Sem
V

PRACTICAL: ORDINARY DIFFERENTIAL EQUATIONS

Compulsory
Marks : 70 + 30

Objectives of the course:

- To Understand the concept of Ordinary Differential Equations.
- To Develop the skills of obtaining solutions of Various Ordinary Differential Equations.
- To acquire Knowledge of Various Ordinary Differential Equations.
- To Apply the knowledge of Various Ordinary Differential Equations for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand problems with new ideas of Ordinary Differential Equations.
- Develop problem solving ability.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Verify some properties of Bessel Functions
1.2 Verify the Series Solution of second order ODE by power series method
1.3 Verify the Series Solution of second order ODE at regular singular points
1.4 Verify the properties of Legendre polynomial

Unit 2

2.1 Practical based on Hermite and Chebyshev polynomial
2.2 Examples based on Picard's theorem
2.3 Solution of system of differential equation
2.4 Solution of Gauss hypergeometric equation

Sem
V

DIFFERENTIAL GEOMETRY

Optional

Marks : 70 + 30

Objectives of the course:

- To Understand the concept of ‘curves and surfaces.
- To Develop the skills of obtaining various curvatures.
- To acquire Knowledge of Geometry with different aspects.
- To Apply the knowledge of Differential Geometry for problem solving.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to understand geometric aspects of mathematics.
- Understand basic concepts of Differential Geometry with new ideas.
- Develop problem solving ability in the subject of Differential Geometry.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Concept of a curve, tangent to a curve
1.2 Osculating planes, envelope of a family of plane curves
1.3 Natural parametrization, curvature
1.4 Torsion, Frenet formulas

Unit 2

2.1 Concept of a surface
2.2 Tangent planes
2.3 Osculating paraboloid
2.4 classification of surface points

Unit 3

3.1 Area of a surface
3.2 Normal curvature, lines of curvature
3.3 Mean and Gaussian curvature
3.4 A surface of constant negative Gaussian curvature 1

Unit 4

4.1 Intrinsic geometry of surfaces; Gaussian curvature is intrinsic
4.2 Geodesic lines; extremal property of geodesics
4.3 Gauss-Bonnet theorem
4.4 Closed surfaces

Sem
V

MATHEMATICAL METHODS

Optional

Marks : 70 + 30

Objectives of the course:

- To understand the concept of special functions and transforms.
- To develop the skills of problem solving of Laplace transform.
- To acquire knowledge of theory of operators and integral equations.
- To Apply the knowledge of this theory in problem solving.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to understand various transforms and equations.
- Understand basic concepts of mathematical methods with new ideas.
- Develop problem solving ability in the subject of Differential Geometry.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Functionals, Euler's equation, other forms of Euler's equation
1.2 Some special forms of Euler's equation, geodesics
1.3 Isoperimetric problems, several dependent variables
1.4 Functionals involving higher order derivatives

Unit 2

2.1 Laplace transform, Laplace transforms of some functions, properties of Laplace transform
2.2 Inverse Laplace transform, convolution theorem
2.3 Applications to solutions of ordinary differential equations
2.4 Applications to the solutions of diffusion equation and wave equation

Unit 3

3.1 Integral equations, types of integral equations
3.2 Conversion of differential equation into an integral equation and vice versa, solution of integral equation
3.3 Integral equations of convolution type
3.4 Abel's integral equations, integro-differential equation.

Unit 4

4.1 Compact operators, some properties of compact operators
4.2 Compact operators on C[a, b] and L2[a, b]
4.3 Fredholm integral equations, Fredholm alternative theorem
Solutions of Fredholm integral equations for separable kernels.

Semester VI

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Partial Differential Equations**	T	60	4	30	70	100
2	**Practical: Partial Differential Equations**	P	120	4	30	70	100
3	**Advance Linear Algebra (Optional)**	T	60	4	30	70	100
4	**Classical Mechanics (Optional)**	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem **VI**

PARTIAL DIFFERENTIAL EQUATIONS

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the concept of Partial Differential Equations.
- To develop the skills of obtaining solutions of Various Partial Differential Equations.
- To acquire knowledge of Various Partial Differential Equations.
- To apply the knowledge of Various Partial Differential Equations for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to understand applications of mathematics.
- Understand basic concepts of Partial Differential Equations with new ideas.
- Develop problem solving ability in the subject Partial Differential Equations.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Review of curves and surfaces; genesis of first order PDE
1.2 Classification of integrals; linear equations of the first order
1.3 Pfaffian differential equations; compatible systems of first order PDE
1.4 Charpit's method, Natani's method for finding solution

Unit 2

2.1 Jacobi's method
2.2 Integral surface through a given curve
2.3 Quasi-linear equations (characteristic curves and the initial value problem)
2.4 Non-linear first order PDE (characteristic curves and the initial value problem)

Unit 3

3.1 Genesis of second order PDE; classification of second order PDE
3.2 Introduction to the initial and boundary value problems, One dimensional wave equation
3.3 Vibrations of an infinite string; Vibrations of a semi-infinite string, Vibrations of a string of finite length
3.4 Heat conduction problem: infinite rod; finite rod.

Unit 4

4.1 Duhamel's principle, Laplace's equation: boundary value problems
4.2 maximum and minimum principles; the Dirichlet problem for a circle, for the upper half plane, for a rectangle
4.3 Neumann's problem for the upper half plane and for a circle
4.4 Harnack's theorem; Green's function, Families of equipotential surfaces

Sem

VI

PRACTICAL – PARTIAL DIFFERENTIAL EQUATIONS

Compulsory

Marks : 70 + 30

Objectives of the course:

- To understand the concept of Partial Differential Equations.
- To develop the skills of obtaining solutions of Various Partial Differential Equations.
- To acquire knowledge of Various Partial Differential Equations.
- To apply the knowledge of Various Partial Differential Equations for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their problem solving skills.
- Understand problems with new ideas of Partial Differential Equations.
- Develop problem solving ability.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Solution of linear equation of first order PDE.
1.2 Solution of Pfaffian differential equations.
1.3 Practical based on Charpit's Method.
1.4 Natani's method for finding solution of PDE.

Unit 2

2.1 Solution of non-linear first order PDE.
2.2 Solution of one dimensional wave equation.
2.3 Solution Laplace equation.

Sem **VI**

ADVANCED LINEAR ALGEBRA

Optional

Marks : 70 + 30

Objectives of the course:

- To Understand important concepts of vector spaces and concept of Diagonalization, Canonical Forms & Quadratic Form.
- To Develop the skills of Calculation & obtaining various Canonical Forms, Quadratic Form
- To acquire Knowledge of Linear Algebra.
- To Apply the knowledge of Linear Algebra for any real-time problem.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to understand advance level topic.
- Understand basic concepts of Linear algebra with new ideas.
- Develop problem solving ability in the subject Advanced Linear algebra.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Revision: Vector spaces-subspaces, bases and dimensions
1.2 Matrix Theory - Rank & Inverse of a Matrix. Basic Concepts-Eigen Value & Eigen Vector of a Square Matrix
1.3 Characteristic equation of square matrix, Cayley-Hamilton Theorem
1.4 Relation between matrix and Eigen values

Unit 2

2.1 Quadratic Form and its Properties.
2.2 Conic Section - Reduction of conic equation into standard forms.
2.3 Linear transformations: Matrix associated with a Linear Map
2.4 Linear Map associated with a Matrix. Linear operations in µ m,n

Unit 3

3.1 Introduction of L(U,V) and Isomorphism between L(U,V)and µ m,n
3.2 Dimension Theorems for µ m,n and L(U,V).
3.3 Rank – Nullity of Matrices.
3.4 Verification of the Rank-Nullity Theorem for Matrices.

Unit 4

4.1 Canonical Forms of a Matrix
4.2 Basic Concepts- Minimum Polynomial of a Matrix, Block Matrix & Properties.
4.3 Nilpotent Canonical Form (NCF), Jordan Canonical Form (JCF)
4.4 Rational Canonical Form (RCF) of a Matrix, Bilinear Form

Sem VI

CLASSICAL MECHANICS

Optional

Marks : 70 + 30

Objectives of the course:

- To understand the concept of classical mechanics.
- To develop the skills of problem solving of canonical equations of motion.
- To acquire knowledge of various principles.
- To Apply the knowledge of this theory in problem solving.

Learning Outcomes

On completion of this paper students will be able to

- Increased their capacity to develop logics.
- Understand basic concepts of Mechanics with new ideas.
- Develop problem solving ability in the subject Classical Mechanics.
- Develop confidence level to teach the same subject.

Unit 1

1.1 Constraints and their classification

1.2 Principle of virtual work

1.3 D'Alembert's principle

1.4 various forms of Lagrange's equations of motion for holonomic systems, examples.

Unit 2

2.1 Euler-Lagrange equations in various forms (statements only), Hamilton's variational principle

2.2 Derivation of Lagrange's equation from Hamilton's variational principle, generalized momentum

2.3 Cyclic coordinates, general conservation theorem, conservation of linear momentum and angular momentum in Lagrangian formalism and symmetry properties

2.4 Energy function and conservation of total energy in Lagrangian formalism

Unit 3

3.1 Hamilton's canonical equation of motion,

3.2 Relation with Lagrange's equation, cyclic coordinate

3.3 Routhian procedure

3.4 Variational principle approach to Hamilton's equation of motion, examples.

Unit 4

4.1 Canonical transformations, generating functions

4.2 symplectic condition, infinitesimal canonical transformations, examples.

4.3 Poisson bracket, Lagrange bracket

4.4 formal solution of equations of motion in terms of Poisson brackets, examples

PHYSICS

SEMESTER - I

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Inter-nal	Exter-nal	To-tal
1	Advanced Quantum Mechanics	T	60	4	30	70	100
2	Advanced Mathematical Physics	T	60	4	30	70	100
3	Electronics and instrumentation	T	60	4	30	70	100
4	Laboratory Experiments in Physical Sci-ences-1	P	90	3	30	70	100
5	Laboratory Experiments in Physical Sci-ences-2	P	90	3	30	70	100
6	Foundation Course on Research in Physical Science-I	T	30	2	50	-	50
	Total		390	20	200	350	550

Sem

I

ADVANCED QUANTUM MECHANICS

Compulsory

Marks : 70 + 30

Objectives:

- Quantum Mechanical View of the Scattering Theory.
- Study of various Approximation methods.
- Study of the Formulation of Relativistic Quantum Mechanics.
- Study of Time dependent Schrodinger equation

Learning outcomes:

- The student would have a proper grip on the subject and would be able to tackle further problems.
- It will help the student to learn the basic approach which is applied in Solid state physics and Nuclear Physics.

Unit: 1 Scattering Theory:

1.1 Kinematics of the scattering process: Differential and total cross-sections,

1.2 Wave mechanical picture of scattering: The scattering amplitude, Green's function; For mal expression for scattering amplitude The Born approximation, Validity of the Born approximation, The Born series.

1.3 Partial Waves Analysis: Asymptotic behavior of partial waves - phase shifts, scattering amplitude in terms of phase shifts, Optical theorem, Phase shifts- relation to the potential, potentials of finite range, Low energy scattering, scattering by a square well potential

Unit: 2 Relativistic wave equations:

2.1 Generalization of the Schrödinger equation, The Klein-Gordon equation: Plane wave solutions; Charge and current densities

2.2 The Dirac's Equation: Dirac's relativistic Hamiltonian, Position probability density; Expectation values, Dirac matrices, Plane wave solutions of the Dirac equation; Energy spectrum, The spin of the Dirac particles, Significance of the negative energy states; Dirac particle in Electromagnetic fields. Relativistic electron in a central potential; Total angular momentum

Unit: 3 Approximation Methods for Stationary States

3.1 Perturbation Theory for Discrete levels: Equation in various orders of Perturbation Theory.

3.2 The Non-Degenerate case, The Degenerate case, Removal of Degeneracy.

3.3 Some application and related numericals

3.4 The WKB Approximation: WKB solution of one dimensional Schrodinger equation. WKB Solution of Radial Wave Equation. Some application and related numericals

Unit: 4 Evolution of system with time:

4.1 General Solution of the Schrödinger equation, Propagators

4.2 Alteration of Hamiltonian: Transitions; Sudden approximation

4.3 Perturbative solution for transition amplitude, First and second order transitions: constant perturbation

Sem
I

ADVANCED MATHEMATICAL PHYSICS

Compulsory

Marks : 70 + 30

Objectives:

- A sound mathematical background is essential to understand and appreciate the principles of physics. This module is intended to make the students understand the fundamental concepts in Vector calculus and linear vector space.
- To make the students familiar with the applications of tensors and group theory
- To lay a strong foundation in Fourier & Laplace transforms.
- To make the students understand complex variable.

Learning outcomes:

- After completing the course students will be able to learn the required Mathematics methods and techniques applicable in different branches of physics in the coming semesters. These methods are necessary for a student to solve any sort of physical problem.

Unit 1 Linear vector space:

1.1 Definition and examples, scalar product, dual vectors and Cauchy inequality,

1.2 real and complex vector spaces, metric spaces.

1.3 Quantum states: State vectors and wave variables and linear operators and their algebra, Projection operators. The quantum condition, self-adjointness Special operators such as Hermitian, Unitary etc. and their properties, Eigenvalues and eigenvectors, Expansion of identity, linear independence of vectors, generalized Eigen vectors, orthogonalization.

1.4 Theory of Probability and Statistics: Elementary probability theory, Random Variables, Binomial, Poisson and Normal Distributions. Central Limit Theorem, Hypothesis Testing and Data Analysis in Statistics.

Unit 2 Integral transforms:

2.1 Fourier transform and its properties as well as applications such as Gaussian function, finite wave train, etc., transform and its properties

2.2 Laplace transforms, Solution of differential equations by Laplace transform, Convolution, Inverse Laplace transforms, Applications of Laplace Transform for different physical problems.

Unit 3 Tensor:

3.1 Introduction, n-dimensional space, superscripts and subscripts, Coordinate transformations, Indicial summation conventions, Dummy and Real indices, Kronekar delta symbol, Scalars, Contravariant vectors and covariant vectors.

3.2 Tensors of higher ranks, Algebraic operations, Symmetric and Antisymmetric tensors, Invariant tensors, Conjugate and reciprocal tensors, Relative and absolute tensors, Line element and matrix tensor, Fundamental tensors.

Unit 4 Complex Variable:

4.1 Introduction, Analytical Function, Theorems, Illustrative examples, Contour Integral Theorem, Cauchy's Integral Formula Theorem, Illustrative examples, Laurent Series Theorem, Method of finding residues.

4.2 The Residue Theorem, Evaluation of Definite, Integrals by use of the residue theorem, Examples, Argument principle Example, Additional illustrative examples, The point at infinity, residue at infinity, Mapping Examples, Conformal mapping, Some Application of conformal Mapping examples, Additional illustrative examples.

Sem

I

ELECTRONICS AND INSTRUMENTATION

Compulsory

Marks : 70 + 30

Objectives:

- To study the different amplifiers.
- To study the working of operational amplifier.
- To illustrate the working of transistor Oscillators and field effect transistor amplifier.
- To study the different multivibrator.

Learning Outcome:

- Students will be able to study types of amplifiers and their characteristics
- Reproduce the I-V characteristics of diode/BJT/MOSFET devices

Unit 1 Power Amplifiers:

1.1 Introduction, Difference between Voltage and Power amplifiers, Performance quantities of power amplifiers.

1.2 Class-A power amplifier, and power distribution, Transformer coupled class –A amplifier, Power consideration and dissipation,

1.3 Class-B power amplifier, Class-A Push-Pull power amplifier, Class-B Push-Pull amplifier, Tuned amplifiers, Single tuned inductively coupled transistor amplifier, Double tuned transistor amplifier.

Unit 2 Operational Amplifiers:

2.1 Basic Concepts, Ideal operational amplifier, Practical Inverting and Non-Inverting OP-AMP, Characteristics of OP-AMP, Differential Amplifier, Some Op-AMP Parameters, Effects of offset, Frequency Response and Stability.

2.2 Applications of OP-AMP: As a Scale Changing- Phase Shifting and Summing amplifier, Voltage Follower, Integrator, Differentiator, Logarithmic and Antilogarithmic amplifier

Unit 3 Bridge amplifier

3.1 Schmitt Trigger, Saw-tooth wave generator, The 555 IC Timer-as a Monostable and As table multivibrator, Bootstrap Sweep generator.

3.2 Multivibrator: Multivibrator, Astable multivibrator, Monostable multivibrator, Bistable multivibrator

Unit 4 FET Amplifiers:

4.1 FET parameters, biasing the FET, basic FET amplifier, FET small signal, common source amplifier, The common drain or source follower, common gate amplifier, general treatment of low frequency common source arid common drain amplifier,

4.2 MOSFET and its characteristics, different types of MOSFET.

Sem I

LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – I

Compulsory

Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1 CLASS A PUSH PULL POWER AMPLIFIER

Practical 2 CLASS B PUSH PULL POWER AMPLIFIER

Practical 3 Study OP-Amp IC 741 Characteristics

Practical 4 Operational Amplifier as Schmitt Trigger

Practical 5 To study Operational Amplifier applications (i) Voltage regulator and (ii) Function generator.

Practical 6 Astable multivibratorusing 555 timer IC

Practical 7 Bistable multivibratorusing 555 timer IC

Practical 8 Mono-stable multivibratorusing 555 timer IC

Practical 9 Characteristics of Field Effect Transistor (FET)

Practical 10 Characteristics of Metal–Oxide–Semiconductor Field-Effect Transistor (MOSFET)

Sem I	LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – II	Compulsory Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	Experiments with MATLAB: Basic features
Practical 2	MATLAB: Mathematical functions
Practical 3	MATLAB: Solving linear equations
Practical 4	MATLAB: Matrices
Practical 5	MATLAB: Ordinary Differential Equations
Practical 6	Introduction to programming in MATLAB

Sem I

FOUNDATION COURSE ON RESEARCH IN PHYSICAL SCIENCES-I

Compulsory

Marks : 50

Objectives:

- After studying the paper
- Can get knowledge about literature survey in physical sciences.
- Can get understanding of how to write research paper/article.
- How to find a problem for dissertation
- To carry out the research work in physical sciences.
- Can study of Results and Discussion coming out from Dissertation work
- Can make summary and conclusion along with references.

Learning Outcomes

Learner will be able

- to get knowledge about literature survey in Physical sciences.
- To learn how to write research paper/article.
- to carry out the research work in physical sciences.
- to study of Results and Discussion coming out from Dissertation work in physical Sciences.
- to make summary and conclusion of research article/paper along with references.

Unit 1 Introduction to Research:

1.1 Meaning and concept, importance of research, objectives, methodology.

1.2 types of research, descriptive and analytical approach, conceptual and empirical. Selecting the topic, literature review, Web as resource, library reference method.

Unit2 Introduction to Methodology:

2.1 Research Design, developing research plan, frame work.

2.2 Data collection and analysis, methods of data collection, data processing and analysis.

2.3 Hypothesis, meaning and importance, Reporting and Project Writing, layout and method of writing, maintain good quality research writing presentation and effective communication and linguistic skills.

SEMESTER - II

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Classical and statistical mechanics**	T	60	4	30	70	100
2	**Solid State Physics**	T	60	4	30	70	100
3	**Electrodynamics and plasma physics**	T	60	4	30	70	100
4	**Laboratory Experiments in Physical Sciences-3**	P	90	3	30	70	100
5	**Laboratory Experiments in Physical Sciences-4**	P	90	3	30	70	100
6	**Foundation Course on Research in Physical Science-II**	T	30	2	30	-	100
	Total		390	20	200	350	550

Sem II

CLASSICAL AND STATISTICAL MECHANICS

Compulsory

Marks : 70 + 30

Objectives:

- To understand and be able to apply the conceptual structure of classical and statistical mechanics.
- To gain skill in problem solving and critical thinking.
- To understand various different forms and methods - Newtonian mechanics, Lagrangian mechanics and Hamiltonian Mechanics which are used according to which provides the answer most easily and conveniently

Learning Outcomes:

- To explain most of the phenomena we encounter in day-to-day activities.
- In machines and parts of machines, in sports, in simple processes like using simple machines, processes like designing a mechanical system.
- In very complex applications like launching rockets and satellites too, the principles of classical mechanics play a very important role.
- The laws have been cast into various different forms and methods - Newtonian mechanics, Lagrangian Mechanics and Hamiltonian Mechanics these methods are used according to which provides the answer most easily and conveniently.

Unit: 1

1.1 Hamiltonian-Jacobi integrals and energy conservation, Concept of symmetry, invariance under Galilean transformation, velocity dependent potential.

1.2 Generating function, Conditions for canonical transformation and problem.

1.3 Poisson Brackets, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity, invariance of Poisson Bracket under canonical transformation.

Unit: 2 Small Oscillations:

2.1 Theory of Small Oscillations-Introduction; Secular equation, Eigen vectors and Eigen frequencies; Orthogonality of Eigen vectors; small oscillations of particles on string; Linear triatomic molecule. forced vibrations.

2.2 dissipation Small Oscillation in a system with one degree of freedom, Small Oscillation in a system with more than one degree of freedom, Normal coordinates and Normal frequencies of vibration.

Unit: 3 System of particles: a statistical point of view

3.1 Basic concepts of probability, Maxwell distribution, Macroscopic and microscopic states, Phase space, μ-space, G-space.

3.2 Postulate of equal a priori probability, Ergodic Hypothesis, Liouville's theorem, Condition for statistical Equilibrium.

3.3 Statistical ensembles Micro-canonical ensemble, canonical ensemble, System with specified mean energy, Mean values and fluctuations in a canonical ensemble, Connection with thermodynamics

Unit: 4

4.1 Grand-canonical ensemble, Mean values and fluctuations in grand canonical ensemble, Reduction of Gibbs distribution to Maxwell and Boltzmann distribution.

4.2 Barometric formulae, Experimental verification of Boltzmann's distribution, Mixture of Gases

4.3 Quantum statistics Density matrix, Liouville's theorem in quantum statistical mechanics, Condition for statistical equilibrium, Ensembles in quantum mechanics.

Sem

II

SOLID STATE PHYSICS

Compulsory

Marks : 70 + 30

Objectives:

- This paper intends to provide knowledge of conceptual solid-state physics. In addition, thiscourse aims to provide depth in condensed matter with theoretical and experimental topics in solid state physics.

Learning Outcomes:

- Upon completion of this course, students are expected to understand the following concepts:
- To learn nature ofmaterialsalong with various properties.
- Learn the concept of crystal, defects, energy band gap and magnetism.
- Understand the phenomena of new state of materials i.e. superconductivity and its properties in details.
- To learn theoretical as well as experimental knowledge in solid state physics.

UNIT 1 Physics of Crystalline Solids:

1.1 Crystalline State, Basic Definitions, Bravais and Non-Bravais Lattices, Elements of Symmetry, Crystal Planes and Miller Indices, Examples of Simple Crystal Structures, Principals of X-Ray, Neutron and Electron Diffraction in Crystalline Solids, Bragg‟s Law, Concept of Reciprocal Lattice, Experimental Techniques of X-Ray Diffraction.

1.2 Defects in Solids Types of Defects - Point Defects, Line Defects, Plane Defects, Grain Boundaries, Stacking Faults, Diffusion in Solids.

UNIT 2: Band Theory of Solids

2.1 Band Theory of Solids Electron in Periodic Potential, Bloch Theorem, Kronig-Penney Model, Effective Mass, Tight Binding Approximation, Brillouin Zones, Cellular and Pseudo Potential Methods, Fermi Surfaces, De Hass Van Alfon Effect, Cyclotron Resonance.

2.2 Classification of Solids, Limit of Band Theory – Metal Insulator Transition

UNIT 3: Superconductivity

3.1 Definition, Types of Superconductors, Properties, Meissner Effect, Isotope Effect

3.2 BCS Theory – Qualitative Approach, Outcomes of BCS Theory, Josephson Effects, SQUID, Applications of Superconductivity

UNIT 4: Magnetism:

4.1 Quantum Theory of Diamagnetism and Paramagnetism.

4.2 Diamagnetic and Paramagnetic Susceptibilities of free electrons, Weiss Theory, Temperature Dependence of Saturation Magnetization (MS), Heisenberg`s Exchange Model, Slater’s Criterion, Concept of Magnons, Ferromagnetic Domains, Origin of Domains, Antiferromagnetism and Ferrimagnetism, Ferrites

Sem

II

ELECTRODYNAMICS AND PLASMA PHYSICS

Compulsory

Marks : 70 + 30

Objectives:

- To develop strong student competencies in Physics and its applications in a technology-rich, interactive environment.
- To develop strong student skills in research, analysis and interpretation of complex information.
- To understand the radiation emitted by a moving charge.
- To understand the origin of plasma, conditions of plasma formation and properties of plasma.
- Distinguish between the single particle approach, fluid approach and kinetic statistical approach to describe different plasma phenomena.
- Classify propagation of electrostatic and electromagnetic waves in magnetized and non-magnetized plasmas

Learning outcomes

- Upon successful completion of the course, the students will be able to
- Explain the emission of radiation by a moving charge.
- Define, using fundamental plasma parameters, under what conditions an ionised gas consisting of charged particles (electrons and ions) can be treated as a plasma.
- Identify different concepts to develop plasma applications.
- Distinguish the single particle approach, fluid approach and kinetic statistical approach to describe different plasma phenomena.
- Define and determine the basic transport phenomena such as plasma resistivity, diffusion (classical and anomalous) and mobility as a function of collision frequency and of the fundamental parameters for both magnetised and non-magnetised plasmas
- Describe problems related to plasma physics.

UNIT 1 Maxwell`s Equation:

1.1 Vector algebra, Introduction to electrodynamics.

1.2 Electrodynamics before Maxwell, Ampere's law, Maxwell equations in matter and boundary conditions

UNIT 2: Electromagnetic Waves:

2.1 Potentials and Fields The wave equation for E and B, propagation in linear media, reflection and transmission at normal and oblique incidence, electromagnetic waves in conductors,

2.2 scalar and vector potentials, Gauge transformations, Retarded potentials, Lienard - Wiechert potentials, the field of a moving point charge

UNIT 3 Plasma Physics:

3.1 Definition of Plasma, Plasma parameters, criteria for plasma.

3.2 Applications of Plasma Motion of Charged particle in Uniform B and E fields, non uniform B and E fields, time varying E field, adiabatic invariants, Dielectric constantof Plasma.

3.2 Fluid equation of Plasma, convective derivative, fluid drifts perpendicular to B, plasma instabilities

UNIT 4:

4.1 Concept of phase and group velocities, plasma oscillations, expression for ωp.

4.2 Experimental consequences – Whistler modes, Faraday rotation, Hydro magnetic waves and Magneto sonic or Alfven waves

Sem II	LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES-III	Compulsory Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	Resistivity of Ge at various temperatures by Four Probe method and determination of band gap.
Practical 2	Temperature ON/OFF Controller Using RTD
Practical 3	Measurement of Linear Displacement Using LVDT
Practical 4	To determine the Hall coefficient and the carrier concentration of semiconductor material using Hall effect.
Practical 5	Study of magnetic hysteresis by magnetostriction method/ anchoring method
Practical 6	To study the resistance temperature characteristics of Thermistor & Determine energy band gap of semiconductor material by Thermistor.
Practical 7	To determine the value of e/m by Thomson's method
Practical 8	To determine the value of e/m by helical method

Sem II	LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES-IV	Compulsory Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	To determine the Curie temperature of ferromagnetic materials
Practical 2	To determine dielectric constant of Ferroelectric materials
Practical 3	To determine the magnetic susceptibility of solid / liquid materials
Practical 4	To determine co-efficient of thermal expansion of materials
Practical 5	To study the thermo emf of a thermocouple
Practical 6	To determine the magnetic susceptibility using Quinke's method (paramagnetic)
Practical 7	To determine of Planck's constant by optical method
Practical 8	Determine Thermal Conductivity using Lee's Disc Apparatus

Sem II

FOUNDATION COURSE ON RESEARCH IN PHYSICAL SCIENCES-II

Compulsory

Marks : 50

After studying the paper

- To learn how to use statistics as a tool in research.
- To have a clear understanding of various data interpretation techniques.
- To understand measures of central tendency, dispersion, and different statistical packages.

Learning Outcomes: Learner will

Have knowledge of statistical tools for research

Understand various data interpretation techniques.

Unit 1

1.1 Meaning of Statistics as a Science, Population and Sample, Methods of sampling, Presentation of Data, Measures of Central Tendency.

1.2 Arithmetic Mean (A.M.), Mode, Median, Quartiles, Deciles and Percentiles.

Unit 2 Means of transformed data:

2.1 Geometric Mean (G.M.), Harmonic Mean (H.M.), Order relation between arithme tic mean, geometric mean, harmonic mean (proof for n = 2).

2.2 Weighted Mean : Weighted A.M., G.M. and H.M. 1 10 2 Measures of Dispersion, Range, Mean deviation, Mean square deviation. Error analysis, Introduction to big data analytics, Introduction to SPSS and R

SEMESTER - III

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Introduction to Computer Programing**	T	60	4	30	70	100
2	**Laboratory experiments in Physical Science-V**	P	90	3	30	70	100
3	**Laser physics and nonlinear optics (Optional)**	T	60	4	30	70	100
4	**Nanotechnology (Optional)**	T	60	4	30	70	100
5	**Dissertation in Physical Sciences-I**	P	30	1	25	-	25
	Total		240	12	115	210	325

Sem III

INTRODUCTION TO COMPUTER PROGRAMING

Compulsory

Marks : 70 + 30

Objectives:

- To teach computer programming.
- Write program focusing on numerical methods.
- To execute program on the computer.
- Develop student's capability and make them eligible for research programs.

Learning outcomes:

- Solve mathematical problems independently using numerical method
- It gives an idea to student about computer programing which is helpful if they want to develop their carriers in computer programming.

UNIT 1 General Topics:

1.1 Keywords, Identifiers, Constants, Variables, Data Types, Operators, Expressions, Precedence and Associativity of operators, Type conversions, I/O operations

1.2 Branching: if, simple if, if-else, nesting of if-else, else if ladder, switch, conditional operator

1.3 Looping: while, do while, for, continue and break, goto.

UNIT 2 Arrays:

2.1 One dimensional arrays, declaration and initialization of arrays, two dimensional and multi-dimensional arrays

2.2 Character strings: Declaration and initialization of string variables, reading and writing of strings, arithmetic operations on characters, concatenation, comparing, copying and finding length of strings, string handling functions, table of strings.

UNIT 3 Programming introduction to FORTRAN:

3.1 Flow Charts, Data type and structures,Constants and variables, mathematical Expressions in programming, , built in functions,

3.2 Input and output statements, Logical control statements(with examples), functions and subroutines , operation with files, formatted input and output

UNIT 4:

4.1 Programme of straight line fitting, Programme for numerical integration techniques, Harmonic analysis.

Sem III

LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – V

Compulsory

Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	Introduction to Linux and Computer Programming Language (C/C++)
Practical 2	Introduction to Graphics (Gnuplot etc.)
Practical 3	Finite & Infinite Series
Practical 4	Solving First & Second Order differential Equations including SimultaneousEquations (Euler & Runge Kutta)
Practical 5	Numerical Integration (Trapezoidal, Simpson and Quadrature methods)
Practical 6	Matrices- Arrays of variable Size, Matrix Operations, Eigenvalues & Eigenvectors,Matrix Inversion, Solving Systems of Linear Equations.

Sem III

LASER PHYSICS AND NONLINER OPTICS

Compulsory

Marks : 70 + 30

Objectives:
- To enable the students to understand the basic concepts of Lasers.
- To comprehend the instrumentation and working of different Laser systems.
- To have idea about different non linear systems, second and third harmonic generation, self focusing and phase matching.
- To know about different non linear optical materials.

Learning outcomes:
- After completing the course, students will be able to
- Know the basic theory of operation of a laser and the working of different laser systems.
- Know the working of non linear systems and different applications of lasers in science and technology.

UNIT 1:

1.1 Properties of laser light, spontaneous and stimulated emission, Einstein coefficients, light amplification, population inversion and threshold condition for laser oscillations.

1.2 Coherence: temporal and spatial, width and profile of spectral lines.

1.3 Resonators – Modes of a resonant cavity: longitudinal & transverse laser modes; stability condition; properties of Gaussian beams; propagation of Gaussian beam through optical components, cavity stability criterion single and multimode oscillations.

UNIT 2 Techniques of intense and short pulse generation:

2.1 Q-switching and mode-locking. Two-, three- and four-level laser systems: rate equations.

2.2 Ammonia maser, ruby laser; He-Ne laser; semiconductor laser; CO2 laser, dye laser, Nd:YAG laser, Titanium sapphire laser, Excimer laser.

2.3 technique of holography.

UNIT 3 Nonlinear optics:

3.1 Nonlinear susceptibility, second harmonic generation, phase matching, parametric oscillation.

3.2 intensity dependent refractive index: self-focusing, phase conjugation. Nonlinear optical media, second-order nonlinear optics, third-order nonlinear optics, three-wave mixing, four-wave mixing, optical solitons.

3.3 Electro-optic effects, intensity modulators, phase modulators, travelling wave modulators; electro-optics of anisotropic media, electro-optics of liquid crystals, photorefraction, electro-optic devices.

3.4 Magneto-optic devices: magneto-optic effects, Faraday effect, magneto-optic Kerr effect.

UNIT 4 Selected applications of lasers in science and technology:

4.1 optical communication, isotope separation, laser-induced fusion, laser-induced fluorescence of vegetation and other biological materials, Isotope separation, laser-induced fusion, Laser cooling of atoms, Applications in physical.

4.2 chemical and biological systems: optical tweezers and chirped pulse amplification.

Sem

III

NANOTECHNOLOGY

Optional

Marks : 70 + 30

Objectives:

- The main goal of this subject is to provide basic understanding of fabrication and
- characterization of nano structured materials by different analytical methods. More
- importantly, the students will have enriched knowledge on the properties of materials at thenanoscale and implementing it for various applications.

Learning Outcomes:

- Upon completion of this course, students are expected to understand the following concepts:
- To learn nature ofmaterialsalong with various properties.
- Learn the concept of nanomaterials system.
- Understand the phenomena of new type of materials i.e. nanomaterials and its properties in details.
- To learn theoretical as well as experimental knowledge in nanotechnology.

UNIT 1 Nanomaterials and Nanotechnology:

1.1 Introduction, Definitions, Emergence, Fabrication Techniques, Challenges, Size Effects.

1.2 Classification and Applications

UNIT 2 Methods of Synthesis of Nanomaterials:

2.1 Bottom-up and Top-down approaches - Mechanical method: High Energy Ball Milling, Methods based on evaporation (PhysicalVapour Deposition), Chemical Vapour Deposition.

2.2 Chemical Methods: Colloidal Method and Sol-gel Method

Special Nanomaterials:Carbon Nanotubes (CNT), Types –Single walled, multiwalled CNT, Structures and properties of CNTs, Synthesis of carbonnanotubes.

UNIT 3 Nanomaterial Characterization Techniques:

3.1 Structural Characterization: X-Ray Diffraction (XRD), Small Angle X-ray Scattering (SAXS), Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM).

3.2 ChemicalCharacterization: Optical Spectroscopy, Electron Spectroscopy, Photoelectron Spectroscopy (PS), Vibrational Spectroscopy, Dynamic Light Scattering (DLS), Ionic Spectrometry.

UNIT 4 Applications of Nanomaterials:

4.1 Molecular and Nano Electronics: Molecular Motors, Molecular Devices.

4.2 Single Molecular Devices Nanotribology: Nano Tribometer, Surface Force Apparatus, Quartz Crystal Microbalance, Superlubricity, Hard Disk Capacity.

4.3 Micro-Electromechanical Systems (MEMS) Nanosensors: Nanoscale Organization, SelfAssembly, Quantum Size Effects, Electrochemical Sensors, Nano-Bio-Sensors, Future

Sem **III**

DISSERTATION IN PHYSICAL SCIENCES – I

Compulsory

Marks : 25

Objectives

After studying this paper students

- Can get knowledge about literature survey in physical sciences.
- Can get understanding of how to write research paper in physical sciences.
- To carry out the research work in physical sciences.
- Can learn selection of the topic and understand how to work path and collection of materials
- Can study of Results and Discussion coming out from Dissertation work in Physical Sciences.
- Can make summary and conclusion along with references.

Learning Outcomes: Learner will be able

- To get knowledge about literature survey in physical sciences.
- To get understanding of how to write research paper in physical sciences.
- To carry out the research work in physical sciences.
- To learn collections of materials and methods identification of experiments
- To study of Results and Discussion coming out from Dissertation work in Physical Sciences.
- To make summary and conclusion along with references.

Dissertation work in Physical Sciences:

Students will carry out dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Materials and Methods

(c) Methodology and Characterization

(d) Each student has to give a midterm presentation of their work.

Semester IV

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Condensed matter Physics**	T	60	4	30	70	100
2	**Laboratory experiments in Physical Science-VI**	P	90	3	30	70	100
3	**Solid State Electronics and devices (Optional)**	T	60	4	30	70	100
4	**Cosmology and astrophysics (Optional)**	T	60	4	30	70	100
5	**Dissertation in Physical Sciences-II**	P	30	1	25	-	25
	Total		240	12	115	210	325

Sem

IV

CONDENSED MATTER PHYSICS

Compulsory

Marks : 70 + 30

Objectives:

- To study different condensed matter phenomena.
- To understand Mossbauer effect.
- To know the working of liquid crystals, polymers and alloys.

Learning outcome:

1. They will study condensed matter phenomena and understand Mossbauer Effect
2. Also they will get to know types of liquid crystals, polymers and alloys characteristics

UNIT 1 Mossbauer effect :

1.1 Introduction, natural broadening, Doppler broadening.

1.2 cross-section of resonance processes, attempts to observe resonance fluorescence, mechanism of Mossbauer effect, the experiment of Mossbauer effect, Debye-Waller factor and its dependence.

1.3General importance of Mossbauer effect, Mossbauer effect and lattice dynamics, quadruple interactions, magnetic hyperfine interactions, line broadening, isomer shift.

UNIT 2 Optical properties:

2.1 Propagation of light in conducting media, Drude model, absorption processes, exciton absorption, free carrier absorption, absorption processes involving impurities.

2.2 Photoconductivity –response time and gain factor, p-n junction photovoltaic cells, characteristics and applications, photovoltaic detectors.

UNIT 3 Resonances:

3.1 Magnetic resonance, paramagnetic resonance, resonance with relaxation.

3.2 nuclear magnetic resonance, line width, hyperfine splitting, Knight Shift, nuclear quadruple resonance.

3.3 ferromagnetic resonance, anti-ferromagnetic resonance, spin wave resonance, electron paramagnetic resonance.

UNIT 4

4.1 Liquid crystals, classification of liquid crystals, properties and applications of liquid crystals.

4.2 Alloys: Introduction, substitutional solid solution-Hume-Rothery rules, order - disorder transformation, elementary theory of order, transition metal alloys.

4.3 Kondo effect Polymers, classification of polymers, structures of long chain polymer, Polaritons, LST relation, Electron-electron interaction.

4.4 electron-phonon interaction: polarons, Peierls instability of linear metals, optical reflectance, Kramers-Kroning relations, electronic interband transitions, Raman Effect in crystals.

Sem IV	LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – VI	Compulsory Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1 Study of MOSFET Characteristics

Practical 2 Study of photoconductivity, response time and gain factor

Practical 3 Study of CMOS Characteristics

Practical 4 Study of magnetic hysteresis loop (B–H)

Practical 5 Method for Determining Crystal Grain Size by X-Ray Diffraction(Theoretical Concept)

Practical 6 Demonstration of X-Ray Diffraction (Theoretical Concept)

Practical 6 IV Characteristics of Light Emitting Diode (LED)

Sem IV

SOLID STATE ELECTRONICS AND DEVICES

Optional

Marks : 70 + 30

Objectives:

- To build up on the basic knowledge of electronics with the introduction of advanced topicslike circuit analysis and applications of semiconductor devices in analog and digital circuits.
- To enhance the understanding of basic design principles and constructional details of
- specialized semiconductor devices used for high frequency applications in modern
- communication networks and systems.
- To understand the use of semiconducting devices fordiverse applications acting as signal/ light sources, detection of signals and transduction ofanalog signals used in day to day electronics.

Learning Outcomes:

A student of this course is expected to be able to understand the design and functional performance of electronic circuits using various semiconductor devices. In addition, the student will understand the functional properties and characteristics of semiconductor devicesin analog & digital circuits using analog and digital signals.

UNIT 1 Microwave Devices:

1.1 Vacuum tube devices: Reflex klystron and magnetron.

1.2 Transfer electron devices: Tunnel and Gunn diode, Avalanche Transit time devices (Read, IMPATT diodes, parametric devices).

UNIT 2 Photonic Devices:

2.1 Radiative transition and optical absorption, LED.

2.2 semiconductor lasers,heterostructure and quantum well devices, charge coupled devices, photodetector, Schottky barrier and p-i-n photodiode, avalanche photodiode.

2.3 photomultiplier tubes, Solar cells.

UNIT 3 Memory Devices: MOSFET (n-MOS, p-MOS) and CMOS.

3.1 Metal Oxide Field Effect Transistor (MOSFET): Accumulation, Depletion and Inversion regions, Capacitance-Voltage characteristics of the MOS structure, MOSFET current-Voltage characteristics.

3.2 Substrate bias effects, Depletion and enhancement MOSFETs, Complementary MOSFETs.

UNIT 4 Other Devices:

4.1 Light emitting diode, Materials for light emitting devices, Internal and external quantum efficiency, LED performance issues, Light-current characteristics.

4.2 Spectral purity, Temporal response, Advanced LED structures, Hetrojunction LED, Edge emitting LED, Surface emitting LED.

4.3 Organic LED: Operating principle and characteristics semiconductor laser.

Sem IV

COSMOLOGY AND ASTROPHYSICS

Optional

Marks : 70 + 30

Objectives:

- The main objective of this course is to teach the fundamentals of Astronomy, earth, sun, moon and other planets of the solar system, Instruments used in space measurements.

Learning Outcomes:

- After learning the course the student will be able to understand the solar system, sun and the activity on the surface of the sun, its effect on the earth's environment, observational instruments and techniques related to space and astrophysics.

UNIT 1 Basic Astronomy:

1.1 Celestial co-ordinate systems,

1.2 Telescope—operational principles and mounting, Atmospheric extinctions, Magnitude systems, Constellations and Zodiac.

1.3 Stellar Structure and Evolution: Mass, luminosity, chemical composition, temperature and equation of a star and their measurements, stellar spectra and classifications, Main sequence stars, Colour-magnitude plot, Herzsprung-Russel (H-R) diagram.

UNIT 2

2.1 Equation of hydrostatic equilibrium, Polytropic stars and related integral theorems, Stellar atmosphere, Black-body radiation, Saha equation, Post-main sequence stars. Red giants.

2.2 Nuclear reactions, reaction rates, p-p chain and carbon-nitrogen-oxygen (CNO) cycle.

2.3 Solar System: Sun and its properties. Planets and satellites. Asteroids. Comets and Oort'sCloud. Dust in the solar system. Origin of the solar system—different hypotheses.

UNIT 3 Advanced Stages of Evolution of Stars:

3.1 Gravitational collapse. Degeneracy pressure in stars, Supernova.

3.2 Compact Objects: White dwarfs (WD). Onset of degeneracy. Chandrasekhar limit. Masses, radii and cooling of WD. Magnetic WD. Neutron stars (NS).

3.3 Equation of state in nuclear domain. Realistic theoretical models. Tolman-Oppenheimer-Volkoff (TOV) equation. Observation of NS masses, maximum masses and effects of rotation.

UNIT 4

4.1 Pulsars (PLSR). History and discovery. Connections with fast rotating NS. Magnetic dipole model for PLSR. Braking index. PLSR emission mechanisms. PLSR glitches. X-ray PLSR.

4.2 Black holes (BH),Schwarzchild BH, Kruskal diagram, Test particle motion. Kerr BH. Area theorem, BH evaporation.

4.3 Galaxies: Hubble's classification of galaxies. Rotation law. Evolution of galaxies. Cluster of galaxies – Virgo and Coma clusters. Galaxy mergers. Radio galaxies. Quasars. Active galactic nuclei (AGN).

Sem IV

DISSERTATION IN PHYSICAL SCIENCES – II

Compulsory

Marks : 25

Objectives

- After studying this paper students
- Can get understanding of how to write research paper in physical sciences.
- To carry out the research work in physical sciences.
- Can learn selection of the topic and understand how to work path and collection of materials
- Can study of Results and Discussion coming out from Dissertation work in Physical Sciences.
- Can make summary and conclusion along with references.

Learning Outcomes

Learner will be able

- To get understanding of how to write research paper in physical sciences.
- To carry out the research work in physical sciences.
- To learn collections of materials and methods identification of experiments
- To study of Results and Discussion coming out from Dissertation work in Physical Sciences.
- To make summary and conclusion along with references.

Dissertation work in Physical Sciences:

Students will carry out dissertation work on the topic of their study comprising of

(a) Characterization and statistical analysis

(d) Results and discussion

(e) Summary and conclusion along with the references.

(f) Each student has to give a presentation of their work and final results.

Semester V

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Nuclear and Particle Physics**	T	60	4	30	70	100
2	**Laboratory experiments in Physical Science-VII**	P	120	4	30	70	100
3	**Atmospheric and space physics (Optional)**	T	60	4	30	70	100
4	**Pulse and microwave electronics (Optional)**	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem

V

NUCLEAR AND PARTICLE PHYSICS

Compulsory

Marks : 70 + 30

Objectives:

- To make the student understand the basic principles of nuclear physics.
- To enable the student to explore the field of nuclear structure.
- To make the student understand different nuclear detectors and particle accelerators.
- To allow the student to have a deep knowledge of the fundamentals of nuclear physics and radioactive decay (α, β, γ decay)
- To understand the basics of elementary particles and their interactions.
- To study applications of nuclear physics.

Learning Outcomes:

- After the successful completion of the course, the students will be able to understand:
- Static Properties of the nuclei along with salient features of the deuteron problem and nuclear forces.
- Know in detail about the shell model of the nucleus.
- To allow the student to have a deep knowledge of the fundamentals of nuclear physics and radioactive decay (α, β, γ decay)
- To understand different theories of particle physics.

Unit 1 Static properties of Nuclei:

1.1 Nuclear Mass & size determination, Mott scattering, nuclear form factors. Angular momentum, spin, parity, iso-spin.

1.2 The deuteron Problem: The ground state of deuteron shape of ground state wave function, Normalization of deuteron wave, Mixing of orbitals in deuteron, Magnetic moment of Deuteron, Quadrupole moment of deuteron.

1.3 Nuclear Forces: charge independence, charge symmetry, Non central (Tensor) force, Exchange forces, Meson theory

Unit 2 Nuclear Models:

2.1 Drawbacks of liquid drop model, Magic nuclei, Single particle shell model, Explanation of nuclear data, Nordheim's rules for odd Z-odd N nuclei, islands of isomerism, Successes and failures of shell model, Collective nuclear model.

2.2 Rotational motion of the nucleus, Vibration of spherical nuclei, classification of vibration of spherical nuclei. Interaction of heavy charged particles with matter.

2.3 energy loss by electrons, Absorption curve and range, Interaction and slowing down of neutrons in matter.Nuclear Reaction mechanism, pre reaction theory, Direct interaction process in nuclear reactions, Coupled channel theory of inelastic scattering.

Unit 3:

3.1 Alpha Decay: Basic alpha decay processes alpha decay systematic, Geiger-Nuttall Law for Alpha Decay, Theory of alpha emission, Angular momentum and parity in alpha decay.

3.2 Beta decay: Experimental information about Betaparticles, Energy released in beta decay (Q value), Continuous beta spectrum and neutrino hypothesis, Fermi theory of beta decay, Fermi-Kurie plot, Angular momentum and parity selection rules, Experimental detection of neutrino.

3.3 Gamma decay: Electromagnetic transitions, Radiation Field multipolarity, selection rules, Gamma ray transition probability.

3.4 Nuclear Fusion: Sources of energy in stars, nucleo- synthesis processes, Controlled fusion, Lawson Criterion. Applications of Nuclear Physics: - Trace element analysis, Alpha decay application, Diagnostic and therapeutic nuclear medicine, Hadron therapy

Unit 4:

4.1 Classification of fundamental forces, Elementary particles and their quantum numbers, Conservation laws, CPT theorem, Gellmann- Nishijima formula, Quark model, Baryons and mesons- their quark structure. Parity non-conservation in weak decays.

4.2 Wu's experiment, Summary of Standard model of Particle physics.

4.3 Introduction to field theory, Gauge theory, Electro-Weak theory, Spontaneous symmetry breaking, Higgs boson, Grand Unification attempts and Early Universe.

Sem
V

LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – VII

Compulsory

Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	To study different magnitudes of Earthquake
Practical 2	To identify the ionospheric DATA from RINEX file
Practical 3	To study the applications of LABVIEW in the analysis of experimental data
Practical 4	To study collection of solar flux data
Practical 5	To study collection disturbance storm time index data
Practical 6	Astable multivibrator using 555 IC Timer
Practical 7	Bistable multivibrator using 555 IC Timer
Practical 8	Mono-stable multivibrator using 555 IC Timer
Practical 9	Radioactive decay
Practical 10	To determine the half life period of the give radioactive sample using GM Counter

Sem **V**

ATMOSPHERIC AND SPACE PHYSICS

Optional

Marks : 70 + 30

Objectives:
- Layers of atmosphere chemistry of different layers.Concept GPS system
- Ionosphere layer and signal propagation.
- Sensors and remote sensing device concept and theory

Learning outcome:
- After the student will bale to understand concept of atmosphere and chemistry of different layers.
- Higher altitude phenomena will easy to explore.
- The detail explanation of Global positioning system and system errors.

UNIT 1 Basic Concepts of Earth's Atmosphere:

1.1 Atmosphere nomenclature, Hydrostatic equations scale height, Geopotential height,Chemical concepts of atmosphere, Thermodynamic considerations, elementary chemical kinetics composition and chemistry of middle atmosphere and thermosphere.

1.2 Thermal balance in the atmosphere, models of neutral atmosphere (CIRA, US Standard atmosphere)

1.3 Solar Radiation and its Effects on the Atmosphere:

Solar radiation at the top of the atmosphere, Attenuation of solar radiation in the atmosphere, radiative transfer, thermal effect of radiation, photochemical effects of radiation.

UNIT 2 Structure and Variability of Earth's Ionosphere:

2.1 Introduction to ionosphere, photochemical processes, Chapman's theory of photo ionization, production of ionospheric layers, loss mechanisms and chemistry of ionospheric regions, morphology of the ionosphere.

2.2 Ionosphere Propagation and Measurement Techniques: Effect of Ionosphere on radio wave propagation, Refraction, Dispersion and polarization, Magneto ionic theory, critical frequency and virtual height, Oblique propagation and maximum usable frequency.

2.3 Ground based techniques: ionosondes, radars, scintillation and TEC, ionospheric absorption, rocket and satellite borne techniques: Langmuir probe, electric field probe mass spectrometer

UNIT 3 Concepts and Foundations of Remote Sensing:

3.1 Energy sources and Radiation principles, Energy interactions in the atmosphere, energy interactions with earth surface features, Data acquisition and Interpretations, Reference data, Characteristics of real remote sensing system, Practical applications of remote sensing, Land and Geographic Information System

3.2 Aurora and Airglow: Night glow, Dayglow, Twilight glow, Aurora, Photometer for airglow measurement, applications of Airglow measurement for ionospheric dynamics and composition

UNIT 4 GPS:

4.1 Coordinate and time systems, Definition of global and local coordinate systems, Relationship between satellite and conventional geodetic systems.

4.2 Satellite orbital motions: Description of motion, Forces acting on the satellites, Satellite NAV messages.Satellite orbits, satellite types augmentation system.

4.3 GPS observables: Pseudo ranges, Carrier phases, SA/AS Format of data (RINEX)

Sem V

PULSE AND MICROWAVE ELECTRONICS

Optional

Marks : 70 + 30

Objectives:

- This paper intends to provide knowledge of Pulse and Microwave Electronics. In addition, this course aims to provide depth in electronics with Pulse and Microwave in physics.

Learning Outcomes:

- Upon completion of this course, students are expected to understand the following concepts:
- To learn the concept of Pulse electronics with various circuits.
- To learn the importance of pulse and microwave electronics in advanced technology.
- To learn theoretical as well as experimental knowledge in Pulse and Microwave electronics.

UNIT 1 Pulse Electronics:

1.1 Characteristic of Pulse waveforms, rise time, fall time, duty cycle concept, tilt.

1.2 R-C circuits, constant rate charging, relationship between rise time and upper cutoff frequency, relationship between fall time and tilt.

1.3 integrating and differentiating circuits. Clipping and clamping circuits using diodes.

UNIT 2 Schmitt trigger and Ramp generator:

2.1 Circuit operation, designing for a given upper trigger point (UTP) and lower trigger point (LTP).

2.2 speed-up capacitor, input and output characteristics

2.3 RC ramp generators, constant current ramp generators.

UNIT 3 Transistorized Multivibrators:

3.1 Astable and Monostable multivibrators, Bistable multivibrator with set-reset triggering.

3.2 The timer IC-555, functional block diagram, Astable & Monostable multivibrator using IC-555.

UNIT 4 Microwave Electronics:

4.1 Fundamentals of microwave technology, limitations of vacuum tubes. Klystrons, Two cavity Klystron, Multi-cavity and Reflex Klystrons, Traveling wave tube.

4.2 Solid-State Microwave Devices: Microwave transistors, Tunnel diodes, Gunn Effect diodes.

Semester VI

Physics

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Spectroscopic Techniques**	T	60	4	30	70	100
2	**Laboratory experiments in Physical Science-VIII**	P	120	4	30	70	100
3	**High energy Physics (Optional)**	T	60	4	30	70	100
4	**Electronic Communication (Optional)**	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem

VI

SPECTROSCOPIC TECHNIQUES

Compulsory

Marks : 70 + 30

Objectives:

- To have a clear understanding of spectra of diatomic molecules.
- To understand the salient features of Electronic spectra.
- To study different techniques of laser spectroscopy.
- To study fluorescence and phosphorescence.
- To have a clear view about the conventional and modern applications of spectroscopy.

Learning outcomes:

- At the end of the course, the students will be able to:
- Understand and be able to apply atomic and molecular spectroscopy.
- Understand the motions of atoms and molecules within a macroscopic substance.
- Understand Electronic and Fluorescence Spectra theory and applications

Unit 1 Spectra of diatomic molecules:

1.1 Hund's coupling cases, symmetry properties of electronic states and rotational levels, selection rules, types of electronic transitions: 1Σ - 1Σ , 2Σ - 2Σ , 1Π – 1Σ , 2Π – 2Σ.

1.2 Continuous and diffuse spectra: pre-dissociation, Auger effect, Heats of dissociation: determination of dissociation limits, band convergence, Birge-Sponerextrapolation.

1.3 Molecular orbital approximation: United and separated atom constructs, correlation of molecular orbitals, LCAO/MO theory, determination of terms and multiplicities from molecular orbitals.

1.4 Atomic Emission Spectroscopy (AES) and Atomic Absorption Spectroscopy (AAS), applications.

Unit 2 Electronic spectra of diatomic molecules – Fine structure of electronic transitions:

2.1 rotational analysis, combination relations with and without Q branches, determination of rotational constants, internuclear distance and moment of inertia, determination of band origins.

2.2 Wave mechanical formulation of Franck Condon principle: overlap integral, band intensities in emission and absorption, vibrational sum rule and vibrational temperature.

2.3 Intensity distribution in rotational structure: rotational temperature, intensity distribution in homonuclear molecules.

Unit 3 Fluorescence spectra – Luminescence:

3.1 fluorescence and phosphorescence, Jablonski diagram,
Characteristics of fluorescence emission, Fluorescence lifetimes and Quantum Yields,

3.2 Fluorescence anisotropy, Resonance energy transfer, Steady state and Time-resolved fluorescence, Molecular information from fluorescence.

Unit 4 Laser spectroscopy:

4.1 Preliminary ideas only of Laser Raman spectroscopy: experimental techniques, resonance Raman, stimulated Raman, hyper Raman and coherent anti Stokes Raman spectroscopy.

4.2 Doppler limited spectroscopy: photoacoustic spectroscopy and laser-induced fluorescence; Time-resolved spectroscopy: phase shift method, pulse excitation and quantum beat spectroscopy.

4.3 Applications of molecular spectroscopy

In nuclear physics: spin & statistics, In astrophysics: absorption and emission in earth’s atmospheres, terrestrial Fraunhofer lines, planetary atmospheres, comets, stellar atmospheres and interstellar space

Sem VI

LABORATORY EXPERIMENTS IN PHYSICAL SCIENCES – VIII

Compulsory

Marks : 70 + 30

LIST OF EXPERIMENTS

Practical 1	I2 Molecule absorption Spectra to find dissociation energy.
Practical 2	Analysis of Rotational Spectra
Practical 3	To develop Deslander's table
Practical 4	Determine Vibrational Constant and anharmonicity constant
Practical 5	Study of wavelength of LASER beam
Practical 6	Michelson Interferometer
Practical 7	Determine vibrational frequency and anharmonicity constant of Aluminium Oxide by digital spectrometer
Practical 8	Absorption Spectra of KMnO4
Practical 9	Fresnel`s biprism
Practical 10	Edser Butler Plate
Practical 11	Fabry Perot Etalon

Sem **VI**

HIGH ENERGY PHYSICS

Optional

Marks : 70 + 30

Objectives:

- To study elementary particles and quark model of hadrons
- To study Introduction to Quantum field theory
- To understand the basics of Quantum Electrodynamics
- To study Gauge theories.

Learning outcomes:

- After learning the course, students will be able to explore the field of High Energy Physics by clearing concepts of elementary particles, quantum field theory, quantum electrodynamics and ideas about neutrino physics.

Unit 1 Introduction to elementary particles and quark model of hadrons:

1.1 classification of elementary particles, spin and parity determination of pions and strange particles, C,P,G conjugation, Gell-Mann and Nishijima scheme, the eightfold way, classification. Quark hypothesis of Gell-Mann and Zweig.

1.2 properties and types of quarks, elementary of idea of Lie groups, spin SU(2) and flavor SU(3) symmetry, colour quantum number, hadron wave functions and classification (spin and flavor), parton model.

1.3 Four fundamental interactions and their characteristics in terms of decay lifetimes, strengths, ranges, conservation laws and decay modes, charged leptonic weak interactions, decay of muon, neutron and charged pions, neutral weak interactions

Unit 2 Introduction to Quantum field theory:

2.1 Concept of fields, classical fields as generalized co-ordinates.

2.2 Lagrangian of a field, Euler-Lagrange equation, canonical quantization of a one-dimensional classical system, Fock space, the method of second quantization,

2.3 canonical quantization of free fields (hermitian and non-hermitian scalar fields, electromagnetic field, Dirac field)Noether's theorem, conservation of energy, momentum and charge of the field, the vacuum in field theory, C P T transformation of scalar and e.m fields.

Unit 3 Quantum Electrodynamics:

3.1 Covariant perturbation theory, Feynman rules in momentum space, reduction of time-ordered products, calculation of second order process, Compton scattering, Klein-Nishijima formula, Mott scattering, elements of renormalization of charge and Mass.

3.2 Gauge theories:Introduction to Gauge symmetries, global and local gauge transformations, Abelian group U(1) (QED), Ynag-Mills (non-Abelian) groups, SU(2) (isospin), SU(3) C(QCD)

Unit 4 Spontaneous symmetry breaking:

4.1 Ground state with symmetry breaking, global symmetry breaking and Goldstone bosons, proof of Goldstone theorem, local symmetry breaking and Higgs mechanism for giving masses to vector bosons, examples U(1), SU(2)

4.2 Standard Model: Standard model of electroweak unification, gauge bosons W+, W-, Z0 charged weak current and neutral current, Higgs particle, experimental status.

4.3 Beyond standard model: (a) introduction to grand unified theories (GUT)s, SU(5) and SU(10), and proton decay predictions (b) minimal supersymmetric standard model(MSSM) and its extension, its predictions (c) introduction to String Theories and Planck Scale Physics

4.4 Neutrino Physics: Solar and atmospheric neutrino puzzles, theory of neutrino oscillations in vacuum and medium (MSW mechanism), neutrino masses and leptonic mixings, survey of various neutrino oscillation experiments, seesaw mechanism for small neutrino masses.

Sem

VI

ELECTRONIC COMMUNICATION

Optional

Marks : 70 + 30

Objectives:

- This paper intends to provide knowledge of Electronic Communication. In addition, this course aims to provide depth in communication system in physics.

Learning Outcomes:

- Upon completion of this course, students are expected to understand the following concepts:
- To learn the concept of communicationwith various fundamental aspects.
- To learn the importance of communication in advanced technology.
- To learn theoretical as well as experimental knowledge in electronic communication.

UNIT 1 Wave Propogation

1.1 Radio wave propagation, propagation in free space, transmission – path, loss, ground wave propagation.

1.2 space-wave propagation: radio horizon.

1.3 sky wave propagation: ionosphere, plasma and critical frequency, secant law and MUF Vertical height, Service range, skip distance.

UNIT 2

2.1 Digital communication, Shannon limit for information capacity, digital amplitude modulation, frequency shift keying.

2.2 FSK transmitter and receiver, Phase shift keying, BPSK, QPSK, Quardrature Amplitude modulation (8-QAM), bandwidth efficiency, Pulse code modulation (PCM)

UNIT 3:

Satellite communication, Orbital and geostationary satellites orbital patterns, look angles, satellite construction, radiation patterns, satellite system link models, transponder, satellite system parameters, Optical fiber communication, fiber optic communication link, fiber type, cable construction, propagation of light through optical fiber configurations.

UNIT 4 Transmission lines and waveguides :

4.1 Equivalent circuit, primary constants, transmission line equations, infinite line, characteristic impedance, secondary constants, open and short circuited line, line with any termination.

4.2 Waveguides Rectangular waveguides, Modes, Properties of TE10 mode, generating TE10 mode from two TEM waves, fields patterns

CHEMISTRY

Semester I

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Organic Chemistry-I	T	60	4	30	70	100
2	Inorganic Chemistry-I	T	60	4	30	70	100
3	Physical Chemistry-I	T	60	4	30	70	100
4	Laboratory Experiments in Chemistry-1	P	90	3	30	70	100
5	Laboratory Experiments in Chemistry-2	P	90	3	30	70	100
6	Foundation Course on Research in Chemical Sciences-1	T	60	2	50	-	50
	Total		390	20	200	350	550

Sem

I

Organic Chemistry-I

Compulsory

Marks : 70 + 30

Objectives:

- To understand fundamentals of Organic Chemistry.
- To get familiar with the Oxidation of organic molecules.
- To get familiar with the Reduction of organic molecules.
- To get knowledge about Pericyclic reaction mechanisms.

Learning Outcomes:

- Student can understand atomic and molecular basis of organic chemistry
- They can understand the fundamentals Reaction intermediates, Ylides & Enamines and their applications in organic reactions
- They can identify organic molecules by functional group: alkane, alkene, alkyne, haloalkane, alcohol, thiol, ether, sulfide, amine, aldehyde, ketone, carboxylic acid and carboxylic acid derivatives.
- Students will understand the mechanism of the reactions
- They can also learn the fundamental principles of functional group conversion in organic synthesis.

UNIT 1 Reaction intermediates, Ylides & Enamines

1.1 Introduction
1.2 Stability
1.3 Generation
1.4 Reaction & Application of Carbocations
1.5 Carbanions
1.6 Free radicals
1.7 Carbenes
1.8 Nitrenes
1.9 Benzynes
1.10 Ylides,& Enamines.

UNIT 2 Oxidation

2.1 Introduction,
2.2 Oxidation of hydrocarbons, alcohols, 1,2-diols, aldehydes, ketones, carboxylic acids, amines, hydrazine, sulphides.
2.3 Some microbial oxidations of Progesterone, Oestrone, Diazepam, Oleic acid.(only reactions)

UNIT 3 Reduction

3.1 Introduction
3.2 Reduction of hydrocarbons aldehydes, carboxylic acids, ester, acid chlorides, anhydrides, amides, nitriles, epoxides, nitro group, nitroso, azo, oximes.
3.3 Some microbial reduction with Baker's yeast
3.4 Beauveria sulfurescens. (only reactions)

UNIT 4 Pericyclic reactions

4.1 Introduction
4.2 Type of Pericyclic reaction reactions
4.3 stereochemistry molecular orbital symmetry
4.4 Frontier Orbitals of Ethelene, 1,3- butadiene, 1,3,5-hexatriene and allyl system
4.5 F.M.O. and P.M.O. approach to cycloaddition and electrocyclic reactions
4.6 Generalization of wood-word Hoffmann rule
4.7 sigmatropic rearrangement- suprafacial & antrafacial shift of H
4.8 Stereoselectivity in sigmatropic rearrangement
4.9 enantioselectivity in pericyclic reactions

Sem I

Inorganic Chemistry-I

Compulsory

Marks : 70 + 30

Objectives:

- To get knowledge of Periodic properties
- To get detailed theoretical aspects of Chemistry of s-block elements and their applications.
- To understand chemistry of p-block elements
- To get idea about molecular and structural properties with potential applications
-

Learning Outcomes:

- The students will be able to understand the periodic elements thoroughly.
- The students will be able to understand s-block elements and their applications efficiently.
- The students will be able to understand p-block elements and their applications efficiently.
- The students will be able to get idea about molecular symmetry and structural properties with potential applications.

UNIT 1 Periodic properties and bonding in chemistry

1.1 Electronegativity and electron affinity
1.2 Ionization potential and ionic radii
1.3 Effective nuclear charge
1.4 Chemical bond
1.5 Ionic bond
1.6 Covalent bond
1.7 Hydrogen bond
1.8 Shape and hybridization of molecules
1.9 Bond order
1.10 MO theory of diatomic molecule
1.11 Huckel theory for conjugated π-electron systems.

UNIT 2 Chemistry of s elements

2.1 Alkali & alkaline earth metals
2.2 Solutions in non-aqueous Media
2.3 Application of crown ethers in extraction of alkali & alkaline earth metals,
2.4 Organometallic compounds of Li, Mg, Be, Ca & Na

UNIT 3 Chemistry of p-block elements

3.1 Synthesis, Properties, uses & structures
3.2 Boron Hydrides
3.3 Preparation, structure & bonding and interconversion of lower & higher boranes
3.4 Metalloboranes
3.5 Carboranes
3.6 Allotropes of Carbon, C_{60} and compounds (fullerenes)
3.7 Intercalation compounds of Graphite, Carbon nanotubes, silicates, carbides silicones, phosphazenes, sulphur nitrogen compounds

UNIT 4 Molecular symmetry

4.1 Introduction

4.2 Symmetry operations and symmetry elements: C_n, σ, S_n, i and E

4.3 Point groups for the molecules (excluding S_{2n} and Ih)

4.4 Multiplication tables of C_{2v}, C_{2h} and C_{3v} point groups

4.5 Application of symmetry to molecular vibrations, interpretation of IR and Raman spectra

Sem
I

Physical Chemistry-I

Compulsory

Marks : 70 + 30

Objectives:

- To have detailed study of Entropy, Gibbs Free Energy and Partial molar quantities
- To get basic knowledge of Maxwell Boltzmann distribution law and partition function.
- To understand Study of Chemical kinetics of molecular reactions.
- To get knowledge of Nernst equation and applications of emf

Learning Outcomes:

- Learner will have detailed study of Entropy, Gibbs free energy and Partial molar quantities.
- Learner will get basic knowledge of Maxwell Boltzmann distribution law and partition function.
- Learner will understand Study of Chemical kinetics of molecular reactions.
- Learner will get knowledge of Nernst equation and applications of emf.

UNIT 1 Thermodynamics

1.1 Introduction
1.2 Importance of thermodynamics
1.3 Enthalpy
1.4 Entropy
1.5 Gibbs free energy
1.6 Gibbs-Helmholtz equation
1.7 Gibbs Duhem equation
1.8 Third law of thermodynamics
1.9 Nernst Heat theorem
1.10 Partial molar quantities- partial molar volume and partial molar free energy

UNIT 2 Statistical Thermodynamics

2.1 Introduction
2.2 Permutation and combination
2.3 Maxwell-Boltzmann Distribution Law
2.4 Partition Function- Translational, Rotational, Vibrational, Electronic, Nuclear Partition Function

UNIT 3 Chemical Kinetics

3.1 Rate expression
3.2 Order and molecularity
3.3 Rate of chemical reactions
3.4 Order of reactions
3.5 Half lifetime of reaction
3.6 Arrhenius equation
3.7 Activation energy
3.8 Collision theory
3.9 The transition state theory
3.10 Salt effects-Primary salt effect and secondary salt effect
3.11 Chain reaction
3.12 Chain length
3.13 Reaction Mechanism

UNIT 4 Electrochemistry

4.1 Conductance
4.2 Conductivity
4.3 Specific Conductance
4.4 Molar conductance
4.5 Electrolytes
4.6 Oxidation- Reduction reaction
4.7 Electrochemical cell
4.8 Electrode potential and electrode reaction
4.9 Nernst equation
4.10 Applications of emf
4.11 Faraday's laws of electrolysis
4.12 Fuels cell and batteries.

Sem I

Laboratory Experiments in Chemistry-1

Compulsory

Marks : 70 + 30

Objectives:

- To enhance practical skills of the students for separation techniques of ternary organic compounds.
- To enhance practical skills of the students for organic qualitative analysis and chemical methods of analysis.
- To enhance practical skills of the students for separation of six radicals of inorganic salts.
- To enhance practical skills of the students for inorganic qualitative analysis and chemical methods of analysis.
- To provide overview of the applications of these experiments in applied field to the students.

Learning Outcomes:

- Each practical's listed in the syllabus will be explained and demonstrated in the laboratory.
- Students will be learning more through experimental approach.
- Students will be able to identified the types (Acid, Phenol, Base and Neutral) of organic compounds.
- Students will be able to separate out the ternary mature of organic compounds.
- Students will be able to identified the positive and negative radical's types of inorganic compounds.
- They will be able to learn about systematic analytical approach based on experiments performed during Practicals.

Organic Mixture: (Minimum: 07)

The systematic qualitative analysis of following ternary organic mixtures:

1. Oxalic Acid + β-Naphthol + Acetophenone
2. o-Chloro Benzoic Acid + o-Chloro aniline + m-dinitro benzne
3. Succinic acid + Aniline + Acetanilide
4. Oxalic Acid + p-Chlorobenzoic acid + p-Cresol
5. p-Toluic acid + m-cresol + p-Chloroaniline
6. β-Naphthol + aniline + p-dichloro benzene
7. Salicylic Acid + p-Nitro aniline + urea
8. Thiourea + β-Napthol + Acetophenone
9. Oxalic Acid + p-Chlorobenzoic acid + 4-chloroaniline
10. Succinic Acid + m-cresol + 4-chloroaniline

Inorganic Mixture: (Minimum: 07)

The systematic qualitative analysis of inorganic mixtures containing six radicals as of following:

$CuSO_4$, KBr, KI, Na_2CrO_4, $CaCO_3$, $Zr(NO_3)_3$, $NaNO_3$, ZnS, Na_2SO_4, SeO_2, NaCl, K_2SO_4, $(NH_4)_2SO_4$, $(NH_4)_2MoO_4$, $BaCl_2$, $ZnCO_3$, $Al_2(SO_4)_3$, ZnS, $Ni(NO_3)_2$, KNO_2,KCl, $CdCO_3$, $CuCl_2$, K_2SO_4, $AlPO_4$, H_3BO_3, $(NH_4)_2SO_4$, $CdCl_2$, $NaNO_3$, $ZnCO_3$, $AlPO_4$, $Pb(NO_3)_2$, $NaNO_2$, $MnSO_4$, $NaHSO_3$, K_2CrO_4, $FeSO_4$, (NH_4)-$_2SO_4$, Na_3AsO_3, Na_3AsO_4, $(NH_4)_2SO_4$, K_2SO_4, $CeSO_4$, As_2O_3, NH_4Cl, $NiSO_4$, $LiCO_3$, $MgCO_3$, $NaNO_2$, $Mg_3(PO_4)_2$, V_2O_5, H_3BO_3, $SrCO_3$, $Th(NO_3)_3$, Na_3AsO_3, Na_3AsO_4, $BaCO_3$ and $LiCO_3$.

Sem I

Laboratory Experiments in Chemistry-2

Compulsory

Marks : 70 + 30

Objectives:

- To get understanding and knowledge of pH metry
- To get understanding and knowledge of Potentiometry.
- To get understanding and knowledge of Conductometry.
- To get understanding and knowledge of Chemical Kinetics, distribution method and adsorption.

Learning Outcomes:

- Students can get hands on training of instruments like pH metry, Potentiometry , Conductometry.
- To carry out experiments on Chemical kinetics with accuracy and required skills.
- To carry out experiments on Distribution Coefficient and Adsorption with accuracy and required skills.
- To develop skills to carry out related experiments.

pH Metry:

1. To determine Normality, Gram/Litre and Molarity of each acid present in a Mixture of strong acid and weak acid.
2. To determine Normality, Gram/Litre and Molarity present in Na_2CO_3 + $NaHCO_3$ by titrating against 0.1 N HCl solution.

Conductometry:

1. To determine Molarity of each acid present in a Mixture of strong acid and weak acid by titrating against 0.1 M NaOH solution conductometrically.
2. To determine solubility product of $PbSO_4$/ $BaSO_4$ conductometrically.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes.

Potentiometry:

1. To determine Molarity of each acid present in a Mixture of strong acid and weak acid by titrating against 0.1 M NaOH solution potentiometrically.
2. To determine the amount of iodide, bromide and chloride in the mixture by potentiometric titration with silver nitrate potentiometrically.

Chemical Kinetics:

1. Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. (a=b)
2. Chemical kinetics of a reaction between $K_2S_2O_8$ and KI in an aqueous system. (a ≠ b)
3. To determine the Rate Constant for the reaction between $KBrO_3$ and KI in an aqueous media. (a=b)
4. To determine the Rate Constant for the reaction between $KBrO_3$ and KI in an aqueous media. (a ≠ b)
5. Investigation the reaction between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.

Distribution Coefficient:

1. The Distribution coefficient of acetic acid distributed between water and n-butanol.
2. The Distribution coefficient of acetic acid distributed between water and chloroform.

Sem I

Foundation Course on Research in Chemical Sciences-1

Compulsory

Marks : 50

Objectives:

- To Get Introduction about Research Methodology.
- To get knowledge about scientific research for achieving the targeted hypothetical ideas.

Learning Outcomes:

- Students will be able to get Introduction about Research Methodology.
- Students will be able to get knowledge about scientific research for achieving the targeted hypothetical ideas.

UNIT 1 Introduction to Methodology:

1.1 Format of thesis and dissertation
1.2 Research article
1.3 Reviews
1.4 Monographs
1.5 Bibliography
1.6 Literature search

UNIT 2 Introduction to Research

2.1 Significance of research
2.2 Research methods versus methodology
2.3 Research and Scientific methods
2.4 Defining the research Problem and Research design

Semester II

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Organic Chemistry-II	T	60	4	30	70	100
2	Inorganic Chemistry-II	T	60	4	30	70	100
3	Analytical Chemistry	T	60	4	30	70	100
4	Laboratory Experiments in Chemistry-3	P	90	3	30	70	100
5	Laboratory Experiments in Chemistry-4	P	90	3	30	70	100
6	Foundation Course on Research in Chemical Sciences-2	T	60	2	50	-	50
	Total		390	20	200	350	550

Sem

II

Organic Chemistry -II

Compulsory

Marks : 70 + 30

Objectives:

- To have General introduction of Stereochemistry
- To get understanding of Reagents and its use in organic synthesis
- To get knowledge about Reagents and their properties and applications
- To have idea about Reaction mechanism of selected name reactions
- To get understanding of Photochemical reactions and its use in organic synthesis

Learning Outcomes:

- They learn about various concepts Stereochemistry
- They can understand the role of reagents in the organic synthesis
- Students will have acquired an understanding of synthesis and mechanism of organic compounds
- They learn about various aspects of Photochemistry

UNIT 1 Stereochemistry

1.1 Concept of Chirality
1.2 Chirality and Symmetry
1.3 Elements of Chirality including Chiral centre, Chiral axis, Chiral plane and Helicity,
1.4 CIP Nomenclature
1.5 Molecules with more than one Chiral centre
1.6 Total number of Stereoisomer in such molecules
1.7 Enantiomeric and Diastereomeric Relationship
1.8 Chirogenicity and Stereogenecity
1.9 Pseudochirality, Topicity and Prostereoisomerism
1.10 Determination of Topic relationship between Homomorphic ligands in Intact Molecules
1.11 Sawhorse, Newman and Fischer Projections
1.12 Interconversion of Projections
1.13 Optical Purity

UNIT 2 Reagent in organic synthesis

2.1 Collins reagent,
2.2 Pyridiniumdichromate, MnO_2, DMSO, NBS, HIO_4, $Pb(OAC)_4$, $NaBH_4$, $LIAlH_4$, DIBALH, MPV
2.3 Lindlar catalyst, 1,3-Dicyclohexylcarbodiimide (DCC), Lithium diisopropylamide (LDA), DDQ
2.4 Baker's yeast
2.5 Grignard reagent
2.6 Umpolung reagent

UNIT 3 Reaction mechanism of selected name reaction

3.1 Aldol condensation
3.2 Claisen condensation
3.3 Beckman rearrangement
3.4 Cannizarro
3.5 Wolff-Kishner reduction
3.6 Clemmensen reduction
3.7 Wittig reaction
3.8 Sandmayer reaction
3.9 Rosenmund reduction
3.10 Oppenauer oxidation
3.11 Buchwald Hartwing reaction (C-N coupling)
3.12 Knoevengel condensation
3.13 Michael addition, Suzuki reaction
3.14 Witting reaction
3.15 Ullmann reaction
3.16 Vilsmeier-Haak reaction

UNIT 4 Photochemical Reaction

4.1 Introduction,
4.2 Basic law of photochemistry : Grothus-Draper Law, Beer Lambert Law
4.3 Basis of Photochemistry : electronic excitation, excited states,
4.4 Chemistry of excited molecules- Joblonskii diagram,
4.5 Fluorescence
4.6 Phosphorescence
4.7 Chemiluminescence
4.8 Difference between photochemical and thermal reactions
4.9 Photochemical Reactions of some carbonyl compound, olefins & photochemical cycloaddition reactions.

Sem

II

Inorganic Chemistry -II

Compulsory

Marks : 70 + 30

Objectives:

- To develop knowledge for Transition metal chemistry and their role in biological sciences.
- To get familiarize with Coordination chemistry
- To know Theoretical significance of thermodynamic stability
- To get Introduction and applications of Organometallic Chemistry in inorganic synthetic methodology.

Learning Outcome:

- The students will be able to develop knowledge for Transition metal chemistry and their role in biological sciences.
- The students will be able to explain Coordination chemistry
- The students will be able to know Theoretical significance of thermodynamic stability
- The students will be able to get Introduction and applications of Organometallic Chemistry in inorganic synthetic methodology.

UNIT 1 Transition metal chemistry

1.1 Introduction to transition elements
1.2 Physical and Chemical properties of transition metals
1.3 Chemistry of first, second and third transition elements
1.4 Lanthanide and Actinide elements
1.5 Lanthanide and Actinide contractions,
1.6 Role of transition metal ions in biological processes

UNIT 2 Coordination Chemistry

2.1 Introduction to type of ligands,
2.2 Thermodynamic stability of coordination compounds
2.3 Werner theory,
2.4 Isomerism in coordination compounds
2.5 Bonding in coordination compounds including VBT, CFT, CFSE,
2.6 Factor affecting CFSE, MOT, Electronic spectra of complexes
2.7 Tanabe-Sugano diagrams,
2.8 Magnetic properties of complexes

UNIT 3 Organometallic Chemistry

3.1 Rules of valance electron (16 &18),
3.2 Counting electrons in simple metal carbonyl complexes
3.3 Polynuclear carbonyl complexes
3.4 Nitrosyl complexes
3.5 Metal Alkyl
3.6 Carbenes and Carbide alkyl complexes
3.7 Metallocenes and organomettalic compound of main group elements

UNIT 4 Quantum Chemistry

4.1 Setting up of operators for different observables

4.2 Hermitian operator

4.3 Particle in a one, two three dimensional box

4.4 The rigid Rotator

4.5 The Schrodinger equation in spherical polar coordinates for hydrogen atom.

Sem II

Analytical Chemistry

Compulsory

Marks : 70 + 30

Objectives:

- To get idea for Basic concepts of Analytical Chemistry.
- To get knowledge about Separation techniques.
- To get understanding of Chromatographic techniques.
- To get knowledge about Thermal analytical methods.
- To develop skill for Centrifuge technique and Data analysis of the results.

Learning Outcomes:

- Student will get idea about basic concepts of Analytical Chemistry.
- Learner will be able to understand Separation techniques.
- Student will get understanding of Chromatographic techniques.
- Learner will get knowledge about Thermal analytical methods.
- Learner will be able to understand Centrifuge technique and Data analysis of the results.

UNIT 1 Separation technique:

1.1 Solvent extraction
1.2 Principle of liquid – liquid extraction
1.3 Parameter affecting the extraction process
1.4 Aqueous two-phase extraction
1.5 Principle involving two phase aqueous
1.6 Super fluid extraction 1.7 Reversed micelle extraction method
1.8 Ion-exchange separation
1.9 Membrane separation method
1.10 Lyophilization.

UNIT 2 Chromatographic Technique

2.1 Introduction to chromatographic technique,
2.2 Classification of chromatographic methods
2.3 Application of chromatography
2.4 Definition of retention time, retention volume, relative retention, retention factor and resolution
2.5 Column chromatography
2.6 Principle of column chromatography
2.7 Thin-layer chromatography
2.8 Adsorption chromatography
2.9 Liquid chromatography
2.10 Gas chromatography
2.11 High performance liquid chromatography
2.12 Ion–exchange chromatography
2.13 Size–exclusion chromatography

UNIT 3 Thermal analytical methods

3.1 Introduction
3.2 Thermal methods of analysis
3.3 Thermogravimetry
3.4 Differential Thermal Analysis and Differential Scanning Calorimetry
3.5 Instrumentation. Methodology of TG, DTA and DSC
3.6 Determination of Glass transition, Heat capacity determination

UNIT 4 Centrifuge technique and Data analysis

4.1 Introduction
4.2 Centrifuge force
4.3 Principle of Centrifuge
4.4 Introduction of various centrifuge techniques such as differential centrifuge, density gradient, ultracentrifuge
4.5 Mean and standard deviation
4.6 Absolute and relative errors
4.7 Linear regression, covariance and correlation coefficient

Sem

II

Laboratory Experiments in Chemistry-3

Compulsory

Marks : 70 + 30

Objectives:

- To enhance practical skills of the students for synthetic techniques of organic compounds
- To enhance practical skills of the students for chemical methods of analysis.
- To enhance practical skills of the students for synthetic techniques of inorganic compounds.
- To enhance practical skills of the students for inorganic qualitative analysis and chemical methods of analysis.
- To provide overview of the applications of these experiments in applied field to the students.

Learning Outcomes:

- Each practical's listed in the syllabus will be explained and demonstrated in the laboratory.
- Students will be learning more through experimental approach.
- Students will be able to synthesis of organic compounds.
- Students will be able to find out percentage yield of synthesized organic compounds.
- Students will be able to identified the structural reaction mechanism of organic compounds.
- Students will learn chemical preparation of inorganic compound.
- They will be able to learn about systematic analytical approach based on experiments performed during Practicals.

Organic preparation of one/two stage derivatives using Name Reactions, Rearrangements, Unit Processes. (Any Seven)

1. Preparation of m-dinitrobenzene from nitrobenzene
2. Preparation of p-nitro acetanilide from acetanilide
3. Preparation of 1-nitro naphthalene from naphthalene
4. Preparation of phthalimide from phthalic anhydride
5. Hydrolysis of methyl meta-dinitro benzoate
6. Preparation of m-nitroaniline from m-dinitrobenzene
7. Preparation of benzil from benzoin
8. Preparation of diazoaminobenzene from benzene diazonium chloride
9. Preparation of 2-naphthyl benzoate
10. Preparation of p-nitrobenzene

Chemical preparation of inorganic compound. (Any Seven)

Inorganic Preparation Binuclear and Mono Nuclear Metal Complexes. Preparation of selected inorganic metal complexes and their estimation by volumetric/gravimetric/colorimetric techniques to determine the percentage purity of the complexes prepared.

1. Cis/trans potassium di-aquo di-oxalato chromate (III)
2. Chloro penta-ammino cobalt (III) chloride
3. Nitrito penta-amino cobalt (III) Chloride.
4. Tris, 2-4 pentanedionato cobalt (III)trihydrate
5. Potassium tri-oxalato aluminate
6. Reinecke,s salt
7. Tetrammine cupric sulphate $[Cu(NH_3)_4]SO_4 \cdot H_2O$.
8. Tri (thiourea) cuprous sulphate $[Cu\ (NH_2CSNH_2)_3]_2\ SO_4\ 2H_2O]$.

1. Tri (thiourea) cuprous chloride $[Cu\ (NH_2CSNH_2)_3]\ Cl$.
2. Hexa ammine nickel(II) chloride $[Ni\ (NH_3)_6]\ Cl_2$.
3. Hexathiourea–plumbus nitrate $[Pb\ (NH_2CSNH_2)_6]\ (NO_3)_2$.
4. Potassium trioxalato chromate $K_3\ [Cr\ (C_2O_4)_3]$.
5. Potassium trioxalato aluminate $K_3\ [Al\ (C_2O_4)3]$.
6. sodium trioxalate ferrrate(III) $Na_3\ [Fe\ (C_2O_4)_3]\ 9H_2O$.
7. Hexamminecobalt(III) chloride $[Co(NH_3)_6]\ Cl_3$.
8. Pentathioureadicuprous nitrate $[Cu(NH_2CSNH_2)_5]\ (NO_3)_2$.

Sem

II

Laboratory Experiments in Chemistry-4

Compulsory

Marks : 70 + 30

Objectives:

- To provide the basic knowledge of very important concepts of the Analytical Chemistry.
- To enhance practical skills of the students for analytical techniques.
- To enhance practical skills of the students for chemical methods of analysis.
- To acquire knowledge about separation techniques of various compounds.
- The understanding of theoretical and experimental concepts of thin chromatography, paper
- Chromatography and column chromatography separation techniques.
- To enhance practical skills of the water analysis through chemical and instrumental methods.
- To provide overview of the applications of these experiments in applied field to the students.

Learning Outcomes:

- Each practicals listed in the syllabus will be explained and demonstrated in the laboratory.
- Students can define and able to calculate retardation factor (Rf) and describe how thin chromatography, paper chromatography and column chromatography to be used for separation and qualitative analysis.
- They will learn of the liquid-liquid extraction of miscible liquids.
- Students will able to water analysis through different chemical and instrumental analysis and explains how analytical data can be obtained.
- How to use gas chromatography–mass spectrometry to find the concentrations and identities of components in a mixture.
- Account for the general features of chromatography systems.

Experiments: (Any Fifteen)

1. Separation of amino acids by thin layer chromatography.
2. Separation of carbohydrates by thin layer chromatography.
3. Separation of organic acid by thin layer chromatography.
4. Separation of amino acids by paper chromatography.
5. Separation of carbohydrates by paper chromatography.
6. Separation of organic acid by paper chromatography.
7. Liquid-liquid extraction of miscible liquids.
8. Separation of amino acids by Column chromatography.
9. Separation of organic compounds by Column chromatography and determination of Rf values by TLC
10. Separation of sucrose and fructose by Column chromatography and determination of Rf values by TLC
11. Water Analysis for TDS.
12. Water Analysis for Ca and Mg.
13. Water Analysis for carbonate and bicarbonate.
14. Water Analysis for Sulphate.
15. Water Analysis for Total hardness.
16. Water Analysis for Nitrate. (Colorimetry)
17. Fajan’s method for the chloride determination.
18. Volhard’s method for the determination of silver content.
19. Calibration of volumetric glassware.
20. Sampling techniques for solid & liquid samples. (Spectroscopy)
21. Preparation of primary and secondary standard solution.
22. Measurement of optical rotation using polarimeter instrument. (Glucose)
23. Measurement of optical rotation using polarimeter instrument. (Tartaric acid)
24. Water analysis for dissolved oxygen.
25. Water analysis for chemical oxygen demand.

Sem II

Foundation Course on Research in Chemical Sciences-2

Compulsory

Marks : 50

Objectives:

- Can get idea about use of Mathematical significance in chemical sciences.
- To get familiarize with the Real Analysis, Linear Algebra and Probability to understand the statistical analysis
- Can develop skill to use research and experimental results

Learning Outcomes:

Students will be able

- To get idea about use of Mathematical significance in chemical sciences.
- To get familiarize with the Real Analysis, Linear Algebra and Probability to understand the statistical analysis
- To develop skill to use research and experimental results

UNIT 1 Sampling design

Census and sample survey, Implications of a sample design. Steps in Sampling design, Criteria of selecting a sampling procedure, Characteristics of good sample design. Different types of sample design, Random sample from an infinite universe.

Measurement and scaling techniques

Measurement in research, Measurement research, Measurement scales, Sources of error in measurement, tests of sound measurement, technique of developing Measurement tools, Scaling, meaning of scaling, Scale classification bases, Important Scaling techniques, Scale construction techniques.

UNIT 2 Methods of data collection

Collection of primary data, observation method, Interview method, Collection of data through Questionnaires, Collection of data through schedules, collection of secondary data, selection of appropriate method for data collection.

Processing and analysis of data

Processing operations, statistics in research, measures of dispersion, measures of asymmetry, measures of relationship, Simple regression analysis, Multiple correlation and regression, Partial Correlation, Association in case of Attributes, Other measures.

Semester III

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Molecular Spectroscopy**	T	60	4	30	70	100
2	**Laboratory Experiments in Chemistry-5**	P	90	3	30	70	100
3	**Polymer Chemistry (Optional)**	T	60	4	30	70	100
4	**Natural Products (Optional)**	T	60	4	30	70	100
5	**Dissertation in Chemical Sciences-1**	P	30	1	25	-	25
	Total		**240**	**12**	**115**	**210**	**325**

Sem

III

Molecular Spectroscopy

Compulsory

Marks : 70 + 30

Objectives:

- To get understanding of vibrational spectroscopy
- To get familiarize with Theory, instrumentation and applications of PMR technique
- To realize importance of ^{13}C NMR technique
- To get understanding of Mass spectrometry

Learning outcomes:

- Students will be able to interpret IR spectrum
- Students will be able to differentiate PMR and ^{13}C NMR technique
- Students will explain different types of MS techniques
- Students can develop skill to use spectroscopic techniques in structure elucidation

UNIT 1 Vibrational Spectroscopy (IR Spectroscopy)

1.1 Principle of IR spectroscopy
1.2 Various IR Regions
1.3 Stretching and bending vibration and IR absorption bands
1.4 Hooke's law
1.5 Instrumentation FTIR
1.6 Terms like Felgett's advantage
1.7 Jacquinote advantage etc.
1.8 Characteristic group frequencies for alkanes, alkenes, alkynes, aromatics, alcohols, ethers, phenols, amines and nitro compounds, aldehydes, ketones, esters, amides, acids, anhydride etc.
1.9 Factors affecting Carbonyl frequency

UNIT 2 PMR Spectroscopy

2.1 Proton Resonance Condition
2.2 Aspects of PMR Spectra – Number of Signals
2.3 Chemical Shifts
2.4 Shielding and Deshielding
2.5 Diamagnetic Anisotropy
2.6 Factors Affecting Chemical Shifts, Peak Area and Integration
2.7 Splitting of the Signals
2.8 Spin-Spin Coupling
2.9 Coupling Constants – Vicinal, Geminal, Long Range and Virtual Couplings, 2.10 Chemical Shift Equivalence and Magnetic Equivalence
2.11 First Order and Second Order Spectra,
2.12 NOE
2.13 MRI

UNIT 3 ^{13}C NMR Spectroscopy

3.1 Difficulties and Solution for Recording ^{13}C NMR Spectra,
3.2 ^{13}C NMR Spectra Scale
3.3 Prediction of Number of signals from various isomers in ^{13}C NMR Spectra Solvents
3.4 Multiplicity
3.5 ^{13}C - ^{1}H Coupling Constant
3.6 Proton Coupled and Decoupled ^{13}C NMR Spectra
3.7 Broad Band Decoupling
3.8 Off Resonance Technique
3.9 Chemical Shifts in ^{13}C NMR Spectra
3.10 Chemical Shift Calculation for Alkanes, Alkenes and Alcohols
3.11 Introduction to 2D NMR Spectroscopy
3.12 Introduction to COSY, HETCOR and DEPT techniques

UNIT 4 Mass Spectrometry

4.1 Theory and Principles of Mass Spectroscopy
4.2 Instrumentation
4.3 Low and High Resolution Mass Spectra
4.4 Isotopic abundance
4.5 Ionization Techniques such as Electron Impact (EI) Ionization, Chemical Ionization (CI), Field Desorption (FD), FAB, ESI and MALDI
4.6 Techniques used to separate charged fragments
4.7 Determination of Molecular Weight and Molecular Formula
4.8 Nitrogen Rule
4.9 Metastable Ion Peak
4.10 Rules Governing the Fragmentations
4.11 Mclafferty Rearrangement
4.12 Interpretation of Mass Spectra of Saturated and Unsaturated Hydrocarbons
4.13 Aromatic Hydrocarbons, Alcohols, Ethers, Ketones, Aldehydes, Carboxylic Acids and Amines

Sem
III

Laboratory Experiments in Chemistry-5

Compulsory
Marks : 70 + 30

Objectives:

- To provide the basic and advanced knowledge of very useful concepts of molecular spectroscopy in organic chemistry.
- To understand various molecular transitions and hence the spectra arising on the basis of transitions between different energy levels.
- To provide overview of the applications of spectroscopic concepts and techniques in applied field such as organic synthesis, drug synthesis, natural products and medicines.
- To provide the basic knowledge of the various spectroscopic techniques (UV,IR,PMR and MASS).
- To enhance practical skills of the students for chemical methods of analysis.
- To enhance practical skills of the students for synthetic techniques of polymers.
- To enhance practical skills of the students for determination of physicochemical properties of polymers through chemical and instrumental analysis methods.
- To provide the basic and advanced knowledge of polymers, its phase transitions, various degradation reactions of polymers, different polymerization techniques and properties of polymeric solutions.
- To provide overview of the applications of these experiments in applied field to the students.

Learning Outcomes:

- Students will acquire knowledge about the structure determination through various spectroscopic techniques such as UV-Vis, IR, PMR and Mass.
- Students can understand different concepts of rotational and vibrational spectroscopy
- They can understand the fundamental principles of molecular transitions between various energy level arising due to incidence of different electromagnetic radiations.
- Students can gain knowledge of spectroscopy principles and application of UV-Vis, IR, PMR and Mass spectroscopic techniques.
- Students can understand different concepts of chemical structure of polymer and various phase transition in polymers.
- They can understand different types of polymer degradation reaction and functional group reaction of different polymers.
- They can understand rheological properties of macromolecules and some polymerization techniques.
- Students can gain knowledge of properties of polymeric solutions.
- Students can learn the basic concepts of Chemistry of Natural Products.

Molecular Spectroscopy Tutorials (Any Seven)

Structure elucidation by spectroscopy: integration of all Spectroscopic techniques for structure determination of organic molecules (Problems based on spectroscopy)

1. Interpretation of IR/PMR/Mass Spectrum of Alkane derivatives.
2. Interpretation of IR/PMR/Mass Spectrum of Alkene derivatives.
3. Interpretation of IR/PMR/Mass Spectrum of Alkyne derivatives
4. Interpretation of IR/PMR/Mass Spectrum of Aromatic derivatives
5. Interpretation of IR/PMR/Mass Spectrum of Phenol derivatives
6. Interpretation of IR/PMR/Mass Spectrum of alcohol derivatives
7. Interpretation of IR/PMR/Mass Spectrum of aldehyde derivatives
8. Interpretation of IR/PMR/Mass Spectrum of ketone derivatives

9. Interpretation of IR/PMR/Mass Spectrum of amine derivatives.
10. Interpretation of IR/PMR/Mass Spectrum of halogen derivatives.
11. Interpretation of IR/PMR/Mass Spectrum of Carboxylic acid derivatives.

Polymer Chemistry (Any Seven)

1. Preparation of nylon -6,6 (Interfacial polycondensation)
2. Preparation of PMMA (free radical bulk polymerization)
3. Preparation of polyacrylamide (free radical polymerization)
4. Preparation of polyacrylamide (redox polymerization)
5. Preparation of glyptal resin
6. Preparation of linear polystyrene (free radical polymerization)
7. Preparation of crosslinked polystyrene (suspension polymerization)
8. Preparation of phenol formaldehyde resin (resoles and novolacs)
9. Preparation of urea formaldehyde resin
10. Preparation of polyaniline
11. Preparation of aniline formaldehyde resin
12. Determination of total solid content of latex
13. Determination of alkalinity of latex
14. Determination of dry rubber content of latex
15. Determination of volatile fatty acid number of latex
16. Determination of viscosity of latex
17. Determination of KOH number

Natural Products Tutorials (Any Seven)

Interpretation of IR, NMR and mass spectrographs of important Terpenoids, Hormones and Alkaloids.

(A) Terpenoids

1. Nerol
2. Geraniol
3. Citral
4. Menthol
5. Beta-carotene
6. Carvone,
7. Camphor

(B) Steroids and hormones

1. Cholesterol
2. Ergosterol
3. Testosterone
4. Progesteron
5. Estrogen

(C) Alkaloids and natural pigments

1. Cocaine
2. Nicotine
3. Morphine
4. Piperine
5. Atropine
6. Ephedrine
7. Haemin
8. Chlorophyll

Sem
III

Polymer Chemistry

Optional

Marks : 70 + 30

Objectives:

- To get basic knowledge of polymers.
- To understand characterisation technique used for the determination of structure of polymers.
- To get familiarize with various techniques such as GPC, solution viscosity, VPO etc.
- To get knowing about synthesis properties and application of Thermosetting Polymer

Learning Outcomes:

- Learner will gain knowledge about introduction, classification and application of Polymer.
- Student will learn characterisation technique used for the determination of structure of polymers.
- Student will learn various techniques such as SEC, solution viscosity, VPO etc.
- Learner will gain knowledge about synthesis properties and application of Thermosetting Polymers.

UNIT 1 Introduction and applications of polymers

1.1 Introduction to monomer
1.2 Classification of polymer on the basis of structure, source and polymerization
1.3 Chain growth polymerization (Addition Polymerisation)
1.4 Mechanism of polymerization (Free Radical, Cationic and Anionic)
1.5 Coordination polymerisation
1.6 Ring opening Polymerisation
1.7 Kinetics of Free Radical Addition
1.8 Cationic and Anionic polymerization
1.9 Industrial Polymerisation
1.10 Step-growth polymerization- Mechanism
1.11 Phase Techniques and Kinetics of Polycondensation

UNIT 2 Technique used for characterization of polymer:

2.1 Molecular weight distributions
2.2 Various techniques such as SEC, solution viscosity, VPO, light scattering for to determine relative and absolute molecular weight of polymer.

UNIT 3 Properties of polymer

3.1 Polymer reactions
3.2 Thermal, mechanical and solution properties of polymers
3.3 Thermoplastics, thermosets and elastomers
3.4 Conducting polymers
3.5 Branched polymers (starch, dendritic and hyper branched polymers)

UNIT 4 Behavior of Polymers

4.1 Crystalline Behavior- Factor affecting crystallinity of polymer
4.2 Crystallisation of polymers
4.3 Kinetics of Crystallisation
4.4 Supramolecular structure of polymers
4.5 Thermal Behaviour- Thermal methods of analysis in polymer
4.6 Dilute Solution of polymer
4.7 Thermodynamics of polymer dissolution
4.8 Phase separation
4.9 Rheological Behaviour- Stress-stain behavior in polymer
4.10 Chemical Behaviour-Cross-linking
4.11 Polymer degradation.

Sem III

Natural Products

Optional

Marks : 70 + 30

Objectives:
- Can have General introduction of vital material obtained from nature
- Can get idea about important classes of vital material obtained from nature such as Alkaloids, Vitamins and Terpenoids etc.
- Can get knowledge about structural properties of important natural products

Learning Outcome: Students will be able
- To Illustrate classification and synthesis of Terpenoids and Carotenoids
- To explain fundamentals of Steroids & Hormones
- To carry out classification and synthesis of Alkaloids
- To explain chemistry of Vitamins and their uses

UNIT 1 Introduction and applications of polymers

1.1. Introduction
1.2. Classification and isolation of Terpenoids
1.3. Constitution and synthesis of Terpenoids
    1.3.1. Methanol
    1.3.2. Farnesol
    1.3.3. Zinziberene
    1.3.4. Santonin
1.4. Introduction to Carotenoids
1.5. Structure and synthesis of β-carotene

UNIT 2 Steroids & Hormones

2.1. Introduction
2.2. Diels hydrocarbon
2.3. Cholesterol
2.4. Structure determination
2.5. Availability of Rings
2.6. Position of hydroxyl group and double bond
2.7. Nature and position of side chain
2.8. Introduction and structure determination of
    2.8.1. Bile acids
    2.8.2. Lithocholic
    2.8.3. Hyodeoxycholic acid
3.0. Introduction to Hormones and synthesis of Androsterone
    3.0.1. Testosterone
    3.0.2. Oestrone
    3.0.3. Progesterone

UNIT 3 Alkaloids

3.1. Introduction

3.2. Nomenclature and classification of alkaloids

3.3. Degradation method of alkaloids

3.4. Structure and synthesis of

- 3.4.1. Nicotine
- 3.4.2. Atropine
- 3.4.3. Ephedrine
- 3.4.4. Quinine

3.5 Introduction and synthesis of morphine

UNIT 4 Vitamins

4.1. Introduction

4.2. Classification and source of vitamins

4.3. Structure and synthesis of

- 4.3.1. Vitamin A1
- 4.3.2. Vitamin B1(Thiamine)
- 4.3.3. Vitamin B2 (Riboflavin)
- 4.3.4. Vitamin B6 (Pyridoxine)
- 4.3.5. Biotin (Vitamin H)
- 4.3.6. Vitamin C (Ascorbic acid)
- 4.3.7. Vitamin E (Tocopherol)

Sem

III

Dissertation in Chemical Sciences-1

Compulsory

Marks : 25

Objectives:

- Can get knowledge about literature survey in chemical sciences.
- Can get understanding of how to write research paper in chemical sciences.
- To carry out the research work in chemical sciences.
- Can learn synthesis, purification, characterisation, application of organic compounds.
- Can study of Results and Discussion coming out from Dissertation work in Chemical Sciences.
- Can make summary and conclusion along with references.

Learning Outcomes: Students will be able

- To get knowledge about literature survey in chemical sciences.
- To get understanding of how to write research paper in chemical sciences.
- To carry out the research work in chemical sciences.
- To learn synthesis, purification, characterisation, application of organic compounds.
- To study of Results and Discussion coming out from Dissertation work in Chemical Sciences.
- To make summary and conclusion along with references.

Dissertation work in Chemical Sciences

Students will prepare a report/synopsis/thesis of dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the selection of the topic.
(b) Materials and Methods
(c) Methodology and Characterisation
(d) Results and discussion
(e) Summary and conclusion along with the references.
(f) Each student has to give a midterm presentation of his or her work.

Literature scanning

1. Online sources.
2. Chemical abstracts.
3. Chemistry journals.
4. Scientific journals
5. Sci-Finder

Semester IV

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Heterocyclic Chemistry**	T	60	4	30	70	100
2	**Laboratory Experiments in Chemistry-6**	P	90	3	30	70	100
3	**Inorganic Chemistry-III (Optional)**	T	60	4	30	70	100
4	**Physical Chemistry-II (Optional)**	T	60	4	30	70	100
5	**Dissertation in Chemical Sciences-2**	P	30	1	25	-	25
	Total		**240**	**12**	**115**	**210**	**325**

Sem
IV

Heterocyclic Chemistry

Compulsory

IMarks : 70 + 30

Objectives:

- To get idea about use of Heterocyclic chemistry
- To understand the importance of heterocyclic moieties obtained in nature
- To get idea for nomenclature of various heterocyclic compounds
- To understand reactions and synthesis of different heterocyclic compounds

Learning Outcomes:

- Students Will be able to demonstrate nomenclature of various heterocyclic compounds
- Students Will be able to discuss synthesis of heterocyclic compounds
- Students Will be able prepare heterocyclic compounds in laboratory

UNIT 1 Nomenclature of heterocyclic compounds

1.1. Hantzsch-Widman Nomenclature system
1.2. Introduction and Classification of heterocyclic compounds
1.3. Chemistry, Reactions and synthesis of pyridines and Pyridine N-oxides
1.4. Reactions and synthesis of Pyrans

UNIT 2 Five-membered Heterocycles containing two hetero atoms

2.1. Preparation and properties of pyrazole, imidazole, oxazole, thiazole.
2.2. Preparation of isoxazole, oxazole, isothiazole
2.3. Preparation and properties of indole
2.4. Bicyclic heterocycles:
2.4.1 Introduction, Synthesis and properties of bicyclic heterocycles such as
(a) Quinolines
(b) Isoquinolines
(c) Cinnolines
(d) Quinazolines
(e) Quinoxalines
(f) Phthalazines

UNIT 3 Six-membered Heterocycles containing two hetero atoms

3.1. Diazines:
3.1.1. Reactions and synthesis of the diazines such as
(a) Pyridazines
(b) Pyrimidines
(c) Pyrazines
3.2. Benzodiazines:
3.2.1. Preparations and properties of
(a) Cinnolines
(b) Quinazolines
(c) Quinoxalines
(d) Phthalazines

UNIT 4 Seven and Eight Membered Heterocycle

4.1. Introduction
4.2. Synthesis and reactions of azepine,
4.3. Synthesis and reactions of oxepine,
4.4. Synthesis and reactions of thiepine,
4.5. Synthesis and reactions of diazepine.
4.6. Synthesis of azocine, 1,4-diazocine,1,4-dioxocin

Sem **IV** | **Laboratory Experiments in Chemistry-6** | Compulsory | Marks : 70 + 30

Laboratory Experiments in Chemistry-6

Sem IV

Compulsory

Marks : 70 + 30

Objectives:

- To enhance practical skills of the students for synthetic techniques of heterocyclic compounds.
- To enhance practical skills of the students for chemical methods of analysis.
- To enhance practical skills of the students for synthetic techniques of inorganic compounds.
- To enhance practical skills of the students for inorganic qualitative analysis and chemical methods of analysis.
- To provide overview of the applications of these experiments in applied field to the students.
- Can get understanding and knowledge of pH metry.
- Can get understanding and knowledge of Potentiometry.
- Can get understanding and knowledge of Conductometry.
- Can get understanding and knowledge of Chemical Kinetics, distribution method and adsorption.

Learning Outcomes:

- Each practicals listed in the syllabus will be explained and demonstrated in the laboratory.
- Students will be learning more through experimental approach.
- Students will be able to synthesis of heterocyclic compounds.
- Students will be able to find out percentage yield of synthesized heterocyclic compounds.
- Students will be able to identified the structural reaction mechanism of heterocyclic compounds.
- Students will learn chemical preparation of inorganic compound.
- They will be able to learn about systematic analytical approach based on experiments performed during Practicals.
- Hands on training of instruments like pH metry, Potentiometry, Conductometry.
- To carry out experiments on Chemical kinetics with accuracy and required skills.
- To carry out experiments on Distribution Coefficient and Adsorption with accuracy and required skills.
- To develop skills to carry out related experiments.

Heterocyclic Chemistry (Any Five)

Preparation of following heterocyclic compounds:

1. 7-hydroxy 4-methyl coumarin.
2. 6-methyl-4-oxo-1,2,3,4-tetrahydro-2-thiopyrimidine.
3. 2-methyl benzimidazole.
4. 2,3 diphenyl quinoxalines.
5. 5,5-diphenyl hydantoin.
6. 2-chloromethyl benzimidazole.
7. 2-hydroxy-4-methyl quinoline.
8. 4-phenyl-6-methyl-5 carbethoxy-2-pyrimidone.

Inorganic Chemistry-III (Any Five)

1. Determination of Chromium and Magnesium by colorimetry.
2. Determination of equilibrium constant of complex by colorimetry.
3. Determination of iron by solvent extraction method.
4. Conductomery experiment to verify Debye-Huckel theory of inorganic salt and complex.
5. Interpretation of spectral data of Copper Complex.
6. Interpretation of spectral data of Iron Complex.
7. Interpretation of spectral data of Magnesium Complex.
8. Interpretation of spectral data of Nickel Complex.
9. Interpretation of spectral data of Cobalt Complex.
10. Interpretation of spectral data of Platinum Complex.

Physical Chemistry-II (Any Five)

pH Metry

1. To determine dissociation constant of benzoic acid/acetic acid.
2. To determine acidic and basic dissociation constants of amino acid and its isoelectric point.

Conductometry

1. Determination of $\lambda 0$ or $\lambda\alpha$ and dissociation constant of monochloro acetic acid.
2. To determine degree of hydrolysis of ammonium chloride.

Potentiometry

1. To determine dissociation constant of dibasic acids (Malonic acid)
2. To determine Formula and stability constant of a complex formation between copper and ammonia.

Chemical Kinetics

1. The study of Rate of Reaction between hydrogen peroxide and KI in an aqueous media. (a = b)
2. Study of Autocatalytic reaction betweenKMnO$_4$ and Oxalic acid.
3. Study of ethanol by Cr(VI).

Distribution Method and Adsorption

1. Study of Adsorption of Oxalic acid on Activated Charcoal.

Sem
IV

Inorganic Chemistry-III

Optional

Marks : 70 + 30

Objectives:

- To get familiarize with Advanced Inorganic Chemistry
- Can understand the importance of Organometallic Chemistry and Bioinorganic Chemistry
- Can develop skill for Characterization of inorganic compounds using FTIR, Raman, NMR, EPR, Mossbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
- Can understand the importance of inorganic compounds synthesis, reaction mechanism and analysis.

Learning Outcome:

- The students will be able to understand the concept of advanced inorganic chemistry.
- The students will understand the importance of Organometallic Chemistry and Bioinorganic Chemistry.
- Students will be able to use for Characterization of inorganic compounds using FTIR, Raman, NMR, EPR, Mossbauer, UV-vis, NQR, MS.
- Students will be able to use the evidence based comparative chemistry approach to explain the inorganic compounds synthesis, reaction mechanism and analysis.

UNIT 1 Organometallic chemistry

1.1. Introduction
1.2. Reaction of Organometallic chemistry such as Substitution, insertion and elimination, Nucleophilic and Electrophilic reactions
1.3. Applications of Organometallic compounds as catalyst.

UNIT 2 Bioinorganic chemistry

2.1. Introduction
2.2. Porphyrins
2.3. Metallo enzymes
2.4. Oxygen transport
2.5. Electron- transfer reactions
2.6. Nitrogen fixation
2.7. Enzyme-Carbonic anhydrase
2.8. Xanthine oxidase
2.9. Aldehyde oxidase
2.10. Biochemistry of iron.

UNIT 3 Characterization of Inorganic compounds

3.1. Introduction
3.2. Infrared spectroscopy
3.3. Raman spectroscopy
3.4. NMR spectroscopy
3.5. EPR spectroscopy
3.6. Mössbauer spectroscopy
3.7. UV-vis spectroscopy
3.8. NQR spectroscopy
3.9. Mass spectroscopy
3.10. Photo electron spectroscopy
3.11. Microscopic techniques.

UNIT 4 Inorganic reactions

4.1. Introduction
4.2. Reaction, kinetics and mechanism
4.3. Trans effect and trans influence
4.4. Applications of trans effect in synthesis and analysis
4.5. Theories of trans effect:
    4.5.1. Polarisation theory
    4.5.2. π- bonding theory
4.6. Lability, inertness, stability and instability.
4.7. Electron transfer reaction
4.8. Mechanism of redox reaction (inner-sphere and outer-sphere)

Sem
IV

Physical Chemistry-II

Optional

Marks : 70 + 30

Objectives:

- To understand the concept of ideal solution, Henry's law and Nernst Distribution Law.
- To understand the concept of fugacity and activity.
- To get knowledge of Rotational, Vibrational Spectra.
- To get basic knowledge of Principle of Polarography, different types of currents and half wave potential.

Learning Outcomes: Students will be able to

- understand the concept of ideal solution, Henry's law and Nernst Distribution Law.
- understand the concept of fugacity and activity.
- get knowledge of Rotational, Vibrational Spectra.
- get basic knowledge of Principle of Polarography, different types of currents and half wave potential.

UNIT 1 Ideal solutions and Raoult's Law

1.1. Thermodynamics of mixing of dilute solutions Derivation from Raoult's law
1.2. Henry's law and solubility of gases. Nernst distribution Law and its applications.
1.3. Fugacity and activity:
  1.3.1. Determination of activity and activity coefficients of non-electrolytes.
  1.3.2. Fugacity and method of determination of fugacity of real gases.
  1.3.3. Variation of fugacity with temperature and pressure.

UNIT 2 Solid State Chemistry

2.1. Introduction
2.2. Properties of solid
2.3. Type of solid
2.4. Unit cells
2.5. Miller indices spacing
2.6. Structure of solid
2.7. Defects in solids
2.8. Born-Haber cycle
2.9. Powder XRD

UNIT 3 Molecular Spectra

3.1. Pure rotational spectra
3.2. Equation for frequency of pure rotational spectral line
3.3. Vibrational Rotational spectra
3.4. Equation for frequency of vibrational-rotational spectral line
3.5. Ortho and Para hydrogen.

UNIT 4 Polarography

4.1. Introduction
4.2. Principle
4.3. Electrodes
4.4. Types of currents
4.5. Determination of half wave potential
4.6. Ilkovic equation
4.7. Methods of determining concentration (Standard addition Method, and Calibration Method)

Sem

IV

Dissertation in Chemical Sciences-2

Compulsory

Marks : 140+85

Objectives:

- To get knowledge about literature survey in chemical sciences.
- To get understanding of how to write research paper in chemical sciences.
- To carry out the research work in chemical sciences.
- To learn synthesis, purification, characterisation, application of organic compounds.
- To study of Results and Discussion coming out from Dissertation work in Chemical Sciences.
- To make summary and conclusion along with references.

Learning Outcomes: Students will be able

- To get knowledge about literature survey in chemical sciences.
- To get understanding of how to write research paper in chemical sciences.
- To carry out the research work in chemical sciences.
- To learn synthesis, purification, characterisation, application of organic compounds.
- To study of Results and Discussion coming out from Dissertation work in Chemical Sciences.
- To make summary and conclusion along with references.

Dissertation work in Chemical Sciences

Students must submit a report/synopsis/thesis of dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Materials and Methods

(c) Methodology and Characterisation

(d) Results and discussion

(e) Summary and conclusion along with the references.

(f) Each student has to give a midterm presentation of his or her work.

Literature Scanning

1. Online sources.
2. Chemical abstracts.
3. Chemistry journals.
4. Scientific journals.
5. Sci-Finder

Semester V

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Medicinal Chemistry	T	60	4	30	70	100
2	Laboratory Experiments in Chemistry-7	P	120	4	30	70	100
3	Disconnection Approach (Optional)	T	60	4	30	70	100
4	Dyes (Optional)	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem

V

Medicinal Chemistry

Compulsory

Marks : 70 + 30

Objectives:

- To get idea for Pharmacodynamics and Pharmacokinetics Study Drug molecules and their biological effects
- To understand Host-Guest Chemistry of drug molecules
- To get familiarize with Drug design and allied subjects
- To develop skill for SAR and Computational chemistry

Learning outcomes: Students will be able

- To understand the historical and advance concept of medicinal chemistry and its advantages.
- To understand the fundamental principles of molecular structure and shape as they relate to organic molecules having application to human anatomy
- To understand the drug designing and activities of molecular structure of different drug molecules.
- To understand pharmacokinetics and Pharmacodynamics and their importance in medicine
- How to make drug become active through drug metabolism and also can understand drug metabolic actions.
- To understand application of computers in chemistry

UNIT 1 Drug design

1.1. Concepts of drug design
1.2. Bio transformation
1.3. Analogues and prodrugs
1.4. Approaches to lead discovery
1.5. Classical examples of drug design
1.6. Factors governing drug design
1.7. Rational approach to drug design
1.8. The methods of variation
1.9. Drug design through disjunction and conjugation
1.10. Structure Activity Relationship (SAR)
1.11. Relation between SAR and biological activity
1.12. Quantitative structure activity relationships (QSARS)
1.13. The Hammett constant (σ) in drug design, Combinatorial Chemistry, Prodrugs.

UNIT 2 Pharmacokinetics

2.1. General classification of pharmacokinetics
2.2. Drug absorption
2.3. Drug distribution
2.4. Drug metabolism (general pathway of drug metabolism: Oxidative, reductive and hydrolytic reactions),
2.5. Drug metabolism: Phase I and Phase II
2.6. Metabolism Reactions
2.7. Plasma Concentration
2.8. Drug excretion
2.9. Drug administration
2.10. Lead optimization process
2.11. Parent drug.

UNIT 3 Pharmacodynamics

3.1. General introduction of Pharmacodynamics
3.2. Physiological influence on Pharmacodynamics
3.3. Affinity of drug molecules
3.4. Physiological signals
3.5. Receptors
3.6. Chemical messengers
3.7. Binding sites
3.8. Receptor types and subtypes (Protein receptors, DNA receptors with examples of Agonists and Antagonists)
3.9. Transmembrane and Transduction signaling
3.10. Reaction between a receptor and ligand.

UNIT 4

4.1. Dosage forms
4.2. Quality control and application of computers in chemistry Dosage forms
4.3. Types of dosages
4.4. Different roots of administration
4.5. Quality control of drugs pharmacopias
4.6. Modern methods of pharmaceutical analysis.
4.7. Computer in chemistry
    4.7.1. Use of computer in chemistry and industry
    4.7.2. Important websites for data search chemistry
    4.7.3. Information about online journals for chemistry
    4.7.4. Artificial Intelligence

Sem
V

Laboratory Experiments in Chemistry-7

Compulsory

Marks : 70 + 30

Objectives:

- To understand of optical behaviour of Drug molecules and their biological effects.
- To understand Host-Guest Chemistry of drug molecules through molecular interaction.
- To get idea about the synthesis of drug molecules.
- To get familiarize with Drug design and allied subjects.
- To understand retrosynthetic analysis (Disconnection) of organic molecules.
- To understand the synthetic methodology of dyes.

Learning Outcomes: Students will be able

- To understand the mechanism of molecular interaction.
- To identify the structural behaviour of drug through optical properties.
- To identify the concentration of drug molecules.
- To retrosynthetic analysis of different molecules.
- To understand dye chemistry aspects and their importance.

Medicinal Chemistry: (Any Five)

1. To study of optical activities of paracetamol
2. To study of optical activities of ibuprofen
3. Estimation of aspirin
4. Estimation of isoniazide
5. Estimation of Ibuprofen
6. Estimation of ascorbic acid from Vitamin C tablet
7. Determination of density of ibuprofen different Concentartion
8. Determination of pH of ibuprofen different Concentartion
9. Determination of pH of paracetamol different Concentartion
10. Determination of alkali content of antacid tablets using HCl

Disconnection Approach Tutorial: (Any Seven)

To carry out retrosynthetic analysis (Disconnection) of following drug molecules :

1. Disconnection and synthesis of Paracetamol.
2. Disconnection and synthesis of Aspirin.
3. Disconnection and synthesis of Methyl salicylate.
4. Disconnection and synthesis of Phenacetine.
5. Disconnection and synthesis of Phenylbutazone.
6. Disconnection and synthesis of Propanalol/Inderal.
7. Disconnection and synthesis of Prilocaine.
8. Disconnection and synthesis of Loperamide.
9. Disconnection and synthesis of Sildenafil.
10. Disconnection and synthesis of Donepezil.
11. Disconnection and synthesis of Pfizer’s Maraviroc.

Synthetic Dyes: (Any Five)

1. Preparation of Fluorescein.
2. Preparation of Phenyl azo-beta naphthol.
3. Preparation of Naphthol aniline dye.
4. Preparation of Malachite.
5. Preparation of synthetic indigo dye.
6. Determination of the concentration of Methylene blue dye.
7. Determination of the concentration of Methylene orange dye.
8. Determination of the concentration of Eriochrome Black T.

Sem
V

Disconnection Approach

Optional

Marks : 70 + 30

Objectives:

- To get familiarize with the concept of Disconnection Approach in synthetic chemistry
- To understand Mechanism of disconnections
- To carry out Disconnections based on Name Reactions
- To plan new molecule synthesis and make strategies for new synthesis

Learning Outcomes:

- To get familiarize with the concept of Disconnection Approach in synthetic chemistry
- To understand Mechanism of disconnections
- To carry out Disconnections based on Name Reactions
- To plan new molecule synthesis and make strategies for new synthesis

UNIT 1 Introduction and definition of disconnection

1.1. Various terminology used in disconnection
1.2. One and two group disconnection
1.3. Disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives,
1.4. Disconnections in 1,3-dioxygenated skeletons, 1,3-diacrbonyls, 1,5-diacrbonyls
1.5. Use of Mannich reaction.

UNIT 2 Illogical Two group disconnection

2.1. Disconnection and synthesis of hydroxy carbonyl compounds,
2.2. 1,2-diols, 1,4 and 1,6-diacrbonyl compounds.
2.3. Protecting groups.
2.4. Protection of organic functional groups
2.5. protecting reagents and removal of protecting groups.

UNIT 3 Disconnections based on Diels-Alder reaction and its use in organic synthesis

3.1. Synthesis of small ring compounds
3.2. Special method for small rings preparations
3.3. Synthesis of 3 and 4 membered ring compounds
3.4. Use of ketenes in organic synthesis.

UNIT 4 Ring synthesis

4.1. Five membered ring synthesis
4.2. Pericyclic rearrangements in ring synthesis
4.3. Special methods for ring synthesis
4.4. Six membered ring synthesis
4.5. Strategy for ring synthesis
4.6. Stereoselectivity.

Sem

V

Dyes

Optional

Marks : 70 + 30

Objectives:

- To understand fundamentals of Dyes.
- To get knowledge of classification of dyes and examples of dye.
- To get familiarize with chemical properties and optical properties (Chromophore effects) of dyes and applications.
- Can have idea about applications of dye in non-textile, Leather, Food and Ink industries.
- To get knowledge of Analysis of dyes and intermediates.

Learning Outcomes: Students will be able

- To get knowledge about fundamentals of Dyes.
- To understand general classification of dyes and examples of dyes.
- To get familiarize with chemical properties and optical properties (Chromophore effects) of dyes and applications.
- To get idea about applications of dye in Non textile, Leather, Food and Ink industries.
- To get knowledge of Analysis of dyes and intermediates.

UNIT 1 Fundamental of dyes

1.1. Fundamental of dyes
1.2. General introduction
1.3. Important chemical chromophores of dyes
1.4. Dyes Class for principle applications
1.5. Description of individual class and synthesis of some commercial dyes.

UNIT 2 Dying processes of textiles

2.1. Textile fiber and classification of fiber
2.2. Pre-treatment and preparation of textile materials prior to dyeing
2.3. Dyeing methods for various textiles
2.4. Textile finishes and textile auxiliaries.

UNIT 3 Non textile dyes

3.1. General introduction and various application of non-textile dyes- Leather, Fur, Hair, Food, Ink, holographic indicator dyes.

UNIT 4 Analysis of dyes and dye intermediates

4.1. Nitrite value determination
4.2. Coupling value
4.3. Titanous chloride reduction
4.4. Halogen content determination
4.5. Metal Estimations of Cu, Ni, Cr etc.

Semester VI

Chemistry

Sr. No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	**Drugs**	T	60	4	30	70	100
2	**Laboratory Experiments in Chemistry-8**	P	120	4	30	70	100
3	**Physical Chemistry-III (Optional)**	T	60	4	30	70	100
4	**Environmental Chemistry (Optional)**	T	60	4	30	70	100
	Total		**240**	**12**	**90**	**210**	**300**

Sem
VI

Drugs

Compulsory

Marks : 70 + 30

Objectives:

- To get knowledge of history of drug
- To be able to understand classification of drugs
- To be able to describe mode of action of drugs
- To know synthesis of important drugs e.g. Antibiotics drugs, Cardiovascular Drugs Antineoplastic drugs, Psychoactive drugs, Antimalarial and Antituberculosis drugs etc.

Learning Outcomes: Students will be able

- To understand the drug structure at atomic and molecular basis and their action.
- To know the impact of synthetic drugs in the fields of medicine, pharmacy and its impact biomedical sciences.
- To understand the fundamental principles of molecular structure of drug and their properties.
- To identify organic molecules by functional group: alkane, alkene, alkyne, haloalkanes, alcohol, thiol, ether, sulfide, amine, aldehyde, ketone, carboxylic acid and carboxylic acid derivatives.
- How to do organic nomenclature and its symbolism and can learn also the fundamental principles of functional group convers ion and organic synthesis.
- To identify the medicinal properties of different organic molecules by medicinal application in medical science

UNIT 1 Antibiotics

1.1. General Introduction
1.2. Chemical Classification
1.3. Beta-lactam antibiotics: Penicillins and Cephalosporins
1.4. Beta-lactamase inhibitors
1.5. Amino glycosides
1.6. Antibiotics that interfere with the protein biosynthesis in microorganisms: non lactam antibiotics: tetracycline and chloroamphenicol
1.7. Structure actively relationship (SAR) among penicillins and tetracyclins
1.8. Synthesis of pencillin-V, ampicillin, cephalosporin and chloroamphenicol

UNIT 2 Cardiovascular, diuretics and hypoglycemic drugs

2.1. Introduction of Anti anginal and Vasodilators
2.2. Antihypertensive drugs
2.3. Anti arrhythmic drugs and Anti thyroid drugs
2.4. Synthesis of amyl nitrate, diltiazim, atenolol, methyl dopa, tolbutamide, chloropropamide, glibenclamide, acetazolamide, chlorothiazide, furosemic and ethacrycnic acid

UNIT 3 Antineoplastic Agents

3.1. Introduction and Classification

3.2. Psychoactive drugs

3.2.1. CNS depressant: General and local anaesthetics, Sedative and hypnotics

3.2.2. Antipsychotic drugs: Antidepressant and Neuroleptics

3.3. Synthesis of the following drugs:
Amobarbital, diazepam, chlorozepan, alprazolam, glutethimide, nikethamide, procaine, lidocaine and dibucaine, Ibuprofin, meclofenate sodium

UNIT 4 Antimalarial and Antituberculosis drugs

4.1. Antimalarials: Modern chemotherapy of malaria, 4-amino and 8-amino quinolins, 9-amino acridine.

4.2. Synthesis of mefloquines, chloroquine, primaquine and daraprim

4.3. Mode of action of antimalarial agents

4.4. SAR of antimalarial agents

4.5. Anti tuberculosis: Synthesis of drugs: Isoniazid (INH), Ethionamide, Ethambutol and Dapsone (DDS)

Sem VI

Laboratory Experiments in Chemistry-8

Compulsory

Marks : 70 + 30

Objectives:

- To understand of optical behaviour of Drug molecules and their biological effects.
- To understand Host-Guest Chemistry of drug molecules through molecular interaction.
- To get idea about the synthesis of drug molecules.
- To get familiarize with Drug design and allied subjects.
- To understand the environmental analysis of water.
- Can get understanding and knowledge of pH metry.
- Can get understanding and knowledge of Potentiometry.
- Can get understanding and knowledge of Conductometry.
- Can get understanding and knowledge of Chemical Kinetics, distribution method and adsorption.

Learning Outcomes:

- Students will be able to understand the mechanism of molecular interaction.
- They will able to identify the structural behaviour of drug through optical properties
- Students will be able to synthesize new drug molecules.
- Students will be understanding environmental aspects and their importance.
- Hands on training of instruments like pH metry, Potentiometry and Conductometry.
- To carry out experiments on Chemical kinetics with accuracy and required skills.
- To carry out experiments on Distribution Coefficient and Adsorption with accuracy and required skills.
- To develop skills to carry out related experiments.

Synthetic Drugs: (Any Seven)

1. To synthesize of phthalimide from phthalic anhydride
2. To synthesize of Hippuric acid from glycine
3. Synthesis of p-nitro acetanilide from acetanilide
4. Synthesis of paracetamol drug
5. Synthesis of flouorescein from phthalic anhydride and resorcinol
6. Spectroscopic analysis of ibuprofen
7. Determination of λmax of paracetamol drugs
8. Determination of λmax of ibuprofen drugs
9. Determination of absorbance of various concentration of ascorbic acid
10. Determination of absorbance of various concentration of paracetamol

Physical Chemistry-III: (Any Eight)

pH Metry:

1. To determine dissociation constant of acetic acid.
2. To determine dissociation constant of mono chloro acetic acid.

Conductometry:

1. Determination of λ_0 or λ_α and dissociation constant of acetic acid.
2. To determine degree of hydrolysis of aniline hydrochloride.
3. To determine the equivalent conductance and dissociation constant of a weak electrolyte and to verify Oswald's dilution law.

Potentiometry:

1. To determine Molarity of each acid present in a Mixture of strong acid and weak acid by titrating against 0.1 M NaOH solution.
2. To determine solubility product of AgCl/AgBr.
3. To determine dissociation constant of dibasic acids (Oxalic acid, Succinic acid)
4. To determine Formula and stability constant of a complex formation between silver and ammonia.

Chemical Kinetics:

1. To determine the Rate Constant for the reaction between $KBrO_3$ and KI in an aqueous media. ($a \neq b$)
2. Study the Reaction between acetone and iodine
3. Determination of the order of reaction between Potassium persulphate ($K_2S_2O_8$) and Potassium Iodide (KI) by fractional change method.

Distribution Method and Adsorption:

1. To determine the formula of complex formed between cupric ion (Cu^{+2}) and ammonia.
2. Study of Adsorption of Acetic acid on Activated Charcoal.

Environnemental Chemistry : (Any Five)

1. Determination of dissolved oxygen in water
2. Determination of Chemical Oxygen Demand (COD)
3. Determination of Biological Oxygen Demand (BOD)
4. Percentage of available chlorine in bleaching powder
5. Measurement of chloride, sulphate and salinity of water samples by simple titration method ($AgNO_3$)
6. Measurement of chloride, sulphate and salinity of water samples by simple titration method (Silver Nitrate and potassium chromate).
7. Estimation of total alkalinity of water samples using double titration method
8. Measurement of dissolved CO_2
9. Study of some of the common bio-indicators of pollution
10. Estimation of SPM in air samples
11. Preparation of borax/ boric acid

Sem

VI

Physical Chemistry-III

Optional

Marks : 70 + 30

Objectives:

- Can understand the concept of electrochemistry.
- To get physicochemical aspects of Chemical Equilibrium and surface chemistry.
- To get knowledge of Solid State Chemistry.
- To get familiarize with the study of crystalline materials and ionic compounds.

Learning Outcomes: Learners will be able to

- understand the concept of electrochemistry.
- get Physicochemical aspects of Chemical Equilibrium and surface chemistry
- get knowledge of Solid State Chemistry
- get familiarize with the study of crystalline materials and ionic compounds.

UNIT 1 Photo chemistry

1.1. Introduction
1.2. Difference between thermal and photochemical reactions
1.3. Laws of absorption
1.4. Laws of photochemistry
1.5. Quantum Efficiency
1.6. Fluorescence
1.7. Phosphorescence
1.8. Chemiluminescene Photosensitized reactions
1.9. Application of photochemistry

UNIT 2 Phase Rule

2.1. Introduction
2.2. Phase diagram for one component system (water and Sulphur system)
2.3. Two component system (Zn + Cd, Ag + Pb)
2.4. Zeotropic and Azeotropic mixture
2.5. Steam distillation
2.6. Zone refining
2.7. Numericals

UNIT 3 Solid state Chemistry

3.1. Introduction
3.2. Properties of solid
3.3. Type of solid
3.4. Calculation of Schottky and Frenkel defects using statistical method
3.5. Solid electrolytes
3.6. Diffusion in solids
3.7. Conductivity in ionic compounds
3.8. Superconductivity
3.9. Perovskites

UNIT 4 Surface Chemistry

4.1. Introduction
4.2. BET equation
4.3. Surface tension
4.4. Gibbs Adsorption Isotherm equation
4.5. Positive adsorption
4.6. Negative adsorption Micelles : Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micelle concentration (CMC), factors affecting the CMC of surfactants

Sem **VI**

Environmental Chemistry

Optional

Marks : 70 + 30

Objectives:

- To get familiarize with Chemistry of atmosphere and global warming.
- To get knowledge of basics of Chemistry of water pollution in environment.
- To get understanding of Green Chemistry.
- To get knowledge of basic Instrumental Techniques in Environmental analysis.

Learning Outcomes:

- Student will get familiarize with Chemistry of atmosphere and global warming.
- Learner will get knowledge of basics of Chemistry of water pollution in environment.
- Student will get understanding of Green Chemistry.
- Learner will get knowledge of basic Instrumental Techniques in Environmental analysis.

UNIT 1 Chemistry of atmosphere

1.1. Properties of atmosphere
1.2. Air quality standard
1.3. Carbon monoxide
1.4. Oxide of nitrogen
1.5. Sulfur dioxide
1.6. Volatile organic chemistry
1.7. Acid rain
1.8. Depletion of ozone layer
1.9. Global warming

UNIT 2 Chemistry of water pollution and solid wastes disposal

2.1. Pollutants and sources
2.2. Sedimentation and siltation, pathogens, heavy metals and toxic organic compounds
2.3. Introduction to solid waste
2.4. Municipal solid waste
2.5. Municipal solid waste disposal method landfills and incineration
2.6. Recycling of solid wastes
2.7. Industrial wastes

UNIT 3 Green Chemistry

3.1. Introduction to hazardous compounds
3.2. Concept of atom economy
3.3. Utilizing of green raw material
3.4. Catalyst and solvent in green chemistry

UNIT 4 Instrumental Techniques in Environmental Analysis

4.1. Non-dispersive infrared spectroscopy
4.2. Fourier transform infrared (FTIR)
4.3. Atomic absorption spectroscopy (AAS)
4.4. Inductive coupled plasma atomic emission spectroscopy (ICPAES)
4.5. Anodic stripping voltammetry (ASV)
4.6. Gas chromatography (GC)
4.7. GC-MS and GC-FTIR
4.8. High performance liquid chromatography and Ion chromatography

BOTONY

Semester I

Botany

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Principles of Plant Sciences	T	60	4	30	70	100
2	Anatomy of Higher Plants	T	60	4	30	70	100
3	Concepts of Ecology	T	60	4	30	70	100
4	Laboratory Experiments in Plant Sciences-1	P	90	3	30	70	100
5	Laboratory Experiments in Plant Sciences-2	P	90	3	30	70	100
6	Foundation Course 1: Research in Life Sciences	T	30	2	50	-	50
	Total		390	20	200	350	550

Sem I | **PRINCIPLES OF PLANT SCIENCES** | Compulsory
Marks : 70 + 30

PRINCIPLES OF PLANT SCIENCES

OBJECTIVES

Students will be able to understand the morphology, structure and functions of various parts of plants, They will learn the taxonomical terminology and understand the meaning of the same, They will be enable to understand the nomenclature of plants as well as to identify the plants of selected families on the basis of its taxonomical characters.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Identify the angiosperm plant families on the basis of the morphological characters
- Understand the meaning of taxonomical terminology
- May utilize this knowledge in building career in the field of agricultural biotechnology

UNIT 1 BOTANICAL NOMENCLATURE AND CLASSIFICATION

1.1 Taxonomy and systematic botany, aim, concepts of plant classification.
1.2 Botanical nomenclature, International Code of Botanical Nomenclature, salient features, species concept
1.3 Systems of classification (Natural, Artificial, Phylogenetic) and their merits/ demerits
1.4 Taxonomic evidences (Anatomy and Embryology)

UNIT 2 MORPHOLOGY

2.1 Vegetative plant parts (Root/ Stem) and their modifications
2.2 Reproductive plant parts (Inflorescence/ Flower/ Fruit/ Seed)
2.3 Plant forms, origin and general evolutionary trends in flowering plants

UNIT 3 PLANT FAMILIES-I

3.1 Plant families – Dicot (05) characteristics with representative examples and economic importance
3.2 Plant families – Monocot (01) features with examples and economic importance

UNIT 4 PLANT FAMILIES-II

4.1 Plant families – Dicot (05) characteristics with representative examples and economic importance
4.2 Plant families – Monocot (01) features with examples and economic importance

Sem

I

ANATOMY OF HIGHER PLANTS

Compulsory

Marks : 70 + 30

OBJECTIVE:

- Student will learn anatomical structure and function of various tissues, They will also understand the mechanism of growth in plants and the role of different tissues in the same.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand the primary& secondary anatomical structures of various plant parts
- Gain the fundamental knowledge of secondary growth and wood types
- Experience the benefits of team work which will foster their flexibility and responsiveness, especially the ability to respond to change

UNIT 1 INTRODUCTION TO PLANT TISSUES

1.1 Introduction and significance of Plant anatomy

1.2 Meristematic Tissue: Characteristics, classification, theories and functions

1.3 Types of tissues

1.3.1 Permanent and Meristematic tissues

1.3.2 Simple and complex tissues

UNIT 2 PLANT TISSUE SYSTEMS

2.1 Structure, orientation and arrangement of Epidermal Tissue System

2.2 Structure, Types and Classification of Stomata and Epidermal out growth

2.3 Ground Tissue system: Definition, Types and Functions

2.4 Vascular tissue system: Definition, Types and Functions

UNIT 3 SECONDARY GROWTH

3.1 Secondary Growth in Dicot stem

3.2 Secondary growth in Dicot Root

3.3 Dicot wood Anatomy: Types and Importance

3.4 Anomalous secondary growth with various examples

UNIT 4 PLANT ANATOMY IN EVOLUTION

4.1 Phylogeny of xylem and phloem elements

4.2 Nodal anatomy

4.3 Stele types

4.4 Application of Plant anatomy

Sem
I

CONCEPTS OF ECOLOGY

Compulsory
Marks : 70 + 30

OBJECTIVE

- Students will become familiar with the variety of ways that organisms interact with both the physical and the biological environment; they will develop an understanding of the differences in the structure and function of different types of ecosystems.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Develop an appreciation of the natural world through direct experience with local ecosystems
- Learn techniques of data analysis as well as methods of presenting scientific information in figures and tables
- Learn techniques for gathering data in the field

UNIT 1 ECOLOGICAL FACTORS:

1.1 Abiotic Factors: i. Climatic ii. Edaphic
1.2 Biotic Factors:
  1.2.1 Positive Interaction
    1.2.1. a Mutualism
    1.2.1. b Commensalism
  1.2.2 Negative Interaction
    1.2.2. a. Exploitation
    1.2.2. b. Antibiosis
    1.2.2. c. Competition

UNIT 2 ECOLOGICAL ADAPTATION

2.1 Ecological Adaptations of Hydrophytes
2.1 Ecological Adaptations of Xerophytes
2.3 Ecological Adaptations of Mesophytes
2.4 Ecological Adaptations of Helophytes
2.5 Autecology
2.6 Population ecology

UNIT 3 COMMUNITY

3.1 Succession:
  3.1.1 Types of Succession,
  3.1.2 Xerarch succession
  3.1.3 Hydrach succession
3.2 Ecosystem
  3.2.1 Types of ecosystem
  3.2.2 Forest ecosystem
  3.2.3 Pond ecosystem
  3.3 Ecological pyramids
  3.3.1 Community
  3.3.2 Biogeochemical cycles (C, N, P and S).

UNIT 4 ENVIRONMENTAL ISSUES

4.1 Environmental Pollutions [Air, Water and Soil]
4.2 Bioremediation
4.3 Global Warming
4.4 Climate change

Sem

I

LABORATORY EXPERIMENTS IN PLANT SCIENCES 1

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will be able to understand the morphology, structure and functions of various parts of plants, They will develop an understanding of the differences in the structure and function of different parts of plant.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Identify the angiosperm plant families on the basis of the morphological characters.
- Understand the meaning of taxonomical terminology
- Learn various forms of plant parts
- Understand diversity of plant parts in the plant kingdom

LIST OF EXPERIMENTS

PLANT TAXONOMY AND MORPHOLOGY

Practical 1: Types of Root modification
Practical 2: Types of Stem modification
Practical 3: Types of Racemose inflorescence
Practical 4: Types of Cymose inflorescence
Practical 5: Types of special inflorescence
Practical 6: Types of Flowers
Practical 7: Types of Fruits
Practical 8: Types of Seeds
Practical 9: Study of dicot family 1
Practical 10: Study of dicot family 2
Practical 11: Study of dicot family 3
Practical 12: Study of dicot family 4
Practical 13: Study of dicot family 5
Practical 14: Study of dicot family 6
Practical 15: Study of dicot family 7
Practical 16: Study of dicot family 8
Practical 17: Study of dicot family 9
Practical 18: Study of dicot family 10
Practical 19: Study of monocot family 1
Practical 20: Study of monocot family 2

Sem I

LABORATORY EXPERIMENTS IN PLANT SCIENCES 2

Compulsory

Marks : 70 + 30

OBJECTIVES:

- Student will learn anatomical structure and function of various tissues, They will develop an understanding of the differences in the structure and function of different types of ecosystems.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand the primary and secondary anatomical structures of different plant parts
- Gain the fundamental knowledge of secondary growth and wood types
- Experience the benefits of team work which will foster their flexibility and responsiveness, especially the ability to respond to change
- Develop an appreciation of the natural world through direct experience with local ecosystems
- Learn techniques of data analysis as well as methods of presenting scientific information in figures and tables

LIST OF EXPERIMENTS

ANATOMY OF HIGHER PLANTS

1. Study of shoot apex and root apex
2. Study of simple tissues in Dicot stem T.S
3. Study of complex tissues in Dicot stem L.S
4. To study the types of vascular bundle from the available plants in campus.
5. To study primary and secondary growth in dicot stem
6. To study anomalous secondary growth due to abnormal behavior of cambium
7. To study Periderm and Lenticel
8. To study types of nodal anatomy
9. Preparation of permanent slides
10. To study Types of Wood anatomy

CONCEPTS OF ECOLOGY

1. To Study the community by Quadrats
2. To study the vegetation using Line Quadrate
3. To study the vegetation using Belt transect method
4. To study the vegetation by Chart Quadrate
5. To estimate IVI of the species using quadrate method
6. To determine present organic carbon and organic matter in the soil of crop lands, grass lands and forest
7. To estimate alkalinity ($CO3_2$-, HCO_3-) from soil sample
8. To estimate hardness (Ca^2+, Mg^2+) from soil sample.
9. To determine dissolved oxygen content in eutrophic and oligotrophic water samples by Azide modification of Winklers method
10. To determine water holding capacity of soil collected from different Location

Sem I

FOUNDATION COURSE 1: RESEARCH IN LIFE SCIENCES

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will learn about different aspects of research and will be able to write research paper and reports in proper scientific manner

LEARNING OUTCOMES

- On completion of this paper, students will able to
- Demonstrate ability to identify a research problem
- Formulate clear objectives for the study
- Design a feasible methodology to research into the problem
- Increase their capacity to think critically, ability to design and execute an experiment
- Improve confidence and ability in communicating ideas
- This will serve as a lasting and practical basis for a career, for example, in research - whether industry or academia - as well as teaching, media, law, commerce, government or management

Unit-1 Introduction to Research & Methodology

1.1 Significance of Research,
1.2 Research methods : Research and Scientific methods,
1.3 Defining the research problem and Research Design.
1.4 Format of a thesis
1.5 Research article, Reviews and Monographs
1.6 Citations, Bibliography and Webliography

Unit -2 Interpretation and Report Writing:

2.1 Meaning of interpretation; Techniques of interpretation;
2.2 Precautions in Interpretation;
2.3 Significance of Report writing;
2.4 Different steps in Report writing;
2.5 Layout of Research Project; Types of Reports
2.6 Research Ethics: IPR, Research Report, Presentation table, Figure formatting and typing

Semester II

SEMESTER II

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Principles of Genetics	T	60	4	30	70	100
2	Molecular Cell Biology	T	60	4	30	70	100
3	Developmental Biology	T	60	4	30	70	100
4	Laboratory Experiments in Plant Sciences-3	P	90	3	30	70	100
5	Laboratory Experiments in Plant Sciences-4	P	90	3	30	70	100
6	Foundation Course 2 : Academic and Research Organizations in Life Sciences	T	30	2	50	-	50
	Total		390	20	200	350	550

Sem

II

PRINCIPLES OF GENETICS

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will review the genetic basis of heredity for both Mendelian and quantitative characters, they will be able to explain classical transmission genetics and discuss this in the context of genes.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand the terminologies, fundamental processes and applications of Genetics
- Learn significance of gene interactions.
- Understand genetic mutations and chromosomal aberrations
- Learn the modern concept of gene

UNIT 1 MENDELIAN GENETICS

1.1 Laws of inheritance:

1.1.1 Mendel's Laws

1.1.2 Concept of dominance

1.1.3 Segregation, independent assortment

1.1.4 Chromosomal theory of inheritance

1.2 Allelic and non-allelic interactions:

1.2.1 Concept of alleles

1.2.2 Types of dominance : Incomplete Dominance and Co Dominance

1.2.3 Multiple alleles

1.2.4 Epistasis

UNIT 2 LINKAGE AND SEX DETERMINATION

2.1 Linkage:

2.1.1 Concepts, recombination

2.1.2 Experiments of Morgan and Sturtevant Formula

2.2 Sex Determination :

2.2.1 Sex-linked inheritance, Theories of sex determination

UNIT 3 CHROMOSOMES AND GENES

3.1 Chromatin structure:

3.1.1 Histones, DNA,

3.1.2 Nucleosome morphology & Chromosome Packaging

3.1.3 Euchromatin, Heterochromatin and Non Histone Proteins in chromosome packaging

3.2 Concept of gene:

3.2.1 Conventional and modern views

3.2.2 Fine structure of gene

3.2.2 Gene Cistron Relationships in prokaryotes and Eukaryotes

3.2.3 Split genes, pseudogenes, non-coding genes, overlapping genes and Nested genes

UNIT 4 MUTATION AND CHROMOSOMAL ABBERATIONS

4.1 Mutation :

4.1.1 Mutation Rate

4.1.2 Types of Mutations

4.1.3 Phenotypic Effects

4.1.4 Reversion

4.2 DNA Repair Mechanisms

4.3 Changes in Chromosome number and structure:

4.3.1 Polyploidy, aneuploidy,

4.3.2 Chromosomal rearrangements - deletion, duplication, inversion, and Translocation and Transposition

Sem **II**

MOLECULAR CELL BIOLOGY

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will be able to learn the cell biology from the ground level to the molecular level, understand the structure and functions of different types of cell organells.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand about the basic knowledge of molecular structure and functions of cell organelles
- Gain knowledge about the molecular mechanisms of cell organelles in living organisms
- Advanced techniques in practicals will make them skilled in the field of molecular biology.

UNIT 1 DIVERSITY, STRUCTURE AND INTERACTION OF CELLS:

1.1 Diversity of cell size and shapes
1.2 Structure of Prokaryotic and Eukaryotic cells
1.3 Cell - Cell interactions; Cell adhesions, and cell junctions

UNIT 2 CELL SIGNALLING

2.1 Introduction, Definition of Cell Signalling
2.2 Forms of cell Signalling
2.3 Molecular basis of Cell Signalling process
2.4 Signalling molecules: structure, function and importance in organisms

UNIT 3 CELL ORGANELLES-I

3.1 Molecular organization of Mitochondria, Mechanism of Oxidative Phosphorylation, Electron Transport Chain
3.2 Molecular organization of Chloroplast, Photosynthetic pigments, Photosystem I & II
3.3 Ultrastructure and Functions of Nucleus

UNIT 4 CELL ORGANELLES-II

4.1 Molecular Organization and functions of:
- 4.1.1 Endoplasmic reticulum
- 4.1.2 Golgi complex
- 4.1.3 Lysosomes
- 4.1.4 Microbodies: Peroxisomes and Glyoxisomes
- 4.1.5 Ribosomes

Sem **II**

DEVELOPMENTAL BIOLOGY

Compulsory

Marks : 70 + 30

OBJECTIVES

Students gain knowledge about the lower plants, They learn about the evolution process on the basis of the structural difference between different organisms.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Differentiate between various groups of Algae, Fungi and Bryophytes
- Able to practically identify the various groups of plant kingdom

UNIT 1 INTRODUCTION: CRYPTOGAMS

1.1 General Characteristic of Algae
1.2 Classification of Algae proposed by Smith
1.3 General Characteristic of Fungi
1.4 Classification of Fungi proposed by Ainsworth
1.5 General Characteristic of Bryophytes
1.6 Classification of Bryophytes

UNIT 2 ALGAE

2.1 General features, occurrence, distribution and reproduction of Division Phaeophyta
    2.1.1 Ectocarpus
2.2 General features, occurrence, distribution and reproduction of Division Rhodophyta
    2.2.1 Batracospermum
2.3 Economic importance of Algae

UNIT 3 FUNGI

3.1 General features, occurrence and reproduction of Lower Fungi
    3.1.1 Pythium
3.2 General feature, Occurrence and reproduction of Higher Fungi
    3.2.1 Aspergillus
3.3 Economic importance of Fungi

UNIT 4 BRYOPHYTA

4.1 Study of class Hepaticopsida
    4.1.1 Distribution, Habitat, External morphology and reproduction of Pellia
4.2 Study of class Bryopsida
    4.2.1 Distribution, Habitat, External morphology and reproduction of Sphagnum
    4.3 Economic importance of Bryophyta

Sem II

LABORATORY EXPERIMENTS IN PLANT SCIENCES 3

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will review the genetic basis of heredity for both Mendelian and quantitative characters, they will be able to explain classical transmission genetics and discuss this in the context of genes, to learn the cell biology from the ground level to the molecular level, understand the structure and functions of different types of cell organelles.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand the terminologies, fundamental processes and applications of Genetics
- Learn techniques of data analysis as well as methods of presenting scientific information in figures and tables
- Understand about the basic knowledge of molecular structure and functions of cell organelles
- Gain knowledge about the molecular mechanisms of cell organelles in living organisms
- Learn to use laboratory and computer skills in studying genetic and molecular biological processes

LIST OF EXPERIMENTS

PRINCIPLES OF GENETICS

1. Genetic problems of law of dominance
2. Genetic problems of law of segregation
3. Genetic problems of Independent assortment
4. Genetic problems related to epistatis
6. Genetic problem related to gene mapping
7. Pedigree Analysis
8. DNA Estimation by DPA Method
8. Isolation of Auxotrophic Mutants
9. UV induced Lac Negative Mutagenesis in bacteria

MOLECULAR CELL BIOLOGY

1. To study different stains used in cell biology
2. Observation of distinguishing features of prokaryotic and eukaryotic cells
3. Measurement of the size of cells and subcellular Components in light microscope
4. To identify the barr body from buccal smear
5. Study of different stages of mitosis in onion root tip Cells
6. Study of the effect of colchicine on mitosis in onion Root tip cells
7. Study of divisional stages in Mitosis (different floral buds)
8. Staining of mitochondria in human cheek epithelial cells
9. Differential staining for DNA and RNA in human cheek Epithelial cells

Sem **II**

LABORATORY EXPERIMENTS IN PLANT SCIENCES 4

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students gain knowledge about the lower plants, They learn about the evolution process on the basis of the structural difference between different organisms.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Differentiate between various groups of Algae, Fungi and Bryophytes
- Able to practically identify the various groups of plant kingdom

LIST OF EXPERIMENTS

DEVELOPMENTAL BIOLOGY

1. General Characteristic (morphological) of Algae
2. General Characteristic (Anatomical) of Algae
3. General Characteristic (morphological) of Fungi
4. General Characteristic (Anatomical) of Fungi
5. General Characteristic (morphological) of Bryophytes
6. General Characteristic (Anatomical) of Bryophytes
7. To study Ectocarpus : Vegetative
8. To study Ectocarpus : Asexual
9. To study Ectocarpus : Sexual
10. To study Batracospermum: Vegetative
11. To study Batracospermum: Asexual
12. To study Batracospermum: Sexual
13. To study Aspergillus: Vegetative
14. To study Aspergillus: Asexual
15. To study Aspergillus: Sexual
16. To study Pythium: Vegetative
17. To study Pythium: Asexual
18. To study Pythium: Sexual
19. To study Pellia: Vegetative
20. To study Pellia: Reproductive
21. To study Sphagnum:Vegetative
22. To study Sphagnum:Reproductive

Sem II

FOUNDATION COURSE 2 : ACADEMIC AND RESEARCH ORGANIZATIONS IN LIFE SCIENCES

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will get an opportunity to orient themselves for their future academic or research career by knowing various reputed organizations working in the field of life sciences in India.

LEARNING OUTCOMES

On completion of this paper, students will able to

- understand organizational structure, activities, quality parameters, career opportunities
- develop interpersonal relationships and professional network by visiting the institutes.
- Improve confidence and ability in communicating ideas
- Set their future career goals
- Correlate the theory, curricula with application aspects

Unit 1 : Introduction to Life Science Research Organizations-1

1. Institute of Genomics and Integrative Biology(IGIB), New Delhi
2. National Institute of Immunology, New Delhi
3. International centre for Genetic Engineering and Biotechnology, New Delhi
4. Institute of Microbial Technology (IMTECH), Chandigarh
5. Forest Research Institute (FRI), Dehradun,
6. Central Institute of Fisheries Education, Mumbai
7. Tata Institute of Fundamental Research, Mumbai
8. Central Salt and Marine Chemicals Research Institute(CSMCRI), Bhavnagar, Gujarat
9. Directorate of Groundnut Research(DGR), Junagadh
10. Directorate of Forensic Science, Gandhinagar
11. Gujarat Biotechnology Research Centre (GBRC), Gandhinagar
12. Pharmaceutical Education& Research Development Centre, Ahmedabad

Unit 2 : Introduction to Life Science Research Organizations-2

13. National Institute of Oceanography, Goa
14. National Institute of Virology, Pune
15. National Chemical Laboratory, Pune
16. Indian Institute of Chemical Biology, Kolkata
17. National Centre for Biological Sciences (NCBS) – Bangalore
18. ICAR-Central Plantation Crops Research Institute, Kerala
19. Indian Institute of Horticultural Research, Bangalore
20. Centre for Cellular and Molecular Biology, Hyderabad
21. Jawaharlal Nehru Centre for Advanced Scientific Research, Karnataka

Semester III

SEMESTER III

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Advanced Plant Physiology	T	60	4	30	70	100
2	Laboratory Experiments in Plant Sciences-5	P	90	3	30	70	100
3	Biological Chemistry (Optional)	T	60	4	30	70	100
4	Applied Plant Sciences (Optional)	T	60	4	30	70	100
5	Dissertation in Plant Sciences-1	P	30	1	25	-	25
	Total		240	12	115	210	325

Sem III

ADVANCED PLANT PHYSIOLOGY

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will be able to understand the fundamental physiological processes taking place in plants, They will enable to understand the growth regulators of plants.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand the various physiological phenomenon taking place in plants
- Correlate the physiological processes with the growth and development of plant
- Understand the practical application of plant growth regulators
- May utilize this knowledge in building career in the field of agriculture

UNIT 1 WATER AND SOLUTES TRANSPORT

1.1 Water absorption and transport

1.2 Water Potential

1.3 Transpiration

1.4 Translocation: Mechanism of loading and unloading

UNIT 2 PHOTOSYNTHESIS

2.1 Light harvesting complexes

2.2 Mechanism of Electron Transport

2.3 CO2 fixation: C3/ C4/ CAM

2.4 Factors affecting photosynthesis

2.5 Photorespiration

UNIT 3 STRESS PHYSIOLOGY

3.1 Response of plants to abiotic stress: Water, Temperature and Salt

3.2 Response of plants to biotic Stress: Pathogen and Insects

UNIT 4 PLANT GROWTH REGULATORS

4.1 Growth regulators, biosynthesis, bioassay, mechanism of action, physiological effects, applications (Auxin, Cytokinin, Gibberellins, ABA, Ethylene)

4.2 Physiological effects and role of jasmonic acid, salicylic acid

Sem III

LABORATORY EXPERIMENTS IN PLANT SCIENCES 5

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will be able to understand the fundamental physiological processes taking place in plants, They will enable to understand the growth regulators of plants, Students gain knowledge about the basics molecules of biochemistry, They will be able to understand the mechanism of biomolecules.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Correlate the physiological processes with the growth and development of plant
- Understand the practical application of plant growth regulators
- Students will be able to understand the structure, functions and significance molecules of organisms
- May utilize this knowledge in building career in the field of agriculture

LIST OF EXPERIMENTS

ADVANCED PLANT PHYSIOLOGY

1. Estimation of peroxidase activity in a given plant material
2. To determine the amylase activity from control and stress seeds
3. To determine the invertase activity from control and stress seeds
4. To estimate chlorophyll a, b and total chlorophyll content from given plan material
5. To study water potential of potato tuber
6. To estimate protein cAontent from control and stress seeds
7. To study effect of different types of light on photosynthesis
8. To study effect of different temperature on photosynthesis
9. To study Relative Growth Rate (RGR)
10. To study Leaf Weight Ratio (LWR)
11. To study Net Assimilation Rate (NAR)

BIOLOGICAL CHEMISTRY

1. To perform qualitative tests for carbohydrates
2. Preparation of standard curve for carbohydrates
3. To quantify carbohydrate from unknown plant sample
4. To perform qualitative tests for Protein
5. Preparation of standard curve for Protein
6. To quantify protein from unknown plant sample
7. To perform qualitative tests for lipids
8. To quantify lipids from unknown plant sample.

Sem

III

BIOLOGICAL CHEMISTRY

Compulsory

Marks : 70 + 30

OBJECTIVE

To provide deep understanding of Energy, Enzymes and metabolic processes in plants and the synthesis and importance of secondary metabolites of plants

LEARNING OUTCOMES

On completion of this paper, students will

- Learn the structure, function and metabolic pathways of essential biochemical molecules including their key chemical and physical properties.
- Learn about the rich diversity of secondary compounds and metabolism in plants and how such compounds contribute to human health.
- Learn principles of enzyme kinetics and apply these through hands on problem sets. Students will be shown how enzyme properties contribute to metabolic processes.

UNIT 1 BIOENERGETICS

1.1 Basic concepts of Enthalpy, Entropy, Free energy and chemical equilibrium Determination of ΔG & Energy rich compounds

1.2 Energy Metabolism: Role of ATP in metabolism, Role of reducing power in metabolism, Role of precursor metabolites in metabolism

1.3 Oxidation-Reduction Reactions

1.4 Laws of Thermodynamics

UNIT 2 ENZYMES

2.1 Enzymes – Characteristics, Nomenclature and Classification

2.2 Isoenzymes, Ribozyme, Catalytic antibodies

2.3 Enzyme kinetics : Effect of Temperature, pH, Substrate and Enzyme Concentration on Enzyme Activity

2.4 Steady-state hypothesis and derivation of Michaelis-Menten equation

2.5 Significance of Km and Vmax and their determination using different plots

2.6 Enzyme inhibition, Enzyme kinetics in the presence of inhibitors

UNIT 3 METABOLIC PATHWAYS

3.1 Catabolic pathways of carbohydrates – Glycolysis, TCA cycle

3.2 Modes of ATP generation : Oxidative Phosphorylation and Photophosphorylation

3.3 PPP and Glyoxylate Cycle

3.4 Lipid catabolism – Fatty acid Beta oxidation Pathway

UNIT 4 SECONDARY METABOLITES AND FREE RADICALS

4.1 Structure, properties and importance of phytochemicals

4.2 Terpenes, Polyphenols, Flavonoids, Xanthones, Alkaloids and Pigments.

4.3 Free Radicals: Introduction to free radicals.

4.4 Generation and reaction of free radicals with biological materials and their adverse effects

Sem III

APPLIED PLANT SCIENCES

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will learn the traditional and modern utilization of plants, They will be able to correlate the evolution of plant association of human culture.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Identify the useful plants on the basis of thier morphological characters
- Associate the traditional herbal medicines with their photochemical in order to check the possibilities of validation of that traditional knowledge scientifically
- Aware about the importance of traditional herbal medicines used by ethnic people of India which is an important aspect of traditional knowledge conservation
- Utilize this knowledge in building career in the field of agriculture, biotechnology and pharmacognosy

UNIT 1 PHYTORESOURCES-I

1.1 Origins of agriculture

1.2 World centers of primary diversity of domesticated Plants

1.3 Non-wood forest products (NWFPs): Raw materials for paper – making, Gums and Resins, Dyes.

UNIT 2 PHYTORESOURCES-II

2.1 Origin, evolution, botany, cultivation and uses of

2.1.1 Root crop: Radish, Carrot and Beet Root

2.1.2 Tuber crop: Potato and Sweet potato

2.1.3 Bulb crop: Onion and Garlic

2.1.4 Leafy vegetable crop: Spinach

2.1.5 Fruit: Mango, Grapes and Papaya

2.1.6 Medicinal Plants: Emblica officinalis and Asparagus racemosus

UNIT 3 ETHNOBOTANY AND CONSERVATION

3.1 Basic methods and approaches to study traditional knowledge, various sub disciplines, Scope, voucher specimen, verification, screening and potential applications

3.2 Conservation, principles, strategies, in situ – ex situ, protected areas, gene – seed banks, initiatives (international/ national), IUCN

UNIT 4 PHYTOCHEMISTRY AND PHARMACOGNOSY

4.1 Secondary metabolites, types – characteristics, extraction strategies, analysis, biosynthetic pathways and inter relationships

4.2 Pharmacognosy, morphology (macro – micro), methods, adulterants, quality control.

4.3 Role of Phytochemicals, commercial exploitations (cultivation, in vitro approaches), important medicinal plants with uses and yielding active principles from underground parts/ whole plant/ flowers/ fruits/ seeds.

Sem III | **DISSERTATION IN PLANT SCIENCES -3** | Compulsory Marks : 70 + 30

OBJECTIVES

- Students will be able to formulate original questions about plants into empirically testable hypotheses, collect and analyze data obtained from original research, and translate and apply experimental data to advance the field and solve real-world problems, Synthesize and apply knowledge to better understand and manage plant-based systems.

LEARNING OUTCOMES

On completion of this paper, students will able to

- Demonstrate ability to identify a research problem
- Formulate clear objectives for the study
- Design a feasible methodology to research into the problem
- Increased their capacity to think critically, ability to design and execute an experiment
- Improve confidence and ability in communicating ideas
- This will serve as a lasting and practical basis for a career, for example, in research - whether industry or academia - as well as teaching, media, law, commerce, government or management.

Dissertation work in Biological Sciences: Students will carry out dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Materials and Methods

(c) Results and Discussion

(d) Reference

(d) Each student has to give a midterm presentation of their work.

Semester IV

Botany

SEMESTER IV

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Pteridophytes and Gymnosperms	T	60	4	30	70	100
2	Laboratory Experiments in Plant Sciences -6	P	90	3	30	70	100
3	Microbiology (Optional)	T	60	4	30	70	100
4	Principles of Horticulture (Optional)	T	60	4	30	70	100
5	Dissertation in Plant Sciences-2	P	30	1	25	-	25
	Total		240	12	115	210	325

Sem
IV

PTERIDOPHYTES AND GYMNOSPERMS

Compulsory

Marks : 70 + 30

OBJECTIVES

- To introduce the students to the world of Pteridophytes and Gymnosperms, To make students aware about the basic knowledge of Pteridophytes and Gymnosperms, students will be able to correlate the evolution process

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Identify the various life forms of Pteridophytes and Gymnosperms
- Can understand that Pteridophytes provide an important link in the evolution of plants
- learn basics and evolution of pteridophytes
- Understand the plant fossils and the evolution process will become more easy to understand.

UNIT 1 INTRODUCTION OF PTERIDOPHYTES AND GYMNOSPERM

1.1 General Characteristic and features of Pteridophytes
1.2 Classification of Pteridophytes
1.3 General characters and Features of Gymnosperm
1.4 Classification of Gymnosperm
1.5 Comparative studies of Pteridophytes and Gymnosperm

UNIT 2 PTERIDOPHYTA-BASICS

2.1 Life history: Distribution, Occurrence, External morphology and Reproduction (Excluding anatomy) of
    2.1.1 Equisetum
    2.1.2 Dryopteris
2.2 Economic importance of Pteridophyte

UNIT 3 GYMNOSPERMS

3.1 Economic importance of Gymnosperms with reference to wood, essential oils and drugs.
3.2 Life history: Distribution, Occurrence, External morphology and Reproduction (Excluding anatomy: Internal structure) of Taxus Gnetum

UNIT 4 PHYLOGENESIS

4.1 Tetrasporic seed habitat
4.2 Telome theory
4.3 Steler types in Pteridophytes
4.4 Steler evolution in Pteridophytes
4.5 Heterospory in Pteridophytes

Sem **IV**

LABORATORY EXPERIMENTS IN PLANT SCIENCES 6

Compulsory

Marks : 70 + 30

OBJECTIVES

To introduce the students to the world of Horticulture one of the techniques of applied Botany, to make students aware about the basic knowledge of Pteridophytes and Gymnosperms, students will be able to correlate the evolution process, Students will be able to acquire, articulate, retain and apply scientific language and knowledge relevant to microbiology

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand the green-house technology
- Understand harvest technology
- Describe the taxonomic status of micro organisms.
- Understanding of the use of microscopy to study microbiology
- Understanding of the use of stains

LIST OF EXPERIMENTS

PTERIDOPHYTES AND GYMNOSPERM

1. To study the reproductive structure of Equisetum
2. To study the reproductive structure of Dryopteris
3. To study the reproductive structure of Marsilea
4. To study the reproductive structure of Taxus
5. To study the reproductive structure of Ephedra

MICROBIOLOGY

1. To culture bacteria
2. To isolate microorganism from mixed culture and grow a pure culture.
3. Monochrome Staining of given bacterial culture.
4. Negative Staining from tooth tarter.
5. To perform Gram staining of given culture suspension.
6. To carry out standard plate count of given culture.
7. To perform growth curve of E.Coli and estimate growth rate and generation time.

6\. Isolation of bacteriophages from sewage sample based on PFU.

PRINCIPLES OF HORTICULTURE

1.To study the different horticulture crops

2.To study the different types of biofertilizers

3.To study the techniques of cutting & layering

4.To study the techniques of grafting and budding

5.To study micropropagation

6.To study techniques of fruit preservation

7.To study techniques of Bonsai

8.To study techniques of Topiary

9.To study post harvest method for cut flowers

Sem
IV

MICROBIOLOGY

Compulsory
Marks : 70 + 30

OBJECTIVES

- Students will be able to acquire, articulate, retain and apply scientific language and knowledge relevant to microbiology, This course introduces student to the subject, It opens up a new world of small, tiny creatures of enormous importance which we know as microorganisms, It gives basic information about the existence of microbes and their association with other forms of life.

LEARNING OUTCOMES

On completion of this paper,

- Students will be able to understand about the omnipresence of micro organisms.
- They will be able to describe the taxonomic status of micro organisms.
- Learning importance of micro organisms in our world
- Understanding of bacterial growth and cultivation
- Understanding of extremophilic microorganisms
- Learn the diversity and life cycle of Viruses

UNIT 1 INTRODUCTION TO MICROBIAL DIVERSITY

1.1 Introduction to Groups of Microorganisms
1.2 Distribution of Microorganisms in Nature
1.3 Introduction to Biodiversity- Microbial evolution and diversity
1.4 Microbial Taxonomy: Introduction and overview
1.5 Classification systems - Taxonomic ranks of microorganisms
1.6 Major characteristics used in taxonomy
1.7 Phylogeny- Survey of Prokaryotic Phylogeny

UNIT 2 GROWTH, REPRODUCTION & CULTIVATION OF BACTERIA

2.1 Nutritional requirements and nutritional types of Bacteria
2.2 Chemical & Physical requirement of Growth: Bacteriological media, Physical conditions required for growth
2.3 Reproduction of Bacteria
2.4 Growth of Bacteria: Growth Curve, Synchronous Culture and Continuous growth of Bacteria,
2.5 Pure Culture and Cultural Characteristics

UNIT 3 DIVERSITY OF SOME UNUSUAL PROKARYOTES

3.1 General Features of Bacteria with unusual morphology:

- 3.1.1 Rickettsia and Chlamydia
- 3.1.2 Budding and appendaged bacteria
- 3.1.3 Sheathed Bacteria
- 3.1.4 Bacteria with gliding motility
- 3.1.5 Mycoplasma

3.2 General Features of Bacteria of extreme environments:

- 3.2.1 Thermophiles
- 3.2.2 Halophiles
- 3.2.3 Acidophiles
- 3.2.4 Barophiles
- 3.2.5 Methanogens

UNIT 4 AKARYOTIC DIVERSITY (VIRUSES)

4.1 Introduction and General Characteristics: Definition, Structure, Classification

4.2 Cultivation and Enumeration of Viruses

4.3 Bacterial Viruses: Classification, Lytic life cycle (T4 phage), lysogenic life cycle (Lambda phage)

4.4 Plant Viruses: Classification, Structure & Replication of TMV, Economic importance, Viroids

4.5 Animal Viruses: Classification, Replication, Cytocidal effects, Viruses and Cancer, HIV, HBV, Ebola, Zeka, SARS CoViD, Prions

Sem	PRINCIPLES OF HORTICULTURE	Compulsory
IV		Marks : 70 + 30

OBJECTIVES

- To introduce the students to the world of Horticulture one of the techniques of applied Botany, through understanding of Horticulture will help students to provide their contribution towards the economy of the society

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Understand the green-house technology
- Understand harvest technology
- Develop their better understanding towards the artificial favourable environment for the plants
- To make students aware about the basic knowledge of Horticulture
- May utilize this knowledge to improve the economy of the society

UNIT 1 FUNDAMENTALS OF HORTICULTURE

1.1 Definition, branches, importance, scope and classification of Horticultural crops

1.2 Role of plant growth regulators

1.3 Concept of biofertilizers

1.4 Types of organic manures and their application in horticulture

UNIT 2 TECHNIQUES FOR PLANT PROPAGATION

2.1 Sexual and asexual propagation of plants

2.2 Cutting, layering, grafting, budding

2.3 Selection and preparation of scion, Stock scion incompatibility

2.4 Micro-propagation

UNIT 3 POMOLOGY

3.1 Orchard layouts and types: Square, rectangle, quincunx, hexagons, fencing of orchards

3.2 Fruit preservation, Present status; Local and international demand

3.3 Future prospectus nutritive value of fresh and processed fruits

3.4 Brief account on principles and methods of refrigeration, canning, dehydration and chemical preservation

3.5 Export standards and potential

UNIT 4 FLORICULTURE

4.1 Indoor gardening – Plants and management

4.2 Bonsai, Topiary

4.3 Maintenance of cut flowers, stage of harvest of cut flowers

4.4 Techniques involved in gardening, packing storage and transportation of cut flowers

Sem **IV**

DISSERTATION IN PLANT SCIENCES -4

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will be able to formulate original questions about plants into empirically testable hypotheses, collect and analyze data obtained from original research, and translate and apply experimental data to advance the field and solve real-world problems, Synthesize and apply knowledge to better understand and manage plant-based systems.

LEARNING OUTCOMES

On completion of this paper, students will able to

- Demonstrate ability to identify a research problem
- Formulate clear objectives for the study
- Design a feasible methodology to research into the problem
- Increased their capacity to think critically, ability to design and execute an experiment
- Improve confidence and ability in communicating ideas
- This will serve as a lasting and practical basis for a career, for example, in research - whether industry or academia - as well as teaching, media, law, commerce, government or management.

DISSERTATION WORK IN BIOLOGICAL SCIENCES

Students will carry out dissertation work on the topic of their study comprising of

(a) An introduction on the topic along with literature survey and justification for the Selection of the topic.

(b) Materials and Methods

(c) Results and Discussion

(d) Reference

(d) Each student has to give a midterm presentation of their work.

Semester V

Botany

SEMESTER V

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Molecular Biology and Gene Regulation	T	60	4	30	70	100
2	Laboratory Experiments in Plant Sciences -7	P	120	4	30	70	100
3	Biostatistics and Bioinformatics (Optional)	T	60	4	30	70	100
4	Environmental Biology(Optional)	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem V

MOLECULAR BIOLOGY AND GENE REGULATION

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will be able to understand the molecular basis of inheritance. They will understand the flow of expression and gene regulation. They will get opportunity to explore the genetic engineering technology for crop improvement.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Describe the function and structure of nucleic acid including the metabolic reactions that occur in cells
- Explain the process of inheritance, replication and change
- Explain genetic engineering techniques

Unit – 1: Genetic Material : Replication and Transcription

1.1 DNA is the universal genetic material

1.2 DNA Replication – Mechanism and models

1.3 Transcription and post transcriptional modifications

1.4 Genetic code and Ribosome

1.5 Translation and post translational modifications

Unit – 2: Central Dogma of Molecular Biology : Gene Expression

2.1 Levels of gene expression and regulation

2.2 Types and principles of gene regulation

2.3 Transcriptional regulation

2.4 The Operon Model :Regulation of lactose utilization – The lac operon

2.5 The Operon Model :Regulation of arabinose utilization – The ara operon

2.6 The Operon Model :Regulation of tryptophan biosynthesis – The trp operon

2.7 Post transcription control

UNIT – 3: Mutation and DNA Repair

3.1 Fluctuation analysis

3.2 Mutation and Mutation rate

3.3 Phenotypic effects of mutation, Phenotypic and Phenomic lag

3.4 Types of mutation :Spontaneous mutations and Induced mutations

3.5 Biochemical basis of mutation

3.6 Mutagenesis

3.7 DNA repair mechanisms - Mismatch repair, excision repair, photo reactivation, Recombinational repair and SOS repair

UNIT – 4: Genetic Engineering and Protein Engineering

4.1 Genetic engineering: aims and applications

4.2 Genetic manipulations of prokaryotes:

   a. Isolation of DNA
   b. Vectors of Recombinant-DNA Technology – pBR 322, pUC, Bacteriophages, Cosmid, Phagmid, BACs, YACs
   c. Insertion of DNA molecules into a vector
   d. Transformation and Growth
   e. Detection of Recombinant molecules – Colony Hybridization
   f. Expression of foreign DNA

4.3 Genetic manipulations of eukaryotes: Genetic manipulation of plant cells, animal cells and yeasts

4.4 Polymerase chain reaction (PCR) and its types

4.5 Molecular markers and their applications: RFLP and RAPD

4.6 DNA sequencing techniques

Sem V

LABORATORY EXPERIMENTS IN PLANT SCIENCES 7

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will be able to understand the various techniques of Biology, Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology, Students will be able to understand the process of data collection, evaluation and presentation, to introduce the students to the climate change present scenario, to make students aware about the adaptation and mitigation strategies for environmental issues.

LEARNING OUTCOMES

- On completion of this paper, students will be able to
- Describe the function and structure of nucleic acid including the metabolic reactions that occur in cells
- Explain the process of inheritance, replication and change
- Representing the research data in a valid form
- Students gain knowledge about Biostatistics
- Aware about current climate scenario
- Understand about the whole event of climate change and its effects at national and international level

LIST OF EXPERIMENTS

MOLECULAR BIOLOGY AND GENE REGULATION

1. To study the models/charts of DNA & RNA and its types
2. To study the charts of replication of DNA
3. To study the models/charts of genetic code
4. To prepare the standard curve of DNA
5. Estimation of DNA by diphenylamine method
6. Isolation of plant DNA and its quantification by spectrophotometric method
7. To prepare the standard curve of RNA
8. Isolation of plant RNA and its quantification by spectrophotometric method
9. To study the models/charts of DNA sequencing method, PCR, RFLP, RAPD
10. To perform Cloning (Blue White Screening) using teaching kit
11. Plasmid DNA cloning

BIOSTATASTICS AND BIOINFORMATICS: THEORY AND APPLICATIONS

1. Measures of central tendency- Mean, Median and Mode of frequency distribution from discrete data series
2. Measures of central tendency- Mean, Median and Mode of frequency distribution from continuous data series
3. Calculation of standard error
4. Calculation of Standard Deviation
5. Calculation of variance (ANOVA) and coefficient variance
6. Calculation of correlation and regression
7. Calculation of chia square
8. The ‘t test’ for significance
9. Find the 3D structure of a protein using NCBI database
10. Find research papers related to any topic using NCBI database
11. Find base pair sequences using NCBI website
12. Perform BLASTN and BLASTP analysis
13. Sequence alignment using EMBOSS Needle and EMBOSS Water
14. Primer Designing Software

ENVIRONMENTAL BIOLOGY

1. To study the water pollution
2. To study BOD of water sample
3. To study COD of water sample
4. To study the soil pollution
5. To study the air pollution
6. Study of greenhouse effects, global warming, acid rain, ozone deplation through charts
7. To study the aerosol types

Sem
V

BIOSTATISTICS AND BIOINFORMATICS

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will be able to understand the process of data collection, evaluation and presentation,

To make students aware about the mathematical methods of biology

LEARNING OUTCOMES

On completion of this paper, students will be able to

- To introduce the students to the world of Bioinformatics
- Collect data from original experiments, evaluate it
- Representing the research data in a valid form
- Students gain knowledge about Biostatistics

UNIT 1 BIOSTATESTICS- SCOPE

1.1 Principle and scope of statistical methods in biological research

1.1.1 Sampling

1.1.2 Data- types

1.1.3 Data Collection

1.1.4 Presentation of data

1.2 Measures of central tendency- for different type of series

1.2.1 Mean

1.2.2 Median

1.2.3 Mode

UNIT 2 BIOSTATISTICS- METHODS

2.1 Standard deviation

2.2 Standard error

2.3 variance

2.4 Coefficient of variation

2.5 Tests of statistical significance (chi square)

2.6 Correlation

2.8 Regression

2.9 ANOVA

2.10 Use of tools in statistical analysis

UNIT 3: COMPUTATIONAL BIOLOGY AND DATABASES

3.1 Introduction and applications of Bioinformatics

3.2 Databases, DBMS, Biological database: Primary and Secondary databases

3.3 Structure databases, miscellaneous databases,

3.4 Overview of NCBI, ENTREZ, SRS and DBGET

3.5 File formats

UNIT 4: SEQUENCE ALIGNMENT: BLAST and EMBOSS

4.1 Sequence alignment: Local alignment, Global alignment, multiple alignment and Motif match

4.2 Algorithms: Smith Waterman Algorithm and Needleman Wunsch Algorithm,

4.3 Gap Penalty

4.4 BLAST : Types and Applications, EMBOSS Needle and EMBOSS Water

Sem **V**

ENVIRONMENTAL BIOLOGY

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will get information about Environment and recent Environmental problems, to introduce the students to the climate change present scenario, to make students aware about the adaptation and mitigation strategies for environmental issues.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand the major environmental issues
- Aware about current climate scenario
- Understand about the whole event of climate change and its effects at national and international level

UNIT 1 INTRODUCTION TO CLIMATE CHANGE

1.1 Global atmospheric composition
1.2 Greenhouse gases and aerosols
1.3 Extreme weather events, sea level rise
1.4 Climate projections and their uncertainties

UNIT 2 GLOBAL AND NATIONAL ENVIRONMENTAL ISSUES-I

2.1 Greenhouse effect
2.2 Acid rain
2.3 Global Warming
2.4 Ozone depletion
2.5 Climate change

UNIT 3 GLOBAL AND NATIONAL ENVIRONMENTAL ISSUES-I

3.1 Carbon Sequestration
3.2 Clean Development Mechanism
3.3 Carbon credits
3.4 Deforestation
3.5 Biodiversity loss
3.6 Desertification

UNIT 4 ACTIONS TO OVERCOME CLIMATE CHANGE

4.1 Adaptation
4.2 Mitigation
4.3 National, International and State level initiatives
4.4 Case Study

Semester VI

Botany

SEMESTER VI

Sr No.	Subject Name	T/P	Hours	Credit	Internal	External	Total
1	Analytical and Separation Techniques	T	60	4	30	70	100
2	Laboratory Experiments in Plant Sciences -8	P	120	4	30	70	100
3	Plant Biotechnology: Scope and Principles (Optional)	T	60	4	30	70	100
4	Phytoresources- Utilization and Management (Optional)	T	60	4	30	70	100
	Total		240	12	90	210	300

Sem
VI

ANALYTICAL AND SEPARATION TECHNIQUES

Compulsory
Marks : 70 + 30

OBJECTIVES

- Students will get information about Environment and recent Environmental problems, to introduce the students to the climate change present scenario.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand the working of different instruments utilized in the research of plant sciences
- Apply their theory based knowledge about plants practically
- It will open new paths for scientific research
- Operate various instruments for analysis of various biomolecules

UNIT 1 SPECTROSCOPIC METHODS

1.1 Electromagnetic Spectrum
1.2 Principle of Spectroscopy
1.3 Types of spectrometer/detectors:
 1.3.1 UV Visible Spectroscopy
 1.3.2 Infra-red spectroscopy
 1.3.3 NMR spectrometer

UNIT 2 CHROMATOGRAPHY

2.1 Principles of Chromatographic Separation,
2.2 Theory, principle and applications of Paper Chromatography
2.3 Thin layer chromatography (TLC),
2.4 Gas chromatography

UNIT 3: CENTRIFUGATION

3.1 Centrifugation: introduction, Definition.
3.2 Theory and Principles of Centrifugation, Sedimentation velocity and Sedimentation 3.3 Equilibrium
3.4 Types of Centrifugation

UNIT 4 ELECTROPHORESIS

4.1 Basic Principles of Electrophoresis, Factors affecting Separation,
4.2 Theory and Applications of Paper, Agarose and Polyacrylamide Gel Electrophoresis
4.3 Blotting Techniques

Sem **Vi**

LABORATORY EXPERIMENTS IN PLANT SCIENCES 8

Compulsory

Marks : 70 + 30

OBJECTIVES

- Students will get information about different analytical and separation techniques useful in recent era, Students will learn all basic concepts of plant biotechnology, to introduce the students to In vitro Production and germplasm conservation, Students gain knowledge about utilization of phytoresources.

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand the working of different instruments utilized in the research of plant sciences
- Apply their theory based knowledge about plants practically
- Understand Plant Improvement and complementary Techniques
- To apply their theory based knowledge about plants practically
- To provide their contribution towards sustainable utilization of phyto-resources

LIST OF EXPERIMENTS

ANALYTICAL AND SEPARATION TECHNIQUES

1. To study UV/Visible spectroscopy
2. To study IR spectroscopy
3. To study NMR spectroscopy
4. To separate plant pigments by paper chromatography
5. To detect the unknown compound using thin layer chromatography
6. To study gas chromatography
7. To study the centrifuge machine
8. To study theory and applications of Paper and Gel electrophoresis
9. To study theory and applications of PAGE and SDS – PAGE
10. To study different types of blotting techniques

PLANT BIOTECHNOLOGY: SCOPES AND PRINCIPLES

1. To acquaint with various instruments used in plant biotechnology laboratory
2. Preparation of stock solutions for MS medium
3. To prepared the MS medium
4. Inoculation of Explant
5. To study the callus culture
6. To study the bud culture
7. To study the pollen culture
8. To study the embryo culture
9. Preparation of Artificial seed and their germination
10. To study the homogeneity of in vitro generated plantlets by RAPD

PHYTO RESOURCES- UTILIZATION AND MANAGEMENT

1. Study of various food, fodder and forage crops
2. To analyze presence of starch of plants used as food, fodder and forage
3. To study morphology and microscopic structure of whole fibres
4. To study gums, resins and dyes
5. To separate curcuminoid in turmeric by TLC
6. To study variou oil yielding plants
7. To perform test for presence of fixed oil/ fats and also to ditect presence of various adultanrants
8. To study various Earth, leaf and fruit vegetables
9. To study various medicinal and aromatic plants
10. To detect various chemical constituents in some medicinal plants

Sem
VI

PLANT BIOTECHNOLOGY: SCOPE AND PRINCIPLES

Compulsory

Marks : 70 + 30

OBJECTIVES

Students will learn all basic concepts of plant biotechnology, to introduce the students to In vitro Production and germplasm conservation

LEARNING OUTCOMES

On completion of this paper, students will be able to

- Understand Plant Improvement and complementary Techniques
- To apply their theory based knowledge about plants practically
- It will open new paths for scientific research.
- Learn about the plant improvement through various techniques
- Practically apply in agriculture field

UNIT 1 PLANT TISSUE CULTURE

1.1 General techniques, Laboratory and equipments

1.2 Aseptic techniques

1.3 Nutrient medium

1.4 Plant growth regulators

UNIT 2 IN VITRO PRODUCTION AND GERMPLASM CONSERVATION

2.1 Micropropagation, cloning, various stages, applications

2.2 Haploids, androgenesis, various pathways, factors affecting, advantages –applications, gynogenesis

2.3 Germplasm conservation, slow growth, cryopreservation (freezing – thawing), cryoprotectants, applications

UNIT 3 PLANT IMPROVEMENT AND COMPLEMENTARY TECHNIQUES

3.1 Somatic hybridization, protoplast isolation, Protoplast fusion, selection of hybrids, advantages

3.2 Somaclonal variation, origin, factors inducing variations, advantages

3.3 Distant hybridization, in vitro pollination/ fertilization, embryo culture, applications

UNIT 4 APPLICATIONS OF PLANT BIOTECHNOLOGY

4.1 Plant regeneration, Somatic embryogenesis, Advantages, Synthetic seeds

4.2 Production of virus free plants- shoot meristem culture. Thermotherapy, cryotherapy and chemotherapy

4.3 Virus indexing. Maintenance of virus free stocks. Applications and limitations

4.4 Transgenic plants - insect resistant and herbicide resistant plant for crop improvement

4.5 Molecular farming

Sem **VI**

PHYTO RESOURCES- UTILIZATION AND MANAGEMENT

Compulsory

Marks : 70 + 30

OBJECTIVES

To introduce the students to the world of applied Botany, to make students aware about the basic knowledge of identification of phytoresources, Students gain knowledge about utilization of phytoresources

LEARNING OUTCOMES

On completion of this paper, students will be able to

- To provide their contribution towards sustainable utilization of phyto-resources
- To develop green-house technology and harvest technology for improve the income of society
- Develop their better understanding toward the artificial favourable environment for the plants

UNIT 1 INTRODUCTION OF PHYTORESOURCES

1.1 Concept, natural resources, biological resources, plants as natural resources

1.2 Management practices - need and methods

1.3 Utilization - Bioenergy, food, fodder, fibre, medicine and essences.

1.4 Plant Resources Processed – Jam, jelly, squash, ketchup, raisin, pickle and rubber

1.5 Unprocessed – Honey, timber, wood, tannins and latex

UNIT 2 PLANT RESOURCES USED IN COSMETICS, AROMATICS AND PHARMACEUTICS

2.1 Introduction and scope, Herbal preparations, Methods of extraction –

2.2 Aloe, Henna, Lemon grass, Rose, with reference to part used, products and uses

2.3 Turmeric, Ginger, Neem, Aamla with reference to part used, products and uses

UNIT 3 HARVEST TECHNOLOGY

3.1 Harvest technology management for fruit

3.2 Artificial ripening,

3.3 Methods of picking Post-harvest technology and management for fruits,

3.4 Flowers and medicinal plants – Grading, processing, storage and packing

UNIT 4 ORGANIC FARMING

4.1 Green manuring and organic fertilizers and Biofertilizers,

4.2 Recycling of biodegradable municipal, agricultural and Industrial wastes

4.3 biocompost making methods, types and method of vermicomposting

4.4 field Application

Evaluation Pattern

Evaluation Pattern

Type of Paper	Internal			External			Grand Total
	Particulars	Marks	Total Marks	Particulars	Marks	Total Marks	
Theory (all) & Practical papers of M.Sc.	Assignment/ Seminar/ Project/ Workshop	5	30	Semester end Written Examination	70	70	**100**
	Attendance	5					
	CCE	5					
	From Prelim Exam	15					
EPC T/P* (Tool Course) of 4 Credit	Assignment/ Seminar/ Project/ Workshop	5	30	Semester end Written Examination	35	70	**100**
	Attendance	5		Practical	35		
	CCE	5					
	From Prelim Exam	15					
EPC Practical** (Tool Course) of 2 Credit	Submission	20	50	-	-	-	**-**
	Presentation	20					
	Viva	10					

***EPC Theory/Practical Papers*:** Yoga Studies, Communication and Compsitory Writing, Academic Writing

****EPC Practical Papers:** Prepration and Presentation of TLM/E Content Development, Prepration of Theme Paper and Its Presentation, Prepration and Administration of Psychological Tests

*****Preliminary Examination:** One Exam of 35/70 Marks to be taken on the pattern of Annual Exam. It is to be converted to 15 Marks. Converted from Preliminary Exam

CCE (Continuous Comprehensive Evaluation): Two CCE of 25 Marks each to be taken .
Average of two CCE to be converted to 5 Marks.
CCE I- Unit 1 & 2 , CCE 2- Unit 3 & 4

Evaluation Pattern

SEMESTER WISE DISTRIBUTION OF MARKS RESEARCH AND PG DISSERTATION (Education)

Preparation and Presentation of Research Proposal						
SEM	**Credit**	**Hrs.**	**Activity**	**Marks**		
				Internal	External	Total
I	2	60	Research Review at least 10	20	-	20
			Preparation of Research Proposal	40	-	40
			Presentation of Research Proposal and approval	40	-	40
				100	-	100
Dissertation (Tool Development)						
SEM	**Credit**	**Hrs.**	**Activity**	**Marks**		
				Internal	External	Total
II	2	60	Development and validation of tool	20	-	20
			Submission of Chapter 1, 2 and 3	20	-	10
			Presentation of work done	10	-	20
				50	-	50
Dissertation						
SEM	**Credit**	**Hrs.**	**Activity**	**Marks**		
				Internal	External	Total
IV	4	120	Data Collection	20	-	20
			Data Analysis and Results	20	-	20
			Submission of Chapter 4, 5 and/6	20	-	20
			Submission of Research Report	-	40	40
			Presentation of work done	-	100	100
				60	140	200

SEMESTER WISE DISTRIBUTION OF MARKS RESEARCH AND PG DISSERTATION (Mathematics)

Sr No.	Subject Name	Semester	Hours	Credit	Internal	External	Total
1	**Foundation Course on Research in Mathematical Science-I**	1	30	2	50	-	50
2	**Foundation Course on Research in Mathematical Science-II**	2	30	2	50	-	50
3	**Dissertation in Mathematical Sciences – I**	3	30	1	25	-	25
4	**Dissertation in Mathematical Sciences – II**	4	30	1	25	-	25
5	**Dissertation Submission**	4	-	-	60	140	200
	Total				210	140	350

SEMESTER WISE DISTRIBUTION OF MARKS RESEARCH AND PG DISSERTATION (Physics)

Sr No.	Subject Name	Semester	Hours	Credit	Internal	External	Total
1	**Foundation Course on Research in Physical Science-I**	1	30	2	50	-	50
2	**Foundation Course on Research in Physical Science-II**	2	30	2	50	-	50
3	**Dissertation in Physical Sciences – I**	3	30	1	25	-	25
4	**Dissertation in Physical Sciences – II**	4	30	1	25	-	25
5	**Dissertation Submission**	4	-	-	60	140	200
	Total				210	140	350

SEMESTER WISE DISTRIBUTION OF MARKS RESEARCH AND PG DISSERTATION (Chemistry)

Sr No.	Subject Name	Semester	Hours	Credit	Internal	External	Total
1	**Foundation Course on Research in Chemical Science-I**	1	30	2	50	-	50
2	**Foundation Course on Research in Chemical Science-II**	2	30	2	50	-	50
3	**Dissertation in Chemical Sciences – I**	3	30	1	25	-	25
4	**Dissertation in Chemical Sciences – II**	4	30	1	25	-	25
5	**Dissertation Submission**	4	-	-	60	140	200
	Total				210	140	350

SEMESTER WISE DISTRIBUTION OF MARKS RESEARCH AND PG DISSERTATION (Botany)

Sr No.	Subject Name	Semester	Hours	Credit	Internal	External	Total
1	**Foundation Course-I on Research in Life Sciences**	1	30	2	50	-	50
2	**Foundation Course-II Academic and Research Organisations in Life Sciences**	2	30	2	50	-	50
3	**Dissertation in Plant Sciences – I**	3	30	1	25	-	25
4	**Dissertation in Plant Sciences – II**	4	30	1	25	-	25
5	**Dissertation Submission**	4	-	-	60	140	200
	Total				210	140	350

Evaluation Pattern

Internship M.Ed. I						
SEM	Credit	Hrs.	Activity	Marks		
				Internal	External	Total
II	2	60	Implementation of a Psychological Test/Status Survey/Social Research	20	-	20
			Guidance, checking and supervision of Microteaching Lessons of B.Ed. Students	20	-	20
			Visit to an agency of curriculum development/ text book bureau/ DIET/ GCERT/ Teacher Education Institution	20	-	20
			Visit to Secondary Teacher Training Institute, GCERT /INFLIBNET/GIET / an institute of special education/NGO and contribute as a teacher/ volunteer	20	-	20
			Presentation of submissions	20	-	20
				100	-	100
Internship M.Ed. II						
SEM	**Credit**	**Hrs.**	**Activity**	**Marks**		
				Internal	External	Total
IV	2	60				
			Lessons in Teacher Education Institution	20	00	20
			Observation of Lessons	10	00	10
			Planning of curricular/ co-curricular activity/ Time Table/unit planning	10	00	10
			Interview of Head/ Institutional Analysis	20	00	20
			Reflective Diary	20	00	20
			Presentation of submissions	20	00	20
				100	00	100

Format of Question Paper

General Instructions:

1. **All questions are compulsory, options are internal.**
2. **Digits marked at the end of questions shows total marks of that questions.**
3. **Answer briefly and to the point.**

For 70 Marks: (Time 3 Hours)

Question 1 Answer following questions as directed: (From Unit 1)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 2 Answer following questions as directed: (From Unit 2)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 3 Answer following questions as directed: (From Unit 3)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 4 Answer following questions as directed: (From Unit 4)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 5: Answer any 7 out of 10 questions: (From All four Units)	14 Marks

For 35 Marks:(Time 2 Hours)

Question 1 Answer following questions as directed: (From Unit 1 & 2)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 2 Answer following questions as directed: (From Unit 3 & 4)	
(A): Answer any two out of three In 400 words	08 Marks
(B): Answer any two out of three In 250 words	06 Marks
Question 3: Answer any 7 out of 10 questions (From All four Units)	07 Marks

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Paper Title: Dissertation in Chemical Sciences-1

- Literature scanning
- Online sources.
- Chemical abstracts.
- Chemistry journals.
- Scientific journals
- Sci-Finder

Semester IV

Paper Title: Heterocyclic chemistry

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Paper Title: Dissertation in Chemical Sciences-2

- Literature scanning
- Online sources.
- Chemical abstracts.
- Chemistry journals.
- Scientific journals
- Sci-Finder

Semester V

Paper Title: Medicinal Chemistry

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Semester VI

Paper Title: Drugs

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Dr Rajesh Kumar Kushwaha	Atomic, Molecular and Optical Physics Division, Physical Research Laboratory,Ahmedabad
Prof Raghavan Rangarajan	Dean, School of Arts and Sciences,Ahmedabad university
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- Dr. Mehul P. Dave, Associate Professor, IITE, Gandhinagar

યુનિવર્સિટી ગીત

રાષ્ટ્રની ઉજળી આવતીકાલના અમે છીએ ઘડવૈયા,
અંધકારની સામે અડીખમ પ્રકાશના લડવૈયા,

તૂટે તિમિર તણાં હર બંધન . . .
આઇ.આઇ.ટી.ઇ. તુજને વંદન . . .(૨)

ઘડવૈયાનું ઘડતર કરતું ઉત્તમ વિદ્યાધામ ,
પરંપરાને પ્રયોગ કેરું થાય ઉચિત સન્માન,

તુજને કોટિ કોટિ અભિનંદન . . .
આઇ.આઇ.ટી.ઇ. તુજને વંદન . . . (૨)

સંસ્કૃતિનું રક્ષણ, આધુનિકતાનું આહ્વાહન,
સુરાષ્ટ્રના નિર્માણને સાર્થક કરતું ઉત્તમ શિક્ષણ,

પ્રગટે જ્ઞાન તણાં જ્યાં સ્પંદન . . .
આઇ.આઇ.ટી.ઇ. તુજને વંદન . . .(૨)