University of Rajasthan

Jaipur-302004

SYLLABUS

(UG0802 – Three/Four Year Bachelor of Science)

(Bio Group)

Subject: Botany

For Semester I & II
Examination 2024-25

(From the Academic Year 2024-25 onwards)

(Syllabus as per NEP-2020 and Choice Based Credit System)

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Vision:

To create potential and competent professionals in Botany through the courses with practical training and advanced technical skills; equipped with knowledge and aptitude for higher education and research.

Mission:

- Dissemination of global demand based knowledge through teaching with technical professionalism.
- Creation of individuals with social and environmental concern.
- Training the students to create economically and environmentally viable solutions in the field of plant science.

Programme Outcomes

PO1. Developing the potential for vertical career growth in plant sciences, academic and service sectors and related fields.

PO2. Development of in-depth analytical and critical thinking, so that students would be able to identify and solve the problems with the help of botany.

PO3. Proficient knowledge in the major domains of plant sciences including plant identification, plant diseases, microbiology, Plant biotechnology etc.

PO4. Students can successfully learn tools and techniques related to plant research.

PO5. After completion of course students would be able to execute their professional roles in society as botanist, plant taxonomist, plant pathologist, etc.

PO6. Students will be able to learn skills to work as a team with the people from multidisciplinary environment.

PO7. To design and develop sustainable solutions to major biological problems by applying appropriate tools.

PO8. Develop skills, attitude and values required for self-directed, lifelong learning and

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professional development.

PO9. Acquire knowledge and understanding of norms and ethics in the field of botany.

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	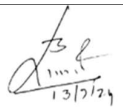	

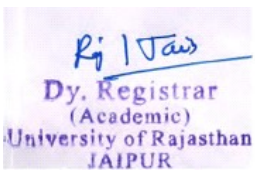

Name of University	**University of Rajasthan, Jaipur**
Name of Faculty	**Science**
Name of Discipline	**Botany**
Type of Discipline	**Major/Minor**
List of Programme where offered as Minor Discipline	**UG0806, UG0812**
Offered to Non-Collegiate Students	**Yes**

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0802–Three/Four Year Bachelor of Science (Bio Group)								
				Botany	**Credits**			
#	**Level**	**Semester**	**Type**	**Title**	**L**	**T**	**P**	**Total**
1.	5	I	MJR	**UG0802 - BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I**	4	0	0	4
2.	5	I	MJR	**UG0802 - BOT-51P-102 – Practical-I**	0	0	2	2
3.	5	II	MJR	**UG0802 - BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II**	4	0	0	4
4.	5	II	MJR	**UG0802 - BOT-52P-104 – Practical-II**	0	0	2	2
5.	6	III	MJR	**UG0802- BOT-63T-201 – Microbiology and Plant Pathology**	4	0	0	4
6.	6	III	MJR	**UG0802- BOT-63P-202 – Practical –III**	0	0	2	2
7.	6	IV	MJR	**UG0802 - BOT-64T-203 Plant Taxonomy and Economic Botany**	4	0	0	4
8.	6	IV	MJR	**UG0802 BOT-64P-204 Practical-IV**	0	0	2	2
9.	7	V	MJR	**UG0802 BOT-75T-301 Plant Biochemistry and Physiology**	4	0	0	4
10.	7	V	MJR	**UG0802 BOT-75P-302 Practical-V**	0	0	2	2
11.	7	VI	MJR	**UG0802 BOT-76T-303 Angiosperm Anatomy and Embryology**	4	0	0	4
12.	7	VI	MJR	**UG0802 BOT-76P-304 Practical VI**	0	0	2	2
13.	8	VII	MJR	**UG0802**	4	0	0	4

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UG0802–Three/Four Year Bachelor of Science (Bio Group)								
				Botany	Credits			
#	Level	Semester	Type	Title	L	T	P	Total
14.	8	VII	MJR	**UG0802**	0	0	2	2
15.	8	VIII	MJR	**UG0802**	4	0	0	4
16.	8	VIII	MJR	**UG0802**	0	0	2	2

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Examination Scheme

1. 1 credit = 25 marks for examination/evaluation
2. For Regular Students there will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of end-semester examination) EoSE (80% weightage).
3. For Regular Students,75% Attendance is mandatory for appearing in the EoSE.
4. To appear in the EoSE examination of a course/subject a regular student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C grade in the CA and EoSE examination of a Course/Subject.
6. In the case of Non-Collegiate Students there will be no Continuous assessment and credit points in a course/subject will be assigned only if, the non-collegiate student obtains at least a C grade in the EoSE examination of a Course/Subject.

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Examination Scheme for Continuous Assessment (CA)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1	Mid-term Exam	*50%*		15	10	10	5	5	5	5	5
2	Assignment	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
3	Attendance	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned.
2. For continuous assessment no remuneration will be paid for paper setting, Evaluation, Invigilation etc.
3. For continuous assessment Paper setting and Evaluation responsibility will be of teacher concern.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.
5. Colleges are advised to keep records of continuous assessment, attendance etc.

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	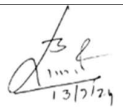	

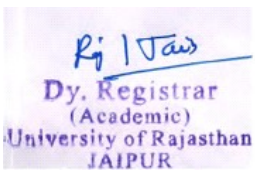

Examination Scheme for EoSE for Semester I

CA – Continuous Assessment EoSE – End of Semester Examination

Regular Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-51P-102 – Practical-I	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of **two** parts **A&B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Non-Collegiate Students –

Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks(EoSE)	Minimum Marks(EoSE)
Theory	BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I	03 Hrs	100 Marks	40 Marks
Practical	BOT-51P-102 – Practical-I	04 Hrs	50 Marks	20 Marks

The theory question paper will consist of **two** parts **A&B**.

PART-A: 20 Marks

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Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 80 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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	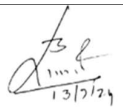	

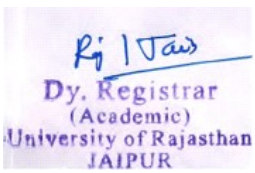

Syllabus

UG0802 – Three/Four Year Bachelor of Science (Bio Group)
I-Semester - Botany
BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
I	BOT-51T-101	Cell Biology and Diversity of Plant Kingdom-I				5	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline	UG0806, UG0812						
Prerequisites	Biology Courses of Senior Secondary level						
Objectives of the Course:	➢ To understand the structural organization and functions of organelles in the cell. ➢ To differentiate between prokaryotic and eukaryotic cells and plant and animal cells. ➢ To gain understanding on Nucleic acids and chromosome organization. ➢ To understand cell cycle and analyze different stages of mitosis and meiosis. ➢ To understand microscopic to macroscopic view of the Algae and Fungi. ➢ To be able to differentiate algal and fungal members. ➢ To understand difference between Hepaticopsida, Anthocerotopsida and Bryopsida. ➢ To be able to identify and know about Lichens.						

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Course Outcomes:

At the completion of the course, the student would be able to:

Cognitive level	Course outcomes
1. Understanding	• To know the structural and functions properties of prokaryotic and eukaryotic cells. • To learn, understand and develop skill and hands on training in basics of cell biology. • To make students know of all the kind of plant groups and understand relationships between them. • To aware students about diversity of lower plant presents on various habitats. • To understand microscopic to macroscopic view of the plants. • To interpret amphibious to symbiotic relationship of the plants.
2. Memorizing	• Composition of cell. • Human chromosomes and organization of chromosomes. • Names of all plant groups and relationships between them. • Diagrammatic representation of the algae, bryophytes and lichens. • Typical type of Life cycles found in algae, Fungi and bryophytes.
3. Applying	• Variations in functions of cell organelles. • Concept of cell cycle, abnormalities, cell membrane, cell-cell interactions. • Economic importance of algae, fungi and lichens. • Microscopic identification of algae, bryophytes, fungi and lichens.

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Detailed Syllabus

BOT-51T-101 -Cell Biology and Diversity of Plant Kingdom-I

Unit – I

Cell and Cytoskeleton	Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells; Chemistry, structure and function of Plant cell wall. Overview of plasma membrane: fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus. Cytoskeleton**:** Role and structure of microtubules, microfilaments and intermediary filaments.	**(8 lectures)**
Cell Organelles	Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semi-autonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum – Types and Structure. Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus.	**(7Lectures)**

Unit –II

Nucleic acids	DNA as genetic material (Griffith's transformation experiment and Hershey and Chase blender experiment); Structure and function of DNA (Watson and Crick Model); Structure and function of different types of RNA (rRNA, mRNA, tRNA, snRNA).	**6 lectures**
Chromosomes	Chromosome number, structure and function, types of chromosomes (metacentric, sub-metacentric, acrocentric, telocentric); Chromosome organization according to Nucleosome model; Special types of chromosomes: Lamp brush and Polytene chromosomes.	**5 lectures**
Cell Division	Phases of eukaryotic cell cycle; Different stages of mitosis; Different stages of Meiosis I and Meiosis II, synaptonemal complex, chiasmata formation and crossing over.	**4 lectures**

Unit –III

Plant Kingdom	Introduction to Plant kingdom- Basic idea of hierarchy in all groups of plants	**2 lectures**
Algae	General characteristics; Diverse Habitats; Range of thallus organization; methods of reproduction (Vegetative, Asexual, Sexual); Economic importance. Criteria and classification system of Fritsch (1935) (distinguishing features upto classes). Morphology and life history of: Cyanophyceae: *Nostoc*; Chlorophyceae: *Volvox*; Xanthophyceae: *Vaucheria*; Phaeophyceae: *Ectocarpus*; Rhodophyceae: *Polysiphonia*.	**10 lectures**

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Lichen General characteristics; Habitat; Structure; Reproduction; Ecological and Economic importance. **3 lectures**

Unit-IV

Fungi General characteristics; Thallus organization; Different hyphal forms; Heterokaryosis and Para sexuality; Nutrition and Reproduction in fungi; Economic importance.Classification (A*lexopoulos & Mims, 1996*); Morphology and life history of: Zygomycota: *Rhizopus*, Ascomycota: *Peziza*, Basidiomycota: *Agaricus*. **7 Lectures**

Bryophytes General characteristics; affinities with algae and pteridophytes; Distribution; Range of thallus structure; Reproduction (Vegetative and Sexual); Alternation of generations and evolution of sporophytes.Classification (Proskauer, 1957); Structures of gametophyte & sporophyte and life history (Development details not included) of: Hepaticopsida: *Marchantia*, Anthocerotopsida: *Anthoceros* and Bryopsida: *Funaria*. **8 lectures**

Suggested Books and References –

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6thEd.). New York: Garland Science
2. Cooper, G. M., and Hausman, R. E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York
4. Veer Bala Rastogi. **Genetics.** Medtech
5. Veer Bala Rastogi. **A Textbook of Cell Biology and Genetics.** Kedarnath Ramnath
6. Alexopoulos, C.J. and Mims, C.W.: **Introductory Mycology**, John Wiley and Sons, New York, 2000
7. Singh, Pande and Jain**. A Textbook of Botany,** Rastogi publications
8. Dube, H.C.: Fungi, Rastogi Publication, Meerut, 1989.
9. Vashishtha, **B.R. Botany for Degree Students -Fungi**, S. Chand & Co., New Delhi, 2001.
10. Gilbart, M. Smith: **Cryptogamic Botany**, Vol. I & II (2nd Ed.) Tata McGraw Hill. Publishing Co., Ltd., New Delhi, 1985.
11. Puri. P.: **Bryophytes**, Atmaram& Sons. Delhi, Lucknow, 1985.
12. Aneja, K.R.: **Experiments in Microbiology, Plant Pathology and Biotechnology**. New Age International (P) Ltd., Publishers, New Delhi 2003.
13. Pandey B. P.(2022) **Algae, Bryophytes and Lichens**. S Chand Publication

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	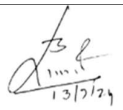	

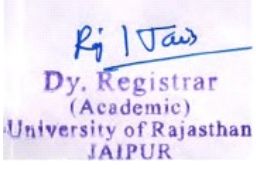

Suggested E-resources:

1. **https://youtu.be/K2teJ6-DBLw**
2. https://archive.nptel.ac.in/courses/102/108/102108086/
3. https://archive.org/details/cellmolecularapp6edcoop

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	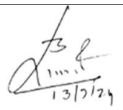	

B.Sc. Semester- I (Bio Group)
BOT-51P-102 Botany Practical-I
Syllabus

Cell and Cell Organelles

- Study of electron microphotographs of prokaryotic and eukaryotic cell.
- Study of electron microphotographs of virus, bacteria and eukaryotic cells for comparative study of cellular organization.
- Study of cell structure in Onion, *Hydrilla* and *Spirogyra*.
- Study of plastid for pigment distribution in *Lycopersicon*, *Cassia* and *Capsicum*.

Cell Division and Chromosomes

Study of permanent slides/photographs of different stages of mitosis and meiosis, sex chromosomes, polytene chromosome and salivary gland chromosomes.

- Study of different stages of mitosis and meiosis in root-tip cells and flower buds respectively of onion.
- Calculate the mitotic index of onion root tip cells.
- Study of induced aberrations in onion root tips employing chemicals and plant extracts.

Algae and Lichen

- **Algae-** Study of morphology and anatomy of *Nostoc*, *Volvox, Chara, Vaucheria, Ectocarpus* and *Polysiphonia* (vegetative and reproductive structures) by preparing temporary slides and studying permanent slides.
- **Lichens:** Study of growth forms of lichens (crustose, foliose and fruticose)

Fungi and Bryophyta

- **Fungi-** Microscopic observation of vegetative and reproductive structures of *Rhizopus*, *Peziza* and *Agaricus* through preparation of temporary slides and permanent slides.
- **Bryophytes**- Study of morphology, anatomy, vegetative and reproductive organs of *Marchantia*, *Anthoceros* and *Funaria* by preparing temporary slides and studying permanent slides.
- Study of renowned Indian scientists in the fields of phycology (M.O.P Iyengar), mycology (K. C. Mehta), bryology (S.R.Kashyap) and lichens (D.D.Awasthi).

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- Make a list of national and international institutes of repute in the fields of cytology, phycology, mycology, bryology and lichens.

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	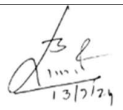	

UNIVERSITY OF RAJASTHAN
B.Sc. Semester- I (Bio Group) Botany Practical-I
Scheme of Practical Examination and Distribution of marks

BOT-51P-102 **Duration- 4 hrs**

Max. Marks: 10*+40 **Min. Marks: 4*+16**

S.No.	**Exercise**	**Regular**	**NC/Ex students**
1.	Exercise based on cell structure and types.	**4**	**6**
2.	Make a suitable acetocarmine preparation of the given material. Draw a well-labelled diagram of any one stage of nuclear division.	**4**	**6**
3.	Make a suitable stained preparation of the given material **A**. Draw a labelled diagram and identify giving reasons.**(Algae)**	**4**	**6**
4.	Make a suitable stained preparation of the given material **B**. Draw a labelled diagram and identify giving reasons. **(Fungi)**	**4**	**6**
5.	Make a suitable stained preparation of the given material **C**(vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons. **(Bryophyte)**	**4**	**6**
6.	Comment upon the spots- identify giving reasons. (1 to 5)	**10**	**15**
7.	Viva-voce	**5**	**5**
8.	Record	**5**	**-**
	Total	**10*+40=50**	**50**
***Internal marks for regular students only**			
Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.			

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Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Learn, understand and develop skill and hands on training in basics of cell biology.
2. Acquire basic knowledge of hereditary material and chromosomes.
3. Know all the kind of plant groups and understand relationships between them.
4. Understand diversity of lower plant presents on various habitats.
5. Identify microscopic to macroscopic view of the plants.
6. Apply the economic importance of lower plants in their endeavours.
7. Promote shared learning through practical classes, presentations and assignments.

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	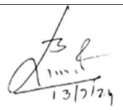	

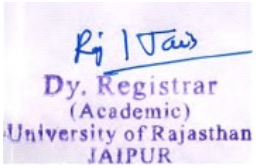

Examination Scheme for EoSE for Semester II

CA – Continuous Assessment EoSE – End of Semester Examination

Regular Students –

Type of Examination	CourseCode and Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II	CA	01 Hr	CA	20 Marks	CA	08 Marks
		EoSE	03 Hrs	EoSE	80 Marks	EoSE	32 Marks
Practical	BOT-52P-104 – Practical-II	CA	1 Hr	CA	10 Marks	CA	04 Marks
		EoSE	04 Hrs	EoSE	40 Marks	EoSE	16 Marks

The theory question paper will consist of **two** parts **A&B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Non-Collegiate Students –

Type	Course Code and Nomenclature	Duration of Examination	Maximum Marks (EoSE)	Minimum Marks (EoSE)
Theory	BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II	03 Hrs	100 Marks	40 Marks
Practical	BOT-52P-104– Practical-II	04 Hrs	50 Marks	20 Marks

The question paper will consist of **two** parts **A&B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

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PART-B: 80 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

Syllabus

UG0802 – Three/Four Year Bachelor of Science (Bio Group)

II-Semester - Botany

BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
II	BOT-52T- 103	Molecular Biology, Genetics and Diversity of Plant Kingdom-II				5	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	Major/Minor	4	2	6	Yes	60 lectures with diagrammatic and informative assessments during lecture hours	
List of Programme Codes in which Offered as Minor Discipline		UG0806, UG0812					
Prerequisites		Biology Courses of Senior Secondary level					
Objectives of the Course:		➢ To understand the Mendel's laws and its deviations. ➢ To impart knowledge on DNA replication, Mendel's laws of inheritance, mutations. ➢ To understand functions of genes, linkage and crossing over. ➢ To understand morphology and anatomy of the Pteridophytes and Gymnosperms. ➢ To understand reproduction in the Pteridophytes and Gymnosperms. ➢ To have a basic idea of Fossil plants.					

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Course Outcomes:

At the completion of the course, the student would be able to:

Cognitive level	Course outcomes
Understanding	• To learn, understand and develop skill and hands on training in basics of genetics. • To understand functions of genes, linkage and crossing over. • To interpret genetics of a large group of population. • To understand characteristic feature and life cycle pattern of pteridophytes and gymnosperms. • To understand adaptation of pteridophytes to land habit.
Memorizing	• Differentiation between linkage, crossing over, allelic interactions. • Mendel's laws of genetics. • Classification of pteridophytes and gymnosperms. • Evolutionary concepts in pteridophytes and gymnosperms. • Habit, habitat, morphology and anatomy of various members.
Applying	• Allelic and non-allelic interactions • Possibilities of mutations and mutagens and ploidy in plants. • Ecology and economic importance of pteridophytes and gymnosperms.

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Detailed Syllabus

BOT-52T- 103 - Molecular Biology, Genetics and Diversity of Plant Kingdom-II

Unit – I

DNA replication	Enzymes and mechanisms of prokaryotic DNA replication: Initiation, Elongation and Termination; Leading and lagging strands, Okazaki fragments.	**7 lectures**
Expression of Gene in Prokaryotes	Transcription, Initiation, elongation and termination. **Genetic code:** Meaning, types of codons, properties. **Translation**: Initiation, Elongation and Termination in Prokaryotes	**8 lectures**

Unit –II

Genetic inheritance	Mendel's laws of inheritance and their exceptions; allelic (incomplete dominance, co-dominance, lethality) and non-allelic interactions (complementary genes, epistasis and duplicate genes); Multiple allelism (ABO blood groups in men); Quantitative inheritance (Grain color in wheat). **Cytoplasmic inheritance:** Plastid inheritance (different types of leaves in *Mirabilis jalapa*); Mitochondrial inheritance (Cytoplasmic male sterility in plants).	**8 lectures**
Structural and numerical aberrations	Deletion, Duplication, Translocation, Inversion, Aneuploidy and Polyploidy. **Mutations**: Types of Mutations, Spontaneous and induced Mutations, Physical and Chemical mutagens.	**7 lectures**

Unit –III

Pteridophytes	General characteristics; Affinities with bryophytes & gymnosperm; Heterospory and seed habit; Evolution of stele in Pteridophytes; Economic importance. Classification (Riemers, 1954); Study of life history of fossil Pteridophyte – *Rhynia*. Life history of Psiloptopsida: *Psilotum;* Lycopsida: *Selaginella*; Sphenopsida: *Equisetum*; Pteropsida: *Marsilea*.	**15 lectures**

Unit-IV

Gymnosperms	General characteristics; Affinities with Pteridophytes and Angiosperms, Distribution; Economic importance. Classification (Sporne, 1965); Life history of Cycadopsia: *Cycas*; Coniferopsida: *Pinus*; Gnetopsida:	**12 lectures**

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Ephedra.

Paleobotany Introduction, Basic concept and significance, Geological time scale; Types of Fossils.

3 lectures

Suggested Books and References –

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). **Molecular Biology of the Cell** (6thEd.). New York: Garland Science
2. Cooper, G. M., and Hausman, R. E. (2013). **The Cell: A Molecular Approach** (6th Ed.). Washington: ASM; Sunderland.
3. Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, New York
4. Lodish, HF. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). **Molecular Cell Biology** (8th Ed.). New York: W.H. Freeman
5. Gupta P.K. **Cell and Molecular Biology** 2018. 5th edition Rastogi Publication India.
6. Veer Bala Rastogi. **Genetics.** Medtech
7. Veer Bala Rastogi. **A Textbook of Cell Biology and Genetics.** Kedarnath Ramnath
8. Singh, Pande and Jain**. A Textbook of Botany,** Rastogi publications
9. B.R. Vashishta and P.C. Vashishta. **Botany for Degree Students: Pteridophyta - Vascular Cryptogams),** S.Chand (G/L) & Company Ltd
10. B.R. Vashishta and P.C. Vashishta. **Gymnsperms (Botany for Degree Students),** S.Chand (G/L) & Company Ltd

Suggested E-resources:

1. **https://youtu.be/K2teJ6-DBLw**
2. https://archive.org/details/cellmolecularapp6edcoop
3. https://assets.cambridge.org/97805217/07725/excerpt/9780521707725_excerpt.pdf
4. https://books.google.co.in/books?id=Xz1RCgAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

B.Sc. Semester- I (Bio Group)
BOT-52P-104-Botany Practical-II
Syllabus

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Practicals related to DNA

- Isolation of Genomic DNA from Onion/Banana/Pineapple/etc.
- Demonstration of Gel-electrophoresis

Practicals related to Genetics

- To solve genetic problems based upon Mendel's laws of inheritance: Monohybrid cross, Dihybrid cross, Back cross and test cross.
- Induction of polyploidy using colchicines
- Emasculation, Bagging and Tagging

Pteridophytes-

- **S**tudy ofvegetative and reproductive stages of *Selaginella*, *Equisetum* and *Marsilea* by preparing temporary slides and studying permanent slides.
- Study of fossil plant: *Rhynia*

Gymnosperms

- Study of Vegetative and reproductive stages of *Cycas*, *Pinus* and *Ephedra* by preparing temporary slides and studying permanent slides.

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UNIVERSITY OF RAJASTHAN
B.Sc. Semester- I (Bio Group) Botany Practical-II
Scheme of Practical Examination and Distribution of marks

BOT-52P-104 **Duration- 4 hrs**

Max. Marks: 10*+40 **Min. Marks: 4*+16**

S.No.	Exercise	Regular	NC/Ex students
1.	Exercise-based on Nucleic acids	**5**	**7**
2.	Exercise-based on Genetics	**5**	**7**
3.	Make a suitable stained preparation of the given material **A**(vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons. (**Pteridophyte)**	**5**	**8**
4.	Make a suitable stained preparation of the given material **B** (vegetative/Reproductive part). Draw a labelled diagram and identify giving reasons. (**Gymnosperm**)	**5**	**8**
5.	Comment upon the spots- identify giving reasons. (1 to 5)	**10**	**15**
6.	Viva-voce	**5**	**5**
7.	Record	**5**	**-**
	Total	**10*+40= 50**	**50**
	***Internal marks for regular students only**		
	Regular Candidates must keep a record of all work done in the practical classes and submit the same for inspection at the time of practical examination.		

Course Learning Outcomes:

At the completion of the course, the student would be able to:

1. Learn, understand and develop skill and hands on training in basics of genetics.
2. Acquire basic knowledge of Mendel's laws of genetics.
3. Develop possibilities of mutations and mutagens and ploidy in plants.
4. Understandcharacteristic feature and life cycle pattern of pteridophytes and gymnosperms.

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SYLLABUS

(Three/Four Year Undergraduate Programme)

B. Sc. I and II Semester

B.Sc. III and IV Semester

B.Sc. V and VI Semester

Subject: Zoology

Session: 2024-2025

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Name of University	University of Rajasthan, Jaipur
Name of Faculty	Science
Name of Discipline	ZOOLOGY
Type of Discipline	Major
List of Programme were offered as Minor Discipline	B.Sc. Chemistry: UG0804 B.Sc. Botany: UG0805
Offered to Non-Collegiate Students	Yes

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0802 – Three/Four Year B. Sc. (Bio Group)								
				ZOOLOGY	**Credits**			
S.No.	**Level**	**Semester**	**Type**	**Title**	**L**	**T**	**P**	**Total**
1.	5	I	MJR	**UG0802 -ZOO-51T-101-** Diversity & Biology of Non-Chordates	4	0	0	4
2.	5	I	MJR	**UG0802 -ZOO-51P-102-** Practicals based on Diversity & Biology of Non-Chordates	0	0	2	2
3.	5	II	MJR	**UG0802 -ZOO-52T-103-** Diversity of Chordates and Developmental Biology of Vertebrates	4	0	0	4
4.	5	II	MJR	**UG0802 -ZOO-52P-104-** Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates	0	0	2	2

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5.	6	III	MJR	**UG0802 -ZOO-63T-201-** Economic Zoology & Ethology	4	0	0	4
6.	6	III	MJR	**UG0802 -ZOO-63P-202-** Practicals based on Economic Zoology & Ethology	0	0	2	2
7.	6	IV	MJR	**UG0802 -ZOO-64T-203-** Cell Biology & Genetics, Biotechnology	4	0	0	4
8.	6	IV	MJR	**UG0802 -ZOO-64P-204-** Cell Practicals based on Biology & Genetics, Biotechnology	0	0	2	2
9.	7	V	MJR	**UG0802 -ZOO-75T-301-** Animal Physiology & Biochemistry	4	0	0	4
10.	7	V	MJR	**UG0802 -ZOO-75P-302-** Practicals based on Animal Physiology & Biochemistry	0	0	2	2
11.	7	VI	MJR	**UG0802 -ZOO-76T-303-** Microbiology, Immunology & Biostatistics	4	0	0	4
12.	7	VI	MJR	**UG0802 -ZOO-76P-304-** Practicals based on Microbiology, Immunology & Biostatistics	0	0	2	2

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Examination Scheme:

CA: Continuous Assessment

EoSE: End of Semester Examination

1. 1 credit = 25 marks for examination/evaluation
2. For Regular Students there will be Continuous Assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous Assessment (20% weightage) and (End of semester examination) EoSE (80% weightage).
3. For Regular Students,75% Attendance is mandatory for appearing in the EoSE.
4. To appear in the EoSE examination of a Course/Subject a regular student must appear in the mid-semester examination and obtain at least a C grade in the Course/Subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C grade in the CA and EoSE examination of a Course/Subject.
6. In the case of Non-Collegiate students there will be no Continuous assessment and credit points in a Course/Subject will be assigned only if, the Non-Collegiate student obtains at least a C grade in the EoSE examination of a Course/Subject.

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Examination Scheme for Continuous Assessment (CA):

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS											
S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1	Mid-term Exam	50%		15	10	10	5	5	5	5	5
2	Assignment	25%		7.5	5	5	2.5	2.5	2.5	2.5	2.5
3	Attendance	25%		7.5	5	5	2.5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

VAC: Value Added Course; AEC: Ability Enhancement Course; SEC: Skill Enhancement Course

Note:

1. Continuous Assessment will be the sole responsibility of the teacher concerned.
2. For Continuous Assessment no remuneration will be paid for paper setting, Evaluation, Invigilation etc.
3. For Continuous Assessment Paper setting and Evaluation responsibility will be of teacher concern.
4. For Continuous Assessment no Answer sheets/question papers etc. will be provided by the University.
5. Colleges are advised to keep records of CA, attendance etc.

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Examination Scheme for EoSE:

Regular Students:

Type of Examination	Course Code and Nomenclature	Duration of Examination (Hrs)		Maximum Marks		Minimum Marks	
Theory	**UG0802 - ZOO-51T-101-** Diversity & Biology of Non-Chordates	CA	1	CA	20	CA	8
		EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-51P-102-** Practicals based on Diversity & Biology of Non-Chordates	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16
Theory	**UG0802 - ZOO-52T-103-** Diversity of Chordates & Developmental Biology of Vertebrates	CA	1	CA	20	CA	8
		EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-52P-104**- Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16
Theory	**UG0802 - ZOO-63T-201**- Economic Zoology & Ethology	CA	1	CA	20	CA	8
		EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-63P-202-** Practicals based on Economic Zoology & Ethology	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16
Theory	**UG0802 -**	CA	1	CA	20	CA	8

	ZOO-64T-203- Cell Biology & Genetics, Biotechnology	EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-64P-204-** Practicals based on Cell Biology &Genetics, Biotechnology	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16
Theory	**UG0802 - ZOO-75T-301**- Animal Physiology & Biochemistry	CA	1	CA	20	CA	8
		EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-75P-302-** Practicals based on Animal Physiology & Biochemistry	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16
Theory	**UG0802 - ZOO-76T-303-** Microbiology, Immunology & Biostatistics	CA	1	CA	20	CA	8
		EoSE	3	EoSE	80	EoSE	32
Practical	**UG0802 - ZOO-76P-304-** Practicals based on Microbiology, Immunology & Biostatistics	CA	2	CA	10	CA	4
		EoSE	4	EoSE	40	EoSE	16

The Theory question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

For **Practical Examination**, the scheme is provided with the detailed syllabus of concerned course.

Non-Collegiate Students:

Type	Course Code and Nomenclature	Duration of Examination (Hrs)	Maximum Marks (EoSE)	Minimum Marks (EoSE)
Theory	**UG0802 -ZOO-51T-101-** Diversity & Biology of Non-Chordates	3	100	40
Practical	**UG0802 -ZOO-51P-102-** Practicals based on Diversity & Biology of Non-Chordates	4	50	20
Theory	**UG0802 -ZOO-52T-103-** Diversity of Chordates & Developmental Biology of Vertebrates	3	100	40
Practical	**UG0802 -ZOO-52P-104**- Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates	4	50	20
Theory	**UG0802 -ZOO-63T-201**- Economic Zoology & Ethology	3	100	40
Practical	**UG0802 -ZOO-63P-202-** Practicals based on Economic Zoology & Ethology	4	50	20
Theory	**UG0802 -ZOO-64T-203-** Cell Biology, Genetics & Biotechnology	3	100	40
Practical	**UG0802 -ZOO-64P-204-** Practicals based on Cell Biology, Genetics & Biotechnology	4	50	20
Theory	**UG0802 -ZOO-75T-301**- Animal Physiology & Biochemistry	3	100	40

Practical	**UG0802 -ZOO-75P-302-** Practicals based on Animal Physiology & Biochemistry	4	50	20
Theory	**UG0802 -ZOO-76T-303-** Microbiology, Immunology & Biostatistics	3	100	40
Practical	**UG0802 -ZOO-76P-304-** Practicals based on Microbiology, Immunology & Biostatistics	4	50	20

The Theory question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 80 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

For **Practical Examination**, the scheme is provided with the detailed syllabus of concerned course.

Detailed Syllabus

UG0802 - ZOO- 51T-101- Diversity & Biology of Non-Chordates

UG0802 -ZOO-51P-102- Practicals based on Diversity & Biology of Non-Chordates

I Semester -Zoology

Semester	**Code of the Course**	**Title of the Course/Paper**				**NHEQF Level**	**Credits**
I	**ZOO-51T-101** **ZOO-51P-102**	**Diversity & Biology of Non-Chordates** **Practicals based on Diversity & Biology of Non-Chordates**				**5**	**6**
Level of Course	**Type of the Course**	**Credit Distribution**			**Offered to NC Student**	**Course Delivery Method**	
		Theory	**Practical**	**Total**			
5	**Major**	**4**	**2**	**6**	**Yes**	Lectures: 60 lectures including diagnostic and informative assessments during lecture hours and 30 Hours of Practical training/demonstration.	
List of Programme Codes in which Offered as Minor Discipline		**B.Sc. Chemistry: UG0804** **B.Sc. Botany: UG0805**					
Prerequisites		**XII Pass**					
Objectives of the Course:		• The main purpose of introducing this course is to teach the students the Morpho-taxonomy, and evolutionary relationships among and between non-chordates and chordates along with creating awareness and concern towards the importance of animal diversity for human survival and its socioeconomic significance. • In addition to this, the course is aimed at					

	nurturing skills of conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.

Detailed Syllabus

ZOO- 51T-101: Diversity & Biology of Non -Chordates

UNIT-I

Principles of taxonomy: International code of nomenclature; Concept of five kingdom system; basis of classification: symmetry, coelom, segmentation, embryogeny and levels of organization, Invertebrate versus vertebrate (comparison) **3 Hrs**

Protozoa: General characteristics and classification up to classes; Habit, Habitat, Morphology, locomotion, nutrition, reproduction and economic importance of protozoa: *Paramecium* **6 Hrs**

Porifera: General characteristics and Classification up to classes; Canal system in Porifera; Habit, Habitat, Morphology, reproduction, regeneration and economic importance of sponges and life cycle: *Sycon* **6Hrs**

UNIT-II

Coelenterata (Cnidaria): General characteristics and Classification up to classes; Polymorphism; Coral, Coral reefs and their economic importance, Habit, Habitat, Morphology, reproduction and life cycle: *Obelia.* **7 Hrs**

Platyhelminthes and Nemathelminthes: General characteristics and Classification up to classes; parasitic adaptations, phylogenetic significance of flatworms; Habit, Habitat, morphology, organ systems: digestive, circulatory, excretory, nervous, reproductive and life cycle: *Taenia* and *Ascaris* **8 Hrs**

UNIT-III

Annelida: General characteristics and Classification up to classes; Habit, Habitat, Morphology, organ systems: locomotion, digestive, circulatory, excretory, nervous, reproduction and life cycle: *Neanthes (Nereis).* **6Hrs**

Arthropoda: General characteristics and Classification up to classes; Larval forms in crustacea, Metamorphosis and Social organization in insects; Habit, Habitat, Morphology, organ systems: digestive, circulatory, excretory, nervous, reproductive and life cycle: Prawn **7 Hrs**

Onycophora: Annelidian, Molluscan and Arthropodian characters of *Peripatus* **2 Hrs**

UNIT-IV

Mollusca: General characteristics and Classification up to classes; Torsion and detorsion in Gastropoda; Pearl formation. Habit, Habitat, Morphology, organ systems: locomotion, digestive, circulatory, excretory, reproductive and life cycle: *Pila.* **7 Hrs**

Echinodermata: General characteristics and Classification up to classes; Water-vascular system in Asteroidea; Habit, Habitat, Morphology, organ system: digestive, circulatory, excretory, reproductive and life cycle: *Asterias.* **4 Hrs**

Hemichordata: Affinities with Chordata and Echinodermata, Systemic position and Phylogeny of *Balanoglossus* **4 Hrs**

Suggested Books and References:

1. Invertebrate Zoology. VII Edition, Barnes, R.D. (2006) Cengage Learning, India.
2. The Invertebrates: A New Synthesis. III Edition, Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002) Blackwell Science
3. Invertebrate Zoology. Jordan E.L., Verma P. S. (2022): S. Chand and Company Limited.
4. Invertebrate Structure and Functions. II Edition Barrington, E.J.W. (2012), EWP Publishers
5. Invertebrate Zoology: A Functional Evolutionary Approach. VII Edition, Ruppert, E.E., Fox, R.S., Barnes, R. D. (2003) Cengage Learning, India
6. Biology of the Invertebrates. VII Edition, Pechenik, J. A. (2015) Mraw-Hill Education

7. जैवविविधता Mali, P. C., Singh, M., Kumari, V. and Digarwal, G. L. (2023) (Animal Diversity-B.Sc I Semester). Neelkanth Publishers (P) Ltd.

Suggested E-roesources:

1. Kachhwaha, N and Kaushik, P (2019): Freely online available gaming websiteinnovativezoology.com to study vertebrate and invertebrate classification.

Course Learning Outcome:

Upon completion of the course, students will have knowledge of:

- Morpho-taxonomy and structural organization of non-chordata and chordata groups.
- Diversity of non-chordata and chordata groups.
- Evolutionary relationships and phylogeny of non-chordates and chordates through functional and structural similarities.
- Economic importance of non-chordates and chordates and their significance in the ecosystem.

Practical Syllabus

UG0802 -ZOO-51P-102- Practicals based on Diversity & Biology of Non-Chordates

1. Organization and working of Optical Microscope: Dissecting and compound microscopes.
2. General methods of microscopic slide preparations: Narcotization; fixing and preservation; washing; staining; destaining; dehydration; clearing and mounting.
3. General idea of composition, preparation and use of:

   i. Fixatives: Formalin, Bouin's fluid.

ii. Stains: Aceto-carmine, Aceto-orcein, Haematoxylin, Eosin.

iii. Common reagents: Normal saline, Acid water, Acid alcohol and Mayer's albumin.

4. Study of Microscopic Slides and Museum Specimens:

i. Protozoa: *Euglena, Amoeba, Plasmodium, Paramecium* (W.M.), binary fission, conjugation*)*

ii. Porifera: *Leucosolenia, Euplectella, Spongilla, sycon*

iii. Coelenterata: Millipora, *Physalia, Aurelia, Velella,* Sea anemone, *Gorgonia*, Stone corals.

iv. Platyhelminthes: *Taenia* (WM*),* Cysticercus larva, *Fasciola* (WM), Miracidium, Sporocyst, Redia, Cercaria and Metacercaria Larvae of *Fasciola.*

v. Aschelminthes: *Ascaris*

vi. Annelida: Neanthes*(Nereis), Aphrodite, Pontobdella, Arenicola, Glossiphonia, Hirudinaria.*

vii. Onychophora: *Peripatus*

viii. Arthropoda: *Limulus,* Scorpion, Centipede, Millipede, *Lepas,* Crab**,** *Mantis, Pediculus,* Termite, *Cyclops, Daphnia,* crustacean larvae (Nauplius, Zoea, Mysis, Megalopa),

ix. Mollusca: *Chiton, Aplysia, Dentalium, Cypraea, Mytilus, Loligo, Octopus, Nautilus.* Glochidium larva

x. Echinodermata: *Asterias, Antendon.*

5. Anatomy:

i. Pila: External features and nervous system.

ii. Prawn: External features, appendages, alimentary canal, and nervous system.

6. Study of the following through Permanent Slide Preparation: *Euglena*, *Paramecium*, Sponge spicules, Gemmule, *Obelia* colony, Statocyst and hastate plate of prawn, osphradium and gill lamella of *Pila*

7. Education tour and report preparation on the study of local invertebrate fauna

Scheme of Practical Examination and Distribution of Marks

S.No.	Practical Exercise	Regular Students	Ex. /N.C. Students
1.	Major exercise	**6**	**12**
2.	Minor exercise	**4**	**6**
3.	Permanent slide preparation	**4**	**6**
3.	Identification and comments on Spots (1 to 8)	**16**	**16**
4.	Viva Voce	**5**	**10**
5.	Class Record	**5**	
		10*+40=50	**50**

Note:

***Internal marks for regular students only.**

1. Anatomy: Study of systems of the prescribed types with the help of dissection. Detailed charts/Dissection softwares/virtual tools/models can also be utilized to study anatomy.

2. With reference to microscopic slides, in case of non-availability, the exercise should be substituted with diagrams / photographs.

3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.

4. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.

5. It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.

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Syllabus

UG0802 -ZOO-52T-103- Diversity of Chordates & Developmental Biology of Vertebrates

UG0802 -ZOO-52P-104- Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates

II-Semester -Zoology

Semester	**Code of the Course**	**Title of the Course/Paper**				**NHEQF Level**	**Credits**
II	**ZOO-52T-103** **ZOO-52P-104**	**Diversity of Chordates & Developmental Biology of Vertebrates** **Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates**				**5**	**6**
Level of Course	**Type of the Course**	**Credit Distribution**			**Offered to NC Student**	**Course Delivery Method**	
		Theory	**Practical**	**Total**			
5	**Major**	**4**	**2**	**6**	**Yes**	Lectures: 60 lectures including diagnostic and informative assessments during lecture hours and 30 Hours of Practical training/demonstration.	
List of Program Codes in which Offered as Minor Discipline		**B.Sc. Chemistry: UG0804** **B.Sc. Botany: UG0805**					
Prerequisites		**B.Sc. I Semester (Bio Group)**					
Objectives of the Course:		• The course offers a complete understanding about diversity and classification of Chordate animals. • It educates the students regarding general and specific characteristics of chordates. Thorough understanding of their affinities and evolutionary aspects of chordates will be developed in students. • The course will also provide a glimpse of scope and historical background of developmental biology to the students. • It will impart knowledge regarding basic					

	concepts of differentiation, morphogenesis and pattern formation and insight into stem cells and cloning. • Understanding of essential events of developmental biology will be imparted through proper explanation of gametogenesis, stages of embryonic development and foetus formation.

Detailed Syllabus

ZOO-52T-103: Diversity of Chordates & Developmental Biology of Vertebrates

Unit-I

General characteristics and classification of Chordata up to classes; Urochordata: General characteristics and classification up to sub-classes, Study of *Herdmania* and its affinities **4 Hrs**

Cephalochordata: General characteristics and classification up to sub-classes, Study of *Branchiostoma* (Amphioxus) and its affinities **4 Hrs**

Cyclostomata (Agnatha): General characteristics and classification up sub-class; Study of *Petromyzon* and its affinities **3 Hrs**

Pisces: General characteristics and classification up to sub-classes; Types of fins and scales, swim bladder, Weberian ossicles, Parental care and migration in fishes. **4 Hrs**

Unit-II

Amphibia: General characteristics and classification up to sub-classes; origin and evolution of Amphibia; Neoteny; Parental care in Amphibians. **4 Hrs**

Reptilia: General characteristics and classification up to sub-classes; Identification of poisonous and non-poisonous snakes. **3 Hrs**

Aves: General characteristics and classification up to sub-classes; Flight adaptations and Migration in birds. **4 Hrs**

Mammals: General characteristics and classification up to sub-classes; Dentition in Mammals; Adaptive radiation in mammals. **4 Hrs**

Unit-III

Scope and History of Developmental Biology; Early Embryonic Development: Gametogenesis: Spermatogenesis and Oogenesis; **4 Hrs**

Fertilization; Cleavage: planes and patterns of cleavage; blastulation and morulation; parthenogenesis **3 Hrs**

Gastrulation: Types of morphogenetic movements; Embryonic induction**;** Fate of germ layers, Fate maps **4 Hrs**

Early embryonic development of frog (up to neurulation) and chick (up to 96 hrs). **4 Hrs**

Unit-IV

Metamorphosis and its hormonal regulation in frogs; Regeneration of limb in frog **5 Hrs**

Types and functions of extra embryonic membranes in chick development **2 Hrs**

Types, formation and functions of placenta in mammals, Implantation, Pregnancy and Parturition **5 Hrs**

Teratology and Developmental disorders. **3 Hrs**

Suggested Books and References:

1. Biology. Campbell & Reece (2005)., Pearson Education, (Singapore) Pvt. Ltd.
2. Chordate Zoology. Jordan E.L., Verma P. S. (2022) S. Chand and Company Limited.
3. Biology, 6th edition. Raven, P. H. and Johnson, G. B. (2004) Tata McGraw Hill Publications. New Delhi.
4. Analysis of Vertebrate Structure. Hilderbrand, M and Gaslow G.E.. John Wiley and Sons

5. Principles of Developmental Biology (4th edition). Wolpert, L & Tickle, C (2011). Oxford University Press, ISBN: 9780198792918

6. Patten's Foundations of Embryology. Carlson, Bruce M (1996). McGraw Hill, Inc. ISBN: 9780070634275

7. The Life of Vertebrates. III Edition. Young, J. Z. (2004) Oxford university press.

8. Comparative Anatomy and Development Biology of Vertebrates (2024) Dr Jyotsna Jain, Dr Dev D. Patel, Dr Pallavi Kaushik and Dr Dau Lal Bohra.Text book for B.Sc. II Semester, Neelkanth Publishers (P) Ltd, Jaipur, India 2024 ISBN: 978-93-5736-733-2.

9. Developmental Biology. X Edition. Gilbert, SF (2014) Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA. ISBN : 9780878939787

10. An Introduction to Embryology. Balinsky, B.I. (2008). International Thomson Computer Press.

Suggested E-resources:

1. Meena G, 2020. Developmental Biology, Glossary, Ideal International Publication Pvt. Ltd. https://drive.google.com/file/d/1ebK1B6QHc6fJG6CXaGicmXTZlY6VkOxi/view?usp=drivesdk

Course Learning Outcome:

Upon completion of this course, students will be able to:

- Know about the levels of organization among different groups of vertebrates.
- Understand how chordates evolved during the course of evolution through succession.
- Know the evolution of different concepts in developmental biology.
- Understand the process of gamete formation from stem cell population to mature ova and sperm.
- Comprehend the sequence of steps leading to the formation of gametes and development of embryo.
- Know the mechanisms underpinning cellular diversity and specificity in animals.

- Have the knowledge about the methods and tools related to developmental biology which help to understand different processes of embryogenesis.

Practical Syllabus

UG0802 -ZOO-52P-104- Practicals based on Diversity of Chordates & Developmental Biology of Vertebrates

1. Anatomy: Study of swim bladder and Cranial nerves in any edible fish
2. Study of microscopic slides and museum specimens:

i. **Protochordates:** *Herdmania*, *Ciona*, *Botryllus*, *Amphioxus*, *Doliolum*, *Oikopleura*, *Pyrosoma*, Tadepole larva of Ascidia
ii. **Agnatha:** *Petromyzon*, *Myxine,* Ammocoete larva.
iii. **Pisces:** *Zygaena* (*Sphyrna*), *Torpedo*, *Pristis*, *Chimaera*; *Acipenser*, *Amia* or *Lepidosteus*, *Labeo*, *Clarias*, *Anguilla*, *Hippocampus*, *Exocoetus*, *Echenies*, any flat-fish, *Syngnathus*, *Protopterus*, *Lepidosiren*, *Neoceratodus*, *Notopterus*.
iv. **Amphibia:** *Icthyophis*, *Necturus*, *Proteus*, *Ambystoma*, *Salamander*, Axolotl, *Siren*, *Alytes*, *Hyla*, *Pipa*, *Rachophorus*, *Rana*
v. **Reptilia:** *Testudo*, *Chelone* and fresh water tortoise, *Sphenodon*, *Hemidactylus*, *Phrynosoma*, *Draco*, *Calotes*, *Chameleon*; *Eryx*, *Hydrophis*, *Krait*, *Naja*, *Viper*, *Bungarus*, *Crocodilus*, Alligator**.**
vi. **Aves:** *Pavo cristatus* (peacock), *Choriotis* (Great Indian Bustard), *Columba*
vii. **Mammalia:** *Ornithorhynchus*, *Echidna*, *Tachyglossus*, *Didelphys*, Kangaroo, Bat, *Loris*, *Manis*, Mongoose, Otter

3. Study of the following through Permanent Slide preparations: oral hood of amphioxus, scales of fishes, hair of mammals
4. Frog - Study of developmental stages - through permanent slides (whole mounts and sections) — cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
5. Study of Chick Embryo: 18 hrs, 21 hrs, 24 hrs, 33 hrs, 48 hrs, 72 hrs and 96 hrs of incubation.
6. Window making in chick eggs to study the various incubation stages of developing chick embryo
7. Study of extra-embryonic membranes in chick development.
8. Educational tour: Visit to Zoo/National Park/Sanctuary and submission of report.

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Scheme of Practical Examination and Distribution of Marks

S.No.	Practical Exercise	Regular Students	Ex. /N.C. Students
1.	Major exercise	**6**	**12**
2.	Permanent slide preparation	**4**	**6**
3.	Developmental Biology	**4**	**6**
3.	Identification and comments on Spots (1 to 8) **Note**: Spot 1 to 4 from Chordata and 5 to 8 from Developmental Biology.	**16**	**16**
4.	Viva Voce	**5**	**10**
5.	Class Record	**5**	
		10*+40=50	**50**

Note:

***Internal marks for regular students only.**

1. Anatomy: Study of systems of the prescribed types with the help of dissection. Detailed charts/Dissection softwares/virtual tools/models can also be utilized to study anatomy.
2. With reference to microscopic slides, in case of non-availability, the exercise should be substituted with diagrams / photographs.
3. Candidates must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. Mounting material for permanent preparations would be as per the syllabus or as available through collection and culture methods.
5. It should be ensured that animals used in the practical exercises are not covered under the wild life act 1972 and amendments made subsequently.

UNIVERSITY OF RAJASTHAN

JAIPUR-302004

THREE/ FOUR-YEAR UNDERGRADUATE PROGRAMME

Name of Faculty	**Science**
Name of Discipline	**Chemistry**
Type of Discipline	**Major**
List of Programme offered as Minor Discipline	**NA**
Offered to Non-Collegiate Students	**YES**

Programme: UG0802/03 – Three /Four Year Bachelor of Science

(Syllabus as per NEP-2020 and Choice Based Credit System)

(Academic Year 2024-25 onwards)

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SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0802/03 – Four Year Bachelor of Science								
#	Level	Semester	Type	Chemistry	Credits			
				Course Title	L	T	P	Total
1.	5	I	MJR	UG0802/03 – CHM-51T-101 – Structure-bonding, Mathematical concept and States of matter	4	0	0	4
2.	5	I	MJR	UG0802/03– CHM-51P-102 – Practical I	0	0	2	2
3.	5	II	MJR	UG0802/03 – CHM-52T-103 – Reaction mechanism, Stereochemistry, Aromatic hydrocarbon and Chemical kinetics.	4	0	0	4
4.	5	II	MJR	UG0802/03 – CHM-52P-104 – Practical II	0	0	2	2
5.	6	III	MJR	UG0802/03 – CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.	4	0	0	4
6.	6	III	MJR	UG0802/03 – CHM-63P-202 – Practical III	0	0	2	2
7.	6	IV	MJR	UG0802/03 – CHM-64T-203 – Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemistry of d & f block elements, Chemical and Ionic Equilibrium, Second and Third law of Thermodynamics.	4	0	0	4
8.	6	IV	MJR	UG0802/03 – CHM-64P-204 – Practical IV	0	0	2	2
9.	7	V	MJR	UG0802/03 – CHM-75T-301 –	4	0	0	4
10.	7	V	MJR	UG0802/03 – CHM-75P-302 – Practical V	0	0	2	2
11.	7	VI	MJR	UG0802/03 – CHM-76T-303 –	4	0	0	4
12.	7	VI	MJR	UG0802/03 – CHM-76P-304 – Practical VI	0	0	2	2
13.	8	VII	MJR	UG0802/03 – CHM-87T-401 –	4	0	0	4
14.	8	VII	MJR	UG0802/03 – CHM-87P-402 – Practical VII	0	0	2	2
15.	8	VIII	MJR	UG0802/03 – CHM-88T-403 –	4	0	0	4
16.	8	VIII	MJR	UG0802/03 – CHM-88P-404 – Practical VIII	0	0	2	2

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PROGRAMME OUTCOMES (POs)

1. **Conceptual knowledge of chemical science**: Students will get acquainted with the conceptual knowledge of chemical science which will help them to understand the subject and it will be beneficial in long run.
2. **Training to manage unusual and unexpected incidents/disasters**: The knowledge of chemical science will help them to deal with unusual incidents in the neighborhood. Sudden explosion by chemicals and excessive misuse of unwanted substances can be managed with basic knowledge of chemistry as well as environmental pollution may be controlled by the students by spreading awareness in the society about the harmful pollutants viz; plastic, pesticides, harmful smog, unused drugs etc.
3. **Laboratory Experimental Skills**: As we know the fact that trials are an essential part of an exploration in our life therefore the students will gain practical experience by conducting experiments, using laboratory instruments and apparatus.
4. **Employment opportunities**: Students will acquire employment in the various national and private R & D sectors such as:
   - The students with the strong chemistry background can get jobs in chemical and related industries viz. Agrochemicals, Metallurgical, Fertilizer, Biofertilizer, Textile, Food, Ceramics, Cement, Petrochemicals, Pesticides, Plastics, Polymers, etc.
   - The students can find opportunities in Pharmaceutical companies, Forensic Lab,etc.
   - Petroleum, Soil Testing Labs, Environment consulting firms and other sectors such as Analytical Chemist, Chemical Product Officer, Radiologist and Toxicologist.
5. **Integrated M.Sc.-Ph.D. courses at prestigious institutions:** After completing this bachelor's degree course**, s**tudents can get engaged in integrated M,Sc.-Ph.D. courses or can get Master's degree in various interdisciplinary fields at prestigious institutions like CSIR, IISc, IITs, NCL (national chemical laboratories), IISERs, NISER etc.

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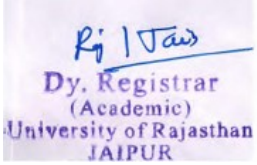
Examination Scheme:

1. **1 credit = 25 marks** for examination/evaluation.
2. For **Regular Students there will be Continuous assessment**, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of Semester Examination) EoSE (80% weightage).
3. For Regular Students, **75% Attendance is mandatory** for appearing in EoSE.
4. To appear in the EoSE examination of a course/subject student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C (40%) grade in the CA (Continuous Assessment) and EoSE examination of a Course/Subject.
6. In case of **the Non-Collegiate Students there will be no continuous assessment**(CA) and credit points in a Course/Subject will be assigned only if, the Non-Collegiate Student obtains at least a C grade(40%) in the EoSE examination of a Course/Subject.



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Examination scheme for Continuous assessment (CA)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory + Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1	Mid-term Exam	50%		15	10	10	5	5	5	5	5
2	Assignment	25%		7.5	5	5	5	2.5	2.5	2.5	2.5
3	Attendance	25%		7.5	5	5	5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75 – 80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80 – 85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned [**under the heading assignment, interactive sessions/ group discussion among students may be conducted by the concerned teacher / PPT for selective topics may be assigned by the teacher at college level.].**
2. For continuous assessment no remuneration will be paid for paper setting, evaluation, invigilation etc.
3. For continuous assessment paper setting and evaluation responsibility will be of teacher concerned.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.

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5. Colleges are advised to keep records of continuous assessment, attendance etc.

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Examination Scheme for EoSE-

CA – Continuous Assessment
EoSE – End of Semester Examination

For Regular Students –

Type of Examination	Course Code / Nomenclature	Duration of Examination		Maximum Marks		Minimum Marks	
Theory	UG0802/03 - CHM-63T-201 - Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halides, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.	CA	1 Hr.	CA	20	CA	8
		EoSE	3 Hrs.	EoSE	80	EoSE	32
Practical	UG0802/03 – CHM-63P-202 – Practical I	CA	1 Hr.	CA	10	CA	4
		EoSE	4 Hrs.	EoSE	40	EoSE	16

The question paper (EoSE – End of Semester Examination) will consist of two parts A & B

PART – A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART – B: 60 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

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Non-Collegiate Students –

Type of Examination	Course Code and Nomenclature	Duration of Examination	Maximum Marks	Minimum Marks
Theory	UG0802/03 – CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halides, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.	3 Hrs.	100	40
Practical	UG0802/03–CHM-63P-202 Practical III	4 Hrs.	50	20

The question paper (EoSE – End of Semester Examination) will consist of two parts A & B

PART – A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART – A: 80 Marks

Part B of the question paper shall be divided into four units comprising question number 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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Syllabus

CHM-63T-201 – **Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.**

CHM-63P-202 **PRACTICAL-III**

III – Semester – Chemistry

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
III	CHM-63T-201	UG0802/03 – CHM-63T-201 – Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.				6	4
III	CHM-63P-202	PRACTICAL-III				6	2
Level of Course	Type of the Course	Credit Distribution			Offered to NC Students	Course Delivery Method	
		Theory	Practical	Total			
6	Major	4	2	6	Yes	Through Lecture, Sixty (60) Lectures	Class room Teaching/Power-Point (PPT)
List of Programme Codes in which offered as Minor Discipline		-NA-					

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Prerequisites/Eligibility	**The students must have earned a minimum of 52 credits (26×2 cerdits)** **OR** **For promotion from the current year to next year it is mandatory to pass all the prescribed co-course of the previous year with the C grade (40%).**
Course Objectives:	The main objective of this course is to provide a theoretical knowledge about s-and p- block element's chemistry with their periodic trends, properties and applications along with noble gases. The uses of non-aqueous aprotic solvents in chemical research and essentials of nuclear chemistry are also included to enrich the knowledge in these fields. Moreover, our aim is to provide clear understanding of the organic reactions of saturated and unsaturated hydrocarbons. Characteristic reactions of alkyl halides and the concepts related to the field of basic and applied thermodynamics, solutions with their colligative properties are also incorporated to enrich the conceptual knowledge in these fields.

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Syllabus

CHM-63T-201: Chemistry of s, p-block elements and Noble Gases, Non-aqueous Solvent, Nuclear Chemistry, Hydrocarbons and Alkyl halide, Fundamentals of Thermodynamics, Solutions and their Colligative Properties.

Unit-I

s-Block Elements: Comparative study of properties of alkaline and alkaline earth metals, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

Periodicity of p-block elements: Periodicity in properties of p-block elements with special reference to atomic and ionic radii, ionization energy, electron-affinity, electronegativity, diagonal relationship, catenation.

Some Important Compounds of p-block Elements: Hydrides of boron, diborane and higher boranes, borazine, borohydrides, fullerenes, carbides, fluorocarbons, silicates (structural principle), tetrasulphur tetranitride, basic properties of halogens, interhalogens and polyhalides.

Chemistry of Noble Gases: Chemical properties of the noble gases, chemistry of Xenon, structure and bonding in Xenon compounds.

15 Lecture

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Unit-II

Oxidation and Reduction:
Uses of Redox Potential data, analysis of redox cycle, redox stability in water. Frost, Latimer and Pourbaix diagrams. Principles involved in the extraction of the elements.

Non-aqueous Solvents:
Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2

Nuclear Chemistry: Fundamental particles of nucleus (nucleons), concept of nuclides and its representation, Isotopes, Isobars and Isotones (with specific examples), forces operating between nucleons (n-n, p-p & n-p), Qualitative idea of stability of nucleus (n/p ratio).
Radioactive elements chemistry: Natural and artificial radioactivity, Radioactive disintegration series, Radioactive displacement law, Radioactivity decay rates, Half-life and average life, Nuclear binding energy, mass defect and calculation of defect and binding energy, Nuclear reactions, Spallation, Nuclear fission and fusion. Brief discussion on Atom bomb, Nuclear reactor and Hydrogen bomb.

15 Lecture

Unit-III

Alkanes and Cycloalkanes: Free radical halogenations of Alkanes: mechanism, orientation, reactivity and selectivity. Cycloalkanes - nomenclature, methods of formation, chemical reactions. Baeyer's strain theory and its limitations. Theory of strainless rings.
Alkenes, Cycloalkenes, Dienes and Alkynes: Relative stabilities of alkenes. Chemical reactions of alkenes - hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis and oxidation with $KMnO_4$. Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes.
Classification and Nomenclature of isolated, conjugated and cumulated dienes. Structure of allenes and butadiene. Methods of formation, properties and chemical reactions - 1,2- and 1,4-additions, Diels-Alder reaction and polymerization reactions.
Structure and bonding in alkynes. Methods of formation. Chemical reactions - acidity of alkynes: mechanism of electrophilic and nucleophilic addition reactions; hydroboration-oxidation; metal-ammonia reduction, oxidation and polymerization.

Alkyl Halides: Methods of formation of alkyl halides, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides S_N2 and S_N1 reactions with energy profile diagrams.

15 Lecture

Unit- IV

Thermodynamics - I
Definition of Thermodynamic Terms: System, surroundings, etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process, concept of heat and work.
First Law of Thermodynamics: Statement, definition of internal energy and enthalpy, heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law, Joule-Thomson coefficient and inversion temperature. Calculation of w, q, dU & dH for the expansion of Ideal gases under isothermal

and adiabatic conditions for reversible process.

Thermochemistry:

Standard state, standard enthalpy of formation, Hess's law of heat summation and its applications. Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

Solutions, Dilute Solutions and Colligative Properties:

Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient.

Dilute solution, colligative properties, Raoult's law, relative lowering of vapor pressure, molecular weight determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.

15 Lecture

Suggested Books and References:

1. Concise Inorganic Chemistry by J.D. Lee, Wiley, India.
2. Inorganic Chemistry by Housecroft, E. Catherine & Sharpe, G Alan, Pearson Education Ltd.
3. Advanced Inorganic Chemistry by G. D. Tuli, S. Chand, New Delhi.
4. Advanced Inorganic Chemistry by Satya Prakash, S. Chand, New Delhi.
5. Nuclear and Radiochemistry: Fundamental and Applications, 2 Vols., Jens-Volker Kratz and Karl Heinrich Lieser; 3rd Edn., John Wiley & Sons: UK, 2013.
6. Essentials of Nuclear Chemistry by H. J. Arnikar, Wiley, New York.
7. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
8. Organic Chemistry by R. T. Morrison & R. N. Boyed, Prentice Hall
9. Organic Chemistry by I. L. Finar, (Vpl. I & II) ELBS
10. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
11. Physical Chemistry by R. J. Silbey, R. A. Alberty & M. G. Bawendi, John Wiley & Sons.
12. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
13. An Introduction to Chemical Thermodynamics by R. P. Rastogi & R. R. Mishra, Vikas Publishing House.
14. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand, New Age International Publishers.
15. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
16. Elements of Physical Chemistry, P. Atkins and J. De Paula, Oxford.
17. A Textbook of Physical Chemistry, Application of Thermodynamics, by K. L. Kapoor, (Volume- 3) McGraw Hill.
18. An Introduction to Chemical Thermodynamics by R. P. Rastogi & R. R. Mishra, Vikas Publishing House.
19. Solutions, Phase Equilibrium, Conductance & Electrochemistry by Puri, Sharma, Pathania and Kaur, Vishal Publishing Co.

Suggested E-resources:

All the above suggested books are available as **e- books.**

Online Lecture Notes and Course Materials: Online Lecture Notes and Course Materials:

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Signature of Dean	Signature of BoS Convenor	Signature of DR (Academic II)

Syllabus

CHM-63P-202: Chemistry Lab III (4 Hrs./week)

Inorganic Chemistry **10 marks**

Gravimetric estimations: (Any three)

(a) Estimate zinc as zinc ammonium phosphate.
(b) Estimate lead as lead chromate.
(c) Estimate copper as cuprous thiocyanate.
(d) Estimate nickel as nickel dimethyl glyoximate.

Organic Chemistry **10 marks**

Qualitative Analysis

(a) Identification of organic compounds (solids or liquids) through element detection (N, S and

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halogens) melting /boiling points, functional group analyses with the preparation of suitable derivative. **(Any two)**

(b) One step organic synthesis containing: -

i. Acetylation

(a) Acetanilide from Aniline

(b). Aspirin from salicylic acid

ii. Reduction

(a)*m* -nitro aniline from *m* -dinitrobenzene.

(b) Anthrone by anthraquinone

iii. Electrophilic substitution Reactions

Nitration of nitrobenzene

Physical Chemistry **10 marks**

Distribution law

(a) To determine partition coefficient of iodine between water and $CCl_4/CHCl_3/CS_2$ at room temperature.

(b) To study the distribution of benzoic acid between benzene and water.

Chemical kinetics

(a) Determine the velocity constant and order of reaction for the hydrolysis of ethyl acetate by sodium hydroxide at room temperature (saponification of an ester).

Thermochemistry

(a) To determine heat of neutralization of given acid and base.

(b) To determine the dissociation energy of given weak acid.

Solution

(a) To determine the molecular mass of given non-volatile substance cryscopically.

Viva-voce **5 marks**

Practical Record **5 marks**

Suggested Books and References:

1. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
2. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
3. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
4. Vogel's Qualitative Inorganic Analysis, A. I. Vogel Prentice Hall.
5. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
6. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
7. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N
8. Advanced Practical Organic Chemistry J. B Yadav, Goel Publishing House.
9. Practical Physical Chemistry, by B. D Khosla, S. Chand & Company.

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Suggested E-resources:

All the above suggested books are available as **e- books.**

Online Lecture Notes and Course Materials:

All prescribed syllabus is available digitally in the form of e-books, Adobe Acrobat documents (PDF),web page ,etc.

Course Learning Outcomes:

With the completion of this course, students will be able to understand concepts related to periodic trends of s and p-block elements their properties, applications along with noble gases. Student will gain knowledge about the uses of non-aqueous aprotic solvents in chemical research and the essentials of nuclear chemistry with their uses range from agricultural to medical and space exploration to water desalination. Moreover, the organic reactions of saturated and unsaturated hydrocarbons and their uses are incorporated to gain clear understanding in this field. Concepts related to the field of basic and applied thermodynamics and solutions with their colligative properties are also incorporated to enrich the knowledge in these fields,

By the end of this degree programme, student would have achieved the essential conceptual knowledge in the field of chemical sciences and will be able to conduct experiments and demonstrate efficiency with appropriate lab skills, techniques and instrumentations.

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Syllabus

IV – Semester – Chemistry

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
IV	**CHM-64T-203**	**UG0802/03 – CHM-64T-203 – Chemistry of d & f block elements, Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemical and Ionic Equilibrium, Second**	**6**	**4**

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		and Third law of Thermodynamics.					
IV	**CHM-64P-204**	**PRACTICAL-IV**				**6**	**2**
Level of Course	**Type of the Course**	**Credit Distribution**			**Offered to NC Students**	**Course Delivery Method**	
		Theory	**Practical**	**Total**			
6	**Major**	**4**	**2**	**6**	**Yes**	**Through Lecture, Sixty (60) Lectures**	**Class room Teaching/Power-Point (PPT)**
List of Programme Codes in which offered as Minor Discipline		**-NA-**					
Prerequisites/Eligibility		Every student automatically promoted from the III to the IV semester.					
Course Objectives:		The objective of this course is to provide a theoretical knowledge about first, second and third series of transition elements, lanthanides and actinides chemistry with their periodic trends, properties and applications. The characteristic organic reactions associated with O/ N-elements containing functional groups with their interconversion are also included to enrich the knowledge in these fields. Moreover, chemical and ionic equilibrium and applied thermodynamics are incorporated to gain conceptual knowledge.					

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Syllabus

CHM-64T-203- **Chemistry of d & f block elements, Chemistry of Oxygen/Nitrogen-Containing Functional Groups and Chemical and Ionic Equilibrium,**

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Thermodynamics-II.

Unit-I

Chemistry of Elements of First Transition Series:
Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds and complexes illustrating relative stability of their oxidation-states, coordination number and geometry.
Chemistry of Elements of Second and Third Transition Series:
General characteristics, comparative treatment with their 3d-analogues in respect of ionic radii, oxidation states, magnetic behaviour, spectral properties and stereochemistry.
Chemistry of Lanthanide and Actinide Elements:
Electronic structure, oxidation states, ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.
General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

15 Lecture

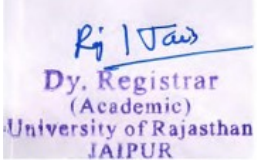
Unit-II

Alcohols - Classification and nomenclature.
Monohydric alcohols - Methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, Acidic nature. Reactions of alcohol with mechanism.
Dihydric alcohols - methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinacol-pinacolone rearrangement.
Trihydric alcohols - methods of formation, chemical reactions of glycerol.
Phenols
Nomenclature, structure and bonding. Preparation of Phenols. Physical properties and acidic character. Comparative acidic strength of alcohols and phenols. Reactions of phenols- electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gattermann synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.
Ethers and Epoxides
Methods of formation, physical properties. Chemical reactions - cleavage and autooxidation. Ziesel's method.
Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Aldehydes and Ketones
Structure of the carbonyl group. Syntheses of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, syntheses of ketones from nitriles and from carboxylic acids. Physical properties.
Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV (Meervein-Pondrof-Verley), Clemmensen, Wolff-Kishner, $LiAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones. Use of acetals and 1,3-dithiane as protecting group.

15 Lecture

Unit-III



Carboxylic Acids

Structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction. Reduction of carboxylic acids, mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acids - malic, tartaric and citric acids.

Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids).

Carboxylic Acid Derivatives

Structure, nomenclature and synthesis of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions, mechanisms of esterification and hydrolysis (acidic and basic).

Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid.

Amines: Structure, nomenclature and preparation of alkyl, and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Physical properties, stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural features effecting basicity of amines. Amine salts as phase-transfer catalysts. Gabriel-phthalimide reaction and Hoffmann bromamide reaction with mechanism.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Diazotisation and mechanism. Synthetic transformations of aryl diazonium salts, azo coupling and its applications.

15 Lecture

Unit- IV

Thermodynamics –II

Second Law of Thermodynamics: Need for the law, different statements of the law. Carnot cycle and its efficiency, Carnot-Theorem. Thermodynamic scale of temperature.

Concept of Entropy: Entropy as a state function, entropy as a function of V&T, entropy as a function of P&T, entropy change in physical change, Clausius inequality and entropy as a criteria of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases.

Third Law of Thermodynamics: Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions: Gibbs function (G) and Helmholtz function **(A)** as: thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation of G and A with P, V and T.

Chemical Equilibrium:

Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle. Reaction Isotherm and reaction isochore. Clapeyron equation and Clausius-Clapeyron equation, applications.

Ionic Equilibrium: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale,

common ion effect. Salt hydrolysis – calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product.

15 Lecture

Suggested Books and References:

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, & P.L Gaus, Willey.
2. Concise Inorganic Chemistry by J. D. Lee, Wiley-India.
3. Inorganic Chemistry by Catherine E. Housecroft, & Alan G Sharpe, Pearson Education Ltd.
4. Principles of Inorganic Chemistry by Puri, Sharma & Kalia, Vishal Publishing Co.
5. Concise Coordination Chemistry by R. Gopalan and V. Ramalingam, Vikas Publishing House Pvt, Ltd.
6. Concepts and Models of Inorganic Chemistry, B.E. Douglas, D. McDaniel, & J. Alexander, Wiley.
7. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure by J March, & M. B Smith Wiley.
8. Organic Chemistry by R. T. Morrison & R. N. Boyed, Prentice Hall
9. Reaction Mechanism in Organic Chemistry by S. M. Mukherji & S. P. Singh, TRINITY Press.
10. Organic Chemistry by I. L. Finar, (Vol. I & II) ELBS.
11. Physical Chemistry by R. J. Silbey, R. A. Alberty & M. G. Bawendi, John Wiley & Sons.
12. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma and M. S. Pathania, Vishal Publishing Co.
13. An Introduction to Chemical Thermodynamics by R. P. Rastogi & R. R. Mishra, Vikas Publishing House.
14. A Text Book of Physical Chemistry: A. S. Negi and S. C. Anand, New Age International Publishers.
15. Advanced Physical Chemistry by Gurdeep Raj, Goel Publishing House.
16. Elements of Physical Chemistry, P. Atkins and J. De Paula, Oxford.
17. A Textbook of Physical Chemistry, Application of Thermodynamics, by K. L. Kapoor, (Volume-3) McGraw Hill.
18. An Introduction to Electrochemistry by Samuel Glasstone, BSC Publishers.
19. Electrochemistry and its Applications by G. Whitmore, Sarup & Sons.
20. Physical Chemistry by G.M Barrow, Tata McGraw-Hill.
21. Fundamentals of Electrochemistry by Morris Sylvin, Sarup & Sons.
22. Solutions, Phase Equilibrium, Conductance & Electrochemistry by Puri, Sharma, Pathania and Kaur, Vishal Publishing Co.
23. Phase Equilibria, Phase Diagrams and Phase Transformations by Mats Hillert, Cambridge University Press
24. Textbook of Physical Chemistry, (Volume 5) by Kapoor, K. L Macmillan India Ltd.

Suggested E-resources:

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Syllabus

CHM-64P-204: Chemistry Lab IV 4 Hrs./week

Inorganic Chemistry **10 marks**

Inorganic Preparations

(a) Preparation of tetraamminecopper(II) sulphate
(b) Preparation of cis and trans-potassium diaquadioxalatochromate(III).
(c) Synthesis of sodium trioxalatoferrate(III).
(d) Preparation of bis(glyoxamato)nickel (II).

Organic Chemistry **10 marks**

Organic Syntheses

(a) Synthesis of iodoform from ethanol and acetone (Aliphatic Electrophilic Substitution).
(b) Synthesis of aspirin from salicylic acid (Acetylation).
(c) Synthesis of phthalimide from phthalic anhydride.
(d) Synthesis of succinic anhydride.

Physical Chemistry **10 marks**

Transition Temperature

(a) Determination of transition temperature of the given substance ($Na_2SO_4.10H_2O, MnCl_2.4H_2O$ or $SrBr_2.6H_2O$) by thermometric method**.**

Phase Equilibrium

(a) To construct the phase diagram of two component system like phenol-H_2O system and determine the CST (critical solution temperature) and composition of the solution at CST.
(b) To study the effect of solute $NaCl$ and succinic acid etc. on the CST (critical solution temperature) of two partially miscible liquids (phenol-H_2O system) and determine the concentration of that solute in the given partially miscible liquid system.

Ionic Equilibrium

Preparation of different types of buffer solutions and determination of pH using pH meter.

Viva voce **5 marks**

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Practical Record **5 marks**

Suggested Books and References:

1. A. I. Vogel, Vogel's Qualitative Inorganic Analysis, Prentice Hall.
2. Vogel's Quantitative Inorganic Analysis Including Elementary Instrumental Analysis, ELBS.
3. Vogel's Textbook of Quantitative Chemical Analysis, A. I. Vogel, Pearson Education Ltd.
4. Advanced Practical Organic Chemistry by N K Vishnoi, Vikas Publishing House PVT LTD
5. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, V. K Ahluwalia. Universities Press, Hyderabad.
6. Laboratory Techniques in Organic Chemistry by V. K Ahluwalia, I K International, N
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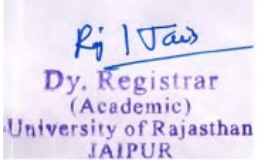
Course Learning Outcomes:

With the completion of this degree programme, student will achieve the essential conceptual knowledge in the field of chemical sciences and will be able to conduct experiments and demonstrate efficiency with appropriate lab skills, techniques and instrumentations.

Student will be able to understand the theoretical knowledge about first, second and third series of transition metals, lanthanides and actinides chemistry with their periodic trends, properties and applications in various fields. In addition to the above, student will acquire knowledge about the characteristic organic reactions associated with O/ N-elements containing functional groups and their interconversion with their uses in synthetic organic chemistry. Moreover, chemical and ionic equilibrium and applied thermodynamics are incorporated to enrich student's conceptual knowledge through the above prescribed course.



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SYLLABUS

I-VI Semester
Examination-2024-25 AND ONWARDS
UNDER NEP-2020

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SYLLABUS

SCHEME OF EXAMINATION AND COURSE OF STUDY

UNDER NEP 2020
for

(SEMESTER SCHEME: I-VI Semester)

UG0803- Three/Four Years Bachelor of Science

Medium of Instruction: Hindi and English

(SEMESTER SCHEME)

EXAMINATION 2024-2025 AND ONWARDS

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Name of University	**University of Rajasthan, Jaipur**
Name of Faculty	**Science**
Name of Discipline	**Mathematics**
Type of Discipline	**Major**
List of Programme were offered as Minor Discipline	
Offered to Non-Collegiate Students	**Yes**

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0803-Three/Four Year Bachelor of Science (Maths Group)								
				Mathematics	**Credits**			
#	**Level**	**Sem**	**Type**	**Title**	**L**	**T**	**P**	**Total**
1.	**5**	**I**	**MJR**	**UG0803-MAT-51T-101** **Discrete Mathematics & Optimization Techniques-I**	**6**	**0**	**0**	**6**
2.	**5**	**II**	**MJR**	**UG0803-MAT-52T-102** **Calculus**	**6**	**0**	**0**	**6**
3.	**6**	**III**	**MJR**	**UG0803-MAT-63T-201** **Real Analysis-I & Differential Equations-I**	**4**	**0**	**0**	**4**
4.	**6**	**III**	**MJR**	**UG0803-MAT-63P-202** **Introduction to Scilab: A Mathematical Tool**	**0**	**0**	**2**	**2**
5.	**6**	**IV**	**MJR**	**UG0803-MAT-64T-203** **Real Analysis-II & Numerical Analysis**	**4**	**0**	**0**	**4**
6.	**6**	**IV**	**MJR**	**UG0803-MAT-64P-204** **Introduction to C Programming: As Mathematical Tool**	**0**	**0**	**2**	**2**

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7.	**7**	**V**	**MJR**	**UG0803-MAT-75T-301** **Abstract Algebra & Three Dimensional Geometry**	**6**	**0**	**0**	**6**
8.	**7**	**VI**	**MJR**	**UG0803-MAT-76T-302** **Complex Analysis & Mechanics**	**6**	**0**	**0**	**6**

Examination Scheme

1. 1 credit = 25 marks for examination/evaluation

2. For Regular Students there will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of end-semester examination) EoSE (80% weightage).

3. For Regular Students,75% Attendance is mandatory for appearing in the EoSE.

4. To appear in the EoSE examination of a course/subject a regular student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.

5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C grade in the CA and EoSE examination of a Course/Subject.

6. In the case of Non-Collegiate Students there will be no Continuous assessment and credit points in a course/subject will be assigned only if, the non-collegiate student obtains at least a C grade in the EoSE examination of a Course/Subject.

Examination Scheme for Continuous Assessment (CA)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)	THEORY					PRACTICAL		
			CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
	Max Internal Marks		30	20	20	10	10	10	10	10
1	Mid-term Exam	*50%*	15	10	10	5	5	5	5	5
2	Assignment	*25%*	7.5	5	5	2.5	2.5	2.5	2.5	2.5
3	Attendance	*25%*	7.5	5	5	2.5	2.5	2.5	2.5	2.5

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		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned.
2. For continuous assessment no remuneration will be paid for paper setting, Evaluation, Invigilation etc.
3. For continuous assessment Paper setting and Evaluation responsibility will be of teacher concern.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.
5. Colleges are advised to keep records of continuous assessment, attendance etc.

Examination Scheme for EoSE-

CA – Continuous Assessment
EoSE – End of Semester Examination

Regular Students –

[Courses which have Practical Examination]

The question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having question no. 1 of 10 very short answer-type questions of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

[Courses which do not have Practical Examination]

The question paper consists of **three** parts A, B & C.

PART-A: 20 Marks

Part A will be compulsory having question no. 1 of 10 very short answer-type questions of two marks each.

PART-B: 20 Marks

Part B of the paper shall consist of 4 questions viz. Question no. 2-5 having one question from each unit and the student shall attempt any 2 questions that carry 10 marks each.

PART-C: 80 Marks

Part C of the question paper shall be divided into four units comprising question numbers 6-9. There will be one question from each unit with internal choice. Each question will carry 20 marks.

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[Examination Scheme for Practical Examination]

The question paper consists of three practicals, one practical each from Group A, Group B and Group C.

(i) One Practical from Group A : 10 Marks

(i) One Practical from Group B : 10 Marks

(i) One Practical from Group C : 10 Marks

(i) Viva-voce : 05 Marks

(i) Practical Record : 05 Marks

Total : 40 Marks

Non-Collegiate Students –

[courses which have Practical Examination]

The question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having question no. 1 of 10 very short answer-type questions of two marks each.

PART-B: 80 Marks

Part B of the question paper shall be comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 20 marks.

[courses which do not have Practical Examination]

The question paper consists of **three** parts A, B & C.

PART-A: 40 Marks

Part A will be compulsory having question no. 1 of 10 very short answer-type questions of two marks each.

PART-B: 30 Marks

Part B of the paper shall consist of 4 questions viz question no. 2-5 having one question from each unit. The student shall attempt any 2 questions that carry 15 marks each.

PART-C: 80 Marks

Part C of the question paper shall be comprising question numbers 6-9. There will be one question from each unit with internal choice. Each question will carry 20 marks.

[Examination Scheme for Practical Examination]

The question paper consists of three practicals, one practical each from Group A, Group B and Group C.

(i) One Practical from Group A : 12 Marks

(i) One Practical from Group B : 12 Marks

(i) One Practical from Group C : 12 Marks

(i) Viva-voce : 07 Marks

(i) Practical Record : 07 Marks

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Total : 50 Marks

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-51T-101] - [Discrete Mathematics & Optimization Techniques-I]
I-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-51T-101 Discrete Mathematics & Optimization Techniques-I	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-51T-101 Discrete Mathematics & Optimization Techniques-I	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
I	UG0803-MAT-51T-101	Discrete Mathematics & Optimization Techniques-I				5	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics courses of XIIStd.ofCentral Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to expose discrete structures and involved topology, an optimization of real world problems.					

Detailed Syllabus
[UG0803-MAT-51T-101] - [Discrete Mathematics & Optimization Techniques-I]

Unit - I

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Relations on a set, Equivalence class, partial order relations, Chains and Anti-chains. Lattices, Distributive and Complemented Lattices. Boolean algebra, conjunctive normal form, disjunctive normal form. Principle of inclusion and exclusion. Propositional calculus, Basic logical operations, Truth tables, Tautologies and contradictions. **(22 Lectures)**

Unit -II

Discrete numeric functions, Generating functions, Recurrence relations, linear recurrence relation with constant coefficients and their solutions: Total solutions, Solution by the method of generating functions.Basic concepts of graph theory, Types of graphs, Walks, Paths & Circuits, Shortest path problem.

(23 Lectures)

Unit -III

Planar graphs, Operations on graphs (union, join, products). Matrix representation of graphs, Adjacency matrices, Incidence matrices. Hamiltonian and Eulerian graphs.Tree, Spanning tree, Minimum spanning tree, Distance between vertices, Center of tree, Binary tree, Rooted tree.

(22 Lectures)

Unit-IV

Linear programming problems. Feasible solution, Basic feasible solution. Some basic properties and theorems on convex sets. Simplex algorithm, Transportation problems. Assignment problems.

(23 Lectures)

Suggested Books and References –

1. V.K.Balakrishnan, Introductory Discrete Mathematics, Prentice-Hall, 1996.
2. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India.
3. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
4. Kenneth H. Roson, Discrete Mathematics and Its Applications, Tata Mc-GrawHiils, New Delhi, 2003.
5. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
6. Hamdy A. Taha, Operations Research, An Introduction (9th edition), Prentice-Hall, 2010.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials**

Course Learning Outcomes:

The course would enable the student

1. To understand the ideas in discrete structures viz. Partially ordered sets, Lattices , Graphs etc. and allied conceptual intricacies with applications.
2. To understand mathematical formulation of optimization problems and allied theoretical concepts for solution methodologies for linear programming problems, Transportation problems and assignment problems.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-52T-102] - [Calculus]
II-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-52T-102 Calculus	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-52T-102 Calculus	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
II	UG0803-MAT-52T-102	Calculus				5	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to provide students with a comprehensive understanding of the fundamental concepts of calculus as a tool for dynamic systems, diverse topics which find applications in many branches of science.					

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Detailed Syllabus

[UG0803-MAT-52T-102] - [Calculus]

Unit - I

Taylor's theorem. Maclaurin's theorem. Power series expansion of a function. Power series expansion of sin(x), cos(x), e^x, $\log_e(1+x)$, $(1+x)^n$. Derivative of the length of an arc. Pedal equations. Curvature: Various formulae, Centre of curvature and Chord of curvature.

(22 Lectures)

Unit -II

Partial differentiation. Euler's theorem for homogeneous functions. Chain rule of partial differentiation. Total differentiation, Differentiation of implicit functions. Envelopes: One parameter family of curves when two parameters are connected by a relation. Maxima and Minima of functions of two variables. Lagrange's method of undetermined multipliers.

(23 Lectures)

Unit -III

Asymptotes: Definition, Parallel to coordinate axes, General rational algebraic curves, inspection method, Intersection of a curve and its asymptotes. Multiple points. Curve tracing of Cartesian, Polar and parametric curves. Beta and Gamma functions.

(22 Lectures)

Unit-IV

Double integrals in Cartesian and Polar Coordinates, Change of order of integration. Triple integrals. Dirichlet's integral. Rectification, Area, Volume and Surface of solids of revolution.

(23 Lectures)

Suggested Books and References –

1. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Co., N. D., 2013.
2. H.S.Dhami, Differential Calculus, Age Int. Ltd., New Delhi, 2012.
3. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2007.
4. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley and sons (Asia), Pt Ltd., Singapore, 2002.
5. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the concept of curvature, padel equations, partial differentiation, envelope, asymptotes.
2. Understand the concept of maxima-minima, curve tracing, double triple integration and their applications.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-63T-201] - [Real Analysis-I & Differential Equations-I]
III-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-63T-201 Real Analysis-I & Differential Equations-I	1 Hrs-CA 3 Hrs-EoSE	20 Marks-CA 80 Marks-EoSE	08 Marks-CA 32 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-63T-201 Real Analysis-I & Differential Equations-I	3 Hrs	100 Marks	40 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
III	UG0803-MAT-63T-201	Real Analysis-I & Differential Equations-I				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	4	0	4	Yes	Lecture, Sixty Lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The primary objective of this course is to introduce the real line with algebraic, order,completeness properties, and convergence/ divergence of sequences. The course also provides the types of ordinary differential equations and their solution strategies.					

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Detailed Syllabus

[UG0803-MAT-63T-201] - [Real Analysis-I & Differential Equations-I]

Unit - I

Bounded set, Neighbourhood, Limit point, Bolzano-Weierstrass theorem, closed and Open sets. Concept of compactness and connectedness. Heine-Borel theorem.

(15 Lectures)

Unit - II

Real sequences- Limit and Convergence of a sequence, Monotonic sequences. Cauchy's sequences, Subsequences, Cauchy's general principle of convergence. Continuous functions: Properties of continuous functions on closed intervals.

(15 Lectures)

Unit -III

Exact differential equations and equations which can be made exact. First order but higher degree differential equations solvable for x,y and p. Linear differential equations with constant coefficients, Complementary function and Particular integral.

(15 Lectures)

Unit-IV

Homogeneous linear differential equations, Linear differential equations of second order. Solution by transformation of the equation by changing the dependent variable/the independent variable, Method of variation of parameters, Method of undetermined coefficients.

(15 Lectures)

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Ross SL, Differential Equation-Jhon Wiley & Sons. Inc. New York. 1984.
7. Raisinghania MD, Ordinary and partial differential equations. S. Chand Publishing; 2013.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Apply Bolzano-Weierstrass and Heine-Borel theorems to real number sets.
2. Test sequence convergence using Cauchy's principle and analyse continuous functions on closed intervals.
3. Solve first-order and higher-degree differential equations and linear differential equations with constant coefficients.
4. Solve second-order linear differential equations using transformation techniques and assess linear

independence of solutions.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-63P-202] - [Introduction to Scilab: A Mathematical Tool]
III-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	UG0803-MAT-63P-202 Introduction to Scilab: A Mathematical Tool	2 Hrs-CA 3 Hrs-EoSE	10 Marks-CA 40 Marks-EoSE	04 Marks-CA 16 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Practical	UG0803-MAT-63P-202 Introduction to Scilab: A Mathematical Tool	3 Hrs	50 Marks	20 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
III	UG0803-MAT-63P-202	Introduction to Scilab: A Mathematical Tool				6	2
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	0	2	2	Yes	Practical, Sixty Hours of Practical	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to equip students with skills to create, analyze, and understand graphs. To teach the use of computational and programming functions within Scilab. To understand and apply methods for solving linear equations and other mathematical problems.					

Detailed Syllabus

[UG0803-MAT-63P-202] - [Introduction to Scilab: A Mathematical Tool]

Group-A

1. Plotting the graphs of the following functions : ax, $\sqrt{(ax+b)}$, $|ax+b|$, $c \pm |ax+b|$, $x^{\pm n}$, e^{ax+b}, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $|\sin(ax+b)|$, $|\cos(ax+b)|$. explaining the effects of

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change in the real constant a, b and c on graphs. Plotting graphs of hyperbolic functions and inverse trigonometric functions, plotting and analyzing the graphs of polynomials and their derivatives.

2. Complex numbers: Operations like addition, subtraction, multiplication, division, Modulus and inbuilt functions conj, imag, imult, isreal, real. **(20 Hours)**

Group-B

1. Matrix operations: addition, multiplication, inverse, transpose, determinant, rank and inbuilt functions eye, ones, zeros. Solving the system of linear equations by using Matrix Division (\ Operator), using 'linsolve' function, using 'inv' function, using 'mldivide' function.
2. Finding Roots of equations by using 'fsolve' function, using 'roots' function, using 'mnewton' function.

(20 Hours)

Group-C

1. Solving linear programming problems by using inbuilt functions of Scilab.
2. Solving Ordinary Differential Equations (ODEs) by using the 'ode' function.

(20 Hours)

Suggested Books and References –

1. Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists, APress; 1st ed. Edition.
2. Claude Gomez, Engineering and Scientific Computing with Scilab, Birkhauser Boston Inc; 1999th edition.
3. Tejas Sheth, Scilab: A Practical Introduction to Programming and Problem Solving, Createspace Independent Pub.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand graphical and numerical techniques and be able to apply them using Scilab.
2. Students should gain practical expertise in solving problems involving graphs, matrices, and equations.
3. Students should be prepared to utilise various mathematical techniques to solve different mathematical problems.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-64T-203] - [Real Analysis-II & Numerical Analysis]
IV-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-64T-203 Real Analysis-II & Numerical Analysis	1 Hrs-CA 3 Hrs-EoSE	20 Marks-CA 80 Marks-EoSE	08 Marks-CA 32 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-64T-203 Real Analysis-II & Numerical Analysis	3 Hrs	100 Marks	40 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
IV	UG0803-MAT-64T-203	Real Analysis-II & Numerical Analysis				6	4
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	4	0	4	Yes	Lecture, Sixty Lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		UG0803-MAT-63T-201 Real Analysis-I & Differential Equations-I					
Objectives of the Course:		The primary objective of this course is to enable students to understand fundamental concepts of differentiable functions, apply Darboux's, Rolle's theorems, Riemann integration, mean value theorems, and to learn numerical techniques viz. Interpolation, Numerical integration, roots of equation, solution of initial value problem.					

Detailed Syllabus
[UG0803-MAT-64T-203] - [Real Analysis-II & Numerical Analysis]

Unit - I

Properties of derivable functions, Darboux's and Rolle's theorem. Notion of limit, continuity and differentiability for functions of two variables. Directional derivative, total derivative, expression of total derivative in terms of partial derivatives.

(15 Lectures)

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Unit - II

Riemann integration – Lower and Upper Riemann integrals, Riemann integrability, Mean value theorems of integral calculus, Fundamental theorem of integral calculus. Functions of bounded variations.

(15 Lectures)

Unit -III

Differences. Relation between differences and derivatives. Differences of a polynomial. Newton's formulae for forward and backward interpolation. Divided differences. Newton's divided difference, Lagrange's interpolation formula. Numerical Differentiation. Derivatives from interpolation formulae.

(15 Lectures)

Unit-IV

Numerical integration, Derivations of general quadrature formulas, Trapezoidal rule. Simpson's one-third, Simpson's three-eighth and Gauss's quadrature formulae. Numerical solution of Algebraic and Transcendental equations: Bisection method, secant method, Regula-Falsi method, Iteration method, Newton- Raphson Method. Numerical solutions of ordinary differential equations of first order with initial conditions using Euler and modified Euler's method.

(15 Lectures)

Suggested Books and References –

1. Royden H, Fitzpatrick PM. Real analysis. China Machine Press; 2010.
2. Rudin W. Principles of mathematical analysis. New York: McGraw-hill; 1964.
3. Bartle RG, Sherbert DR. Introduction to real analysis. New York: Wiley; 2000.
4. Mapa SK. Introduction to Real Analysis. Sarat Book Distributors; 2014.
5. Malik SC, Arora S. Mathematical analysis. New Age International; 1992.
6. Burden RL, Faires JD. Numerical analysis, brooks;1997.
7. Iyengar SR, Jain RK. Numerical Methods. New Age International; 2009.
8. Sastry SS. Introductory methods of numerical analysis. PHI Learning Pvt. Ltd.; 2012.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Analyse multivariable functions using differentiability and partial derivatives.
2. Solve problems using Riemann integrability and integral calculus theorems.
3. Use interpolation formulas for data approximation and numerical differentiation.
4. Apply numerical methods to solve equations and differential equations.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-64P-204] - [Introduction to C Programming: As Mathematical Tool]
IV-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Practical	UG0803-MAT-64P-204 Introduction to C Programming: As Mathematical Tool	2 Hrs-CA 3 Hrs-EoSE	10 Marks-CA 40 Marks-EoSE	04 Marks-CA 16 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Practical	UG0803-MAT-64P-204 Introduction to C Programming: As Mathematical Tool	3 Hrs	50 Marks	20 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
IV	UG0803-MAT-64P-204	Introduction to C Programming: As Mathematical Tool				6	2
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	0	2	2	Yes	Practical, Sixty Hours of Practical	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					
Objectives of the Course:		The objective of the course is to enable students learn the basic knowledge of developing algorithms for various Mathematical problems and preparing codes for these algorithms in C language.					

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Detailed Syllabus

[UG0803-MAT-64P-204] - [Introduction to C Programming: As Mathematical Tool]

Programming languages and problem solving on computers, Algorithm, Flow chart, Programming in C-Constants, Variables, Arithmetic and logical expressions, Input-Output, Conditional statements, Implementing loops in Programs, Defining and manipulating arrays and functions.

Group-A

1. Printing n terms of Fibonacci sequence and finding factorial n, summation n, summation of square of n etc.
2. Defining a function and finding sum of n terms of a series/sequence whose general term is given.
3. Finding gcd and lcm of two numbers by Euclid's algorithm.
4. Checking prime/composite numbers and finding the number of primes less than n, where n is a positive integer.
5. Finding mean, standard deviation and Permutation, Combination.

(20 Hours)

Group-B

6. Numerical integration using Trapezoidal rule.
7. Numerical integration using Simpson's ⅓ rule.
8. Numerical integration using Simpson's 3/8 rule.
9. Numerical integration using Waddle rules.
10. Preparing forward and backward difference tables.

(20 Hours)

Group-C

11. Solution of algebraic and transcendental equations by Bisection method.
12. Solution of algebraic and transcendental equations by Regula-falsi method.
13. Solution of algebraic and transcendental equations by Newton-Raphson method.
14. Solution of Initial value problems by Euler's method.
15. Solution of Initial value problems by Runga-Kutta fourth order method.

(20 Hours)

Suggested Books and References –

1. B. W. Kernighan and D. M. Ritchi : The C-Programming Language, 2nd Edi.(ANSI Refresher), Prentice Hall, 1977.
2. E. Balagurnsamy : Programming in ANSI C, Tata McGraw Hill, 2004.
3. Y. Kanetkar : Let Us C ; BPB Publication, 1999.
4. C. Xavier : C-Language and Numerical Methods, New Age International, 2007.
5. V. Rajaraman : Computer Oriented Numerical Methods, Prentice Hall of India, 1980.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the logic for a given problem.
2. Write the algorithm of a given problem.
3. Draw a flow chart of a given problem.
4. Recognize and understand the syntax and construction of C programming code.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-75T-301] - [Abstract Algebra & Three Dimensional Geometry]
V-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-75T-301 Abstract Algebra & Three Dimensional Geometry	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-75T-301 Abstract Algebra & Three Dimensional Geometry	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
V	UG0803-MAT-75T-301	Abstract Algebra & Three Dimensional Geometry				7	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					

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Objectives of the Course:	The objective of the course on Group Theory, Ring Theory, and three dimensional geometry, as outlined in the syllabus, is to provide students with a thorough understanding of fundamental algebraic structures, their applications and basic three dimensional geometrical shapes.

Detailed Syllabus

[UG0803-MAT-75T-301] - [Abstract Algebra & Three Dimensional Geometry]

Unit - I

Binary operations, Algebraic structure, Groups, Order of group, finite and infinite order groups and their order specific theorems, Subgroups and their properties, Permutation group, Cyclic group. Cosets, Lagrange's theorem.

(22 Lectures)

Unit - II

Morphism of groups, Cayley's theorem. Normal subgroups and Quotient groups. Fundamental theorems of Homomorphism.

(23 Lectures)

Unit -III

Definition and simple properties of Rings and Subrings. Morphism of rings. Integral domain and field. Characteristics of a Ring and Field.

(22 Lectures)

Unit-IV

Sphere: Equation of Sphere, Plane section of sphere, intersection of a sphere by a line, tangent line and tangent plane of a sphere, angle of intersection of two spheres. Cone: Equation of cone, tangent plane of a cone, right circular cone, enveloping cone. Cylinder: Equation of cylinder, enveloping cylinder, right circular cylinder.

(23 Lectures)

Suggested Books and References –

1. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra 2nd Ed., Prentice-Hall Of India Pvt. Limited, 1971.
2. I.N.Herstein, Topics in Algebra, Wiley-Eastern Ltd., New Delhi.
3. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edition), Narosa Publishing House, New Delhi, 1999.(IX Edition 2010).
4. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
5. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra,1998.
6. S.L. Loney, The Elements of Coordinate Geometry, Macmillan and co. London, 1895.
7. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials:**

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Develop a solid theoretical foundation in algebraic structures including groups, rings, integral domains and fields.
2. Apply theoretical concepts to solve problems involving group theory, ring theory.
3. Analyze and differentiate algebraic structures and their interrelations.
4. Understand the applications of algebraic structures in various mathematical and scientific disciplines.

Syllabus
[UG0803-Three/Four Year Bachelor of Science (Maths Group)] - [UG0803-MAT-76T-302] - [Complex Analysis & Mechanics]
VI-Semester - [Mathematics]

Regular Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (CA + EoSE)	Minimum Passing Marks (CA + EoSE)
Theory	UG0803-MAT-76T-302 Complex Analysis & Mechanics	1 Hrs-CA 3 Hrs-EoSE	30 Marks-CA 120 Marks-EoSE	12 Marks-CA 48 Marks-EoSE

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination (EoSE)	Maximum Marks (EoSE)	Minimum Passing Marks (EoSE)
Theory	UG0803-MAT-76T-302 Complex Analysis & Mechanics	3 Hrs	150 Marks	60 Marks

Semester	Code of the Course	Title of the Course/Paper				NHEQF Level	Credits
VI	UG0803-MAT-76T-302	Complex Analysis & Mechanics				7	6
Level of Course	Type of the Course	Credit Distribution			Offered to NC Student	Course Delivery Method	
		Theory	Practical	Total			
Introductory	UG	6	0	6	Yes	Lecture, Ninety lectures	
List of Programme Codes in which Offered as Minor Discipline							
Prerequisites		Mathematics course of XII std. of Central Board of Secondary Education or equivalent.					

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Objectives of the Course:	The objective of the course is to enable students to understand and apply complex analysis, principles of equilibrium and work, and solve mechanical motion problems.

Detailed Syllabus

[UG0803-MAT-76T-302] - [Complex Analysis & Mechanics]

Unit - I

Complex valued function: Limits, Continuity and Differentiability. Analytic functions, Cauchy-Riemann equations. Harmonic functions, Construction of an analytic function. Complex integration, Complex line integrals, Cauchy integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions. Cauchy integral formula, Analyticity of the derivative of an analytic function.

(22 Lectures)

Unit - II

Taylor's theorem. Laurent's theorem. Maximum modulus theorem. Singularities of an analytic function, Branch point, Meromorphic and Entire functions, Residue at a singularity, Cauchy's residue theorem.

(23 Lectures)

Unit -III

Velocity and acceleration – along radial and transverse directions, along tangential and normal directions, Motion in resisting medium – Resistance varies as velocity and square of velocity, Motion on a smooth curve in a vertical plane.

(22 Lectures)

Unit-IV

Equilibrium of coplanar forces, moments, Friction, Virtual Work and catenary.

(23 Lectures)

Suggested Books and References –

1. Brown JW, Churchill RV. Complex variables and applications. McGraw-Hill,; 2009.
2. Kasana HS. Complex variables: theory and applications. PHI Learning Pvt. Ltd.; 2005.
3. Ponnusamy S, Silverman H. Complex variables with applications. Springer Science & Business Media; 2007.
4. A.S.Ramsey, Statics, CBS Publishing & Distributors, New Delhi.
5. M. Ray, A Text Book of Dynamics, S. Chand & Co., 2003.
6. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
7. R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Suggested E-resources:

1. **Online Lecture Notes and Course Materials**

Course Learning Outcomes:

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By the end of the course, students would have achieved the following:

1. Grasped the concepts of Taylor's and Laurent's theorems as they apply to complex functions.
2. Conducted analysis on the singularities of analytic functions, including branch points, meromorphic functions, entire functions, and residues at singularities using the Cauchy residue theorem.
3. Understand and calculate velocity and acceleration in various directions and analyze motion in resisting media.
4. Analyze the equilibrium of coplanar forces, calculate moments, and understand the effects of friction.
5. Apply the principles of virtual work to mechanical systems and analyze motion on smooth curves in vertical planes.
6. Mathematical treatment to the configuration called Catenary.

UNIVERSITY OF RAJASTHAN

Programme Name : UG0803-Four Year B.Sc. (Maths Group)

Name of University	**University of Rajasthan, Jaipur**
Name of Faculty	**Science**
Name of Programme	**UG0803-B. Sc. (Maths Group)**
Name of Discipline	**Major Discipline -Chemistry, Mathematics, Physics** **Major/Minor Discipline – Economics, Geography, Geology, Psychology**

PROGRAMME PREREQUISITES

Physics and Mathematics courses of Central Board of Secondary Education or equivalent.

PROGRAMME OUTCOMES (POs)

Program Outcome in B.Sc.(Physics) with Minor in Chemistry or Mathematics:

1. Strong foundational knowledge: Students will develop a strong foundational knowledge in physics, including core concepts, principles, theories, and mathematical techniques. They will also gain an understanding of the fundamental principles of chemistry or mathematics, depending on their chosen minor.
2. Problem-solving skills: Students will develop excellent problem-solving skills, both qualitative and quantitative, by applying scientific principles and mathematical techniques to analyze and solve complex problems in physics, chemistry, or mathematics.
3. Experimental skills: Students will acquire practical skills in designing, conducting, and analyzing experiments in physics and chemistry. They will learn to use various laboratory instruments and techniques, collect and interpret experimental data, and draw meaningful conclusions.
4. Computational skills: Students will develop proficiency in computational methods and numerical analysis, using appropriate software tools to model and simulate physical systems, solve mathematical problems, and analyze experimental data.
5. Critical thinking and analytical reasoning: Students will develop the ability to think critically, analyze information, and apply logical reasoning to evaluate scientific phenomena and experimental results. They will also learn to assess the validity of scientific arguments and draw evidence-based conclusions.
6. Communication skills: Students will enhance their oral and written communication skills by effectively presenting scientific concepts, experimental results, and research findings. They will learn to communicate complex scientific ideas to both technical and non-technical audiences.
7. Research and inquiry skills: Students will be able to conduct independent research, formulate scientific questions, design experiments, gather and analyse data, and draw

conclusions. They will also develop skills in literature review, data interpretation, and scientific writing.

8. Interdisciplinary perspective: Students with a minor in chemistry or mathematics will gain interdisciplinary knowledge and perspectives, allowing them to explore the connections between physics and other scientific disciplines. They will be able to apply their understanding of chemistry or mathematics concepts to enhance their problem-solving abilities.
9. Ethical and professional conduct: Students will develop an understanding of the ethical responsibilities and professional conduct expected in scientific research and practice. They will be aware of the importance of integrity, safety, and ethical considerations in their work.
10. Lifelong learning: Students will develop a passion for learning and an appreciation for the dynamic nature of scientific knowledge. They will be equipped with the skills and motivation to engage in lifelong learning, keeping up with advancements in physics, chemistry, or mathematics and adapting to new challenges and opportunities in their careers.

These program outcomes will prepare students for diverse career paths in research, academia, industry, government, and other sectors where strong analytical and problem-solving skills, as well as a deep understanding of physics and its interdisciplinary connections, are valued.

Examination Scheme

1. 1 credit = 25 marks for examination/evaluation
2. For Regular Students there will be Continuous assessment, in which sessional work and the terminal examination will contribute to the final grade. Each course in Semester Grade Point Average (SGPA) has two components- Continuous assessment (20% weightage) and (End of end-semester examination) EoSE (80% weightage).
3. For Regular Students,75% Attendance is mandatory for appearing in the EoSE.
4. To appear in the EoSE examination of a course/subject a regular student must appear in the mid-semester examination and obtain at least a C grade in the course/subject.
5. Credit points in a Course/Subject will be assigned only if, the regular student obtains at least a C grade in the CA and EoSE examination of a Course/Subject.
6. In the case of Non-Collegiate Students there will be no Continuous assessment and credit points in a course/subject will be assigned only if, the non-collegiate student obtains at least a C grade in the EoSE examination of a Course/Subject.

Contact Hours –

15 Weeks per Semester

L – Lecture (1 Credit = 1 Hour/Week)
T – Tutorial (1 Credit = 1 Hour/Week)

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S – Seminar (1 Credit = 2 Hours/Week)
P – Practical/Practicum (1 Credit = 2 Hours/Week)
F – Field Practice/Projects (1 Credit = 2 Hours/Week)
SA – Studio Activities (1 Credit = 2 Hours/Week)
I – Internship (1 Credit = 2 Hours/Week)
C – Community Engagement and Service (1 Credit = 2 Hours/Week)

DISTRIBUTION OF CONTINUOUS ASSESSMENT (CA) MARKS

S. No.	CATEGORY	Weightage (out of total internal marks)		THEORY					PRACTICAL		
				CORE (Only Theory)	CORE (Theory + Practical)	AEC	SEC	VAC	CORE (Theory +Practical)	SEC	VAC
	Max Internal Marks			30	20	20	10	10	10	10	10
1	Mid-term Exam	*50%*		15	10	10	5	5	5	5	5
2	Assignment	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
3	Attendance	*25%*		7.5	5	5	2.5	2.5	2.5	2.5	2.5
		Regular Class Attendance	= 75%	3	2	2	1	1	1	1	1
			75-80%	4	3	3	1.5	1.5	1.5	1.5	1.5
			80-85%	5	4	4	2	2	2	2	2
			> 85%	7.5	5	5	2.5	2.5	2.5	2.5	2.5

Note:

1. Continuous assessment will be the sole responsibility of the teacher concerned.
2. For continuous assessment no remuneration will be paid for paper setting, Evaluation, Invigilation etc.

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3. For continuous assessment Paper setting and Evaluation responsibility will be of teacher concern.
4. For continuous assessment no Answer sheets/question papers etc. will be provided by the University.
5. Colleges are advised to keep records of continuous assessment, attendance etc.

[courses which have Practical Examination]

The question paper will consist of **two** parts **A** & **B**.

PART-A: 20 Marks

Part A will be compulsory having 10 very short answer-type questions (with a limit of 20 words) of two marks each.

PART-B: 60 Marks

Part B of the question paper shall be divided into four units comprising question numbers 2-5. There will be one question from each unit with internal choice. Each question will carry 15 marks.

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (Midterm + EoSE)	Minimum Marks (Midterm + EoSE)
Theory	**UG0803**	**1 Hrs-MT 3 Hrs-EoSE**	**20 Marks-MT 60 Marks-EoSE**	**8 Marks-MT 24 Marks-EoSE**
Practical	**UG0803**	**2 Hrs-MT 4 Hrs-EoSE**	**10 Marks-MT 40 Marks-EoSE**	**4 Marks-MT 16 Marks-EoSE**

[For Practical Examination Please specify Examination Scheme with Course Detail]

Non-Collegiate Students –

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (Midterm + EoSE)	Minimum Marks (Midterm + EoSE)

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Theory	**UG0803**	**3 Hrs-EoSE**	**100 Marks-EoSE**	**40 Marks-EoSE**
Practical	**UG0803**	**4 Hrs-EoSE**	**50 Marks-EoSE**	**20 Marks-EoSE**

Exit and Entrance Policy

1. Students who opt to exit after completion of the first year and have secured 48 credits will be awarded a **UG Certificate** if, in addition, they complete one internship of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
2. Students who opt to exit after completion of the second year and have secured 96 credits will be awarded the UG diploma if, in addition, they complete one internship of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
3. Students who wish to undergo a 3-year UG programme will be awarded UG Degree in the Major discipline after successful completion of three years, securing 150 credits and satisfying the minimum credit requirement.
4. A four-year UG Honours degree in the major discipline will be awarded to those who complete a four-year degree programme with 200 credits and have satisfied the minimum credit requirements.
5. Students who secure 75% marks and above in the first six semesters and wish to undertake research at the undergraduate level can choose a research stream in the fourth year. They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 200 credits, including 12 credits from a research project/dissertation, are awarded UG Degree (Honours with Research).

Letter Grades and Grade Points

Letter Grade	Grade Point	Marks Range (%)

O (outstanding)	10	91 – 100
A+ (Excellent)	9	81 – 90
A (Very good)	8	71 – 80
B+ (Good)	7	61 – 70
B (Above average)	6	51 – 60
C (Average)	5	40 – 50
P (Pass)	4	
F (Fail)	0	
Ab (Absent)	0	

When students take audit courses, they may be given a pass (P) or fail (F) grade without any credits.

Name of University	**University of Rajasthan, Jaipur**
Name of Faculty	**UG0803-B. Sc. (Maths Group)**
Name of Discipline	**Physics**

SEMESTER-WISE PAPER TITLES WITH DETAILS

UG0803-B. Sc. (Maths Group)								
				PHYSICS	**Credits**			
#	**Level**	**Semester**	**Type**	**Title**	**L**	**T**	**P**	**Total**
1.	5	I	MJR	**UG0803-PHY-51T-101-Mechanics& Oscillations**	4	0	0	4
2.	5	I	MJR	**UG0803-PHY-51P-102-Physics Lab-I**	0	0	2	2
3.	5	II	MJR	**UG0803-PHY-52T-103-Electromagnetism**	4	0	0	4

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4.	5	II	MJR	**UG0803-PHY-52P-104-Physics Lab-II**	0	0	2	2
5.	6	III	MJR	**UG0803-PHY-63T-201-Optics**	4	0	0	4
6.	6	III	MJR	**UG0803-PHY-63P-202-Physics Lab-III**	0	0	2	2
7.	6	IV	MJR	**UG0803-PHY-64T-203-Thermodynamics & Statistical Physics**	4	0	0	4
8.	6	IV	MJR	**UG0803-PHY-64P-204-Physics Lab-IV**	0	0	2	2
9.	7	V	MJR	**UG0803-PHY-75T-301-Electronics and Solid-State Devices**	4	0	0	4
10.	7	V	MJR	**UG0803-PHY-75P-302-Physics Lab-V**	0	0	2	2
11.	7	VI	MJR	**UG0803-PHY-76T-303-Quantum Mechanics and Spectroscopy**	4	0	0	4
12.	7	VI	MJR	**UG0803-PHY-76P-304-Physics Lab-VI**	0	0	2	2

Syllabus

Semester I

***UG 0803-PHY*-51T-101- Mechanics & Oscillation**

Type	Paper code and Nomenclature	Duration of Examination	Maximum Marks (Midterm + EoSE)	Minimum Marks (Midterm + EoSE)
Theory	UG 0803-PHY-51T-101-Mechanics & Oscillation	1 Hrs-MT 3 Hrs- EoSE	20 Marks-MT 60 Marks-EoSE	8 Marks-MT 32 Marks-EoSE
Practical	UG 0803-PHY-51P-102-Physics Lab-I	2 Hrs-MT 4 Hrs- EoSE	10 Marks-MT 40 Marks-EoSE	4 Marks-MT 16 Marks-EoSE

Semester	Code of the Course	Title of the Course / Paper	NHEQF Level	Credits
I	**UG 0803-PHY-51T-101**	**Mechanics & Oscillation**	**5**	**4**
Level of Course	Type of Course	Delivery of the Course		
Introductory	Major/Minor	Lecture, Sixty Lectures (4 hrs in a week) including diagnostic and formative assessment during lecture hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course	Objectives of the Course in Mechanics: The objective of the course is to provide students with a comprehensive understanding of classical mechanics, including the laws of motion, frames of reference, forces, motion of particles and rigid bodies, oscillations, and central forces. The course aims to develop their knowledge and skills in analyzing and solving problems related to these topics, using appropriate mathematical formalism and physical concepts.			

Unit - I

Physical Law and frame of Reference:

(a) Inertial and non-inertial frames, **C**oordinate transformation**:** transformation of displacement, velocity, acceleration between different frames of reference involving translation motion, Galilean transformation and invariance of Newton's laws.

(b) The Special theory of relativity: Postulates of STR (Special theory of relativity), the Lorentz transformation, transformation of velocity, acceleration, Length contraction, time dilation and its experimental evidence.

(c) Coriolis Force: Transformation of displacement, velocity and acceleration between rotating frame, Pseudo forces, Coriolis force, motion relative to earth, Foucault's pendulum.

(d) Conservative Forces: Introduction about conservative and non-conservative forces, rectilinear motion under conservative forces, discussion of potential energy curve and motion of a particle. **(15 Lectures)**

Unit -II:

Centre of Mass: Introduction about Centre of Mass, Centre of Mass Frame: Collision of two particles in one and two dimensions (elastic and inelastic), Slowing down of neutrons in a moderator, Motion of a system with varying mass, Angular momentum concept, conservation and charge particle scattering by a nucleus.

Rigid body: Equation of a motion of a rigid body, Inertial coefficient, Case of J not parallel to ω, the kinetic energy of rotation and the idea of principal axes, the processional motion of the spinning top. **(15 Lectures)**

Unit -III

Motion under Central Forces: Introduction about Central Forces, Motion under central forces,
gravitational interaction, inertia and gravitational mass, General solution under gravitational interaction, Kepler's laws, Discussion of trajectories: Cases of elliptical and circular orbits, Rutherford scattering.

Damped Harmonic Oscillations: Oscillations in a potential well, Damped force and motion under damping, Damped Harmonic Oscillator, Power dissipation, Anharmonic oscillator and simple pendulum as an example. **(15 Lectures)**

Unit-IV

Driven Harmonic Oscillations: Driven harmonic oscillator with damping, Frequency response, Phase relation, Quality factor, Series and parallel of LCR circuit, Electromechanical system: (Ballistic galvanometer).

Coupled Oscillations: Equation of motion of two coupled Harmonic Oscillators, Normal modes, motion in mixed modes and transient behaviour, Dynamics of many number of oscillators**.** **(15 Lectures)**

Suggested Books and References –

1. Mechanics, Berkeley Physics, Vol.1, Kittel, Knight, et.al. 2007, Tata McGraw-Hill
2. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill
3. Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education.
4. Course of Theoretical Physics, Vol-I Mechanics, L.D. Landau, E.M. Lifshitz, Butterworth-Heinemann
5. Mechanics, D.S. Mathur, S. Chand and Company Limited,
6. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
7. Introduction to Classical Mechanics: With Problems and Solutions, David Morin
8. Classical Mechanics, Herbert Goldstein, Charles P. Poole, and John L. Safko
9. Classical Mechanics, John R. Taylor
10. Mechanics, Keith R. Symon
11. The Physics of Waves & Oscillations, Bajaj
12. Waves, A. P. French

Suggested E-resources:

Online Lecture Notes and Course Materials:

1. MIT Open Course Ware: Classical Mechanics - This resource provides lecture notes, problem sets, and solutions for a complete course on classical mechanics: https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
2. Hyper Physics - This online resource provides concise explanations and interactive simulations for various topics in mechanics: http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

Syllabus

UG0803-PHY-51P-102: Physics Lab-I

Semester	Code of the Course	Title of the Course / Paper	NHEQF Level	Credits
I	**UG 0803-PHY-51P-102**	**Physics Lab-I**	**5**	**2**

Level of Course	Type of Course	Delivery of the Course
Introductory	Major/Minor	Lecture, Sixty Lectures (4 hrs in a week) including diagnostic and formative assessment during lecture hours.
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.	
Objectives of the Course	The objective of the physics Lab-I, with the mentioned experiments, is to provide students with hands-on experience in conducting experiments related to oscillations, damping, coupled oscillators, and properties of materials. The lab aims to reinforce theoretical concepts learned in the classroom, develop practical skills, and enhance the understanding of physics principles through experimentation.	

The colleges are free to set new experiments of equivalent standards. This should be intimated and approved by the Convener, Board of Studies before the start of the academic session. It is binding on the college to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the centre

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	**Experiments**	**Viva-voice**	**Record**	**Maximum marks**
Regular Student	**20**	**10**	**10**	**40**
Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	**Theory/formula**	**Figure/circuit**	**Observation**	**Calculation**	**Results/Error**	**Precautions**
Regular	**3**	**2**	**6**	**5**	**3**	**1**

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Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

Physics Lab - I

List of Experiments:

1. Study the variation of the time period with amplitude in large-angle oscillations using a compound pendulum.
2. To study the damping using a coupled pendulum.
3. To study the excitation of normal modes and measure frequency splitting into two coupled oscillators.
4. To study the frequency of energy transfer as a function of coupling with mass using coupled oscillators.
5. To study the viscous fluid damping of a compound pendulum and determiner the damping coefficient and quality factor of the oscillator.
6. To study the electromagnetic damping of a compound pendulum and to find the variation of damping coefficients with the assistance of a conducting lamina.
7. Study of normal modes of a coupled pendulum system. Study of oscillations in mixed modes and find the period of energy exchange between the two oscillators.
8. To determine Young's modulus by bending of the beam method.
9. To determine Y, σ and η by Searle's method
10. To determine the modulus of rigidity of a wire using Maxwell's needle.
11. To determine the moment of Inertia of a fly-wheel.
12. To find the motion of a spring and calculate (a) Spring constant (b) Acceleration due to gravity (g) (c) Modulus of Rigidity.

Suggested Books and References -

Suggested E-resources:

Course Learning Outcomes:

Through these experiments, students will develop practical skills in experimental techniques, data collection, analysis, and interpretation. They will also enhance their understanding of fundamental concepts and principles in oscillations, damping, coupled oscillators, and material properties. The lab experiences will foster critical thinking, problem- solving abilities, and the application of theoretical knowledge to real-world scenarios.

Syllabus

Semester II

UG 0803-PHY-52T-103- Electromagnetism

Semester	Code of the Course	Title of the Course / Paper	NHEQF Level	Credits
II	**UG 0803-PHY-52T-103**	**Electromagnetism**	**5**	**4**
Level of Course	Type of Course	Delivery of the Course		
Introductory	Major/Minor	Lecture, Sixty Lectures (4 hrs in a week) including diagnostic and formative assessment during lecture hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course	Objectives of the Course in Electromagnetism: Objectives of the Course: The objective of the course is to provide students with a comprehensive understanding of the fundamental concepts and principles of electromagnetism. It aims to develop their knowledge and skills in analyzing scalar and vector fields, electric and magnetic fields, and their interactions, as described by Maxwell's equations. The course will also cover important topics such as electric potential, polarization, magnetostatics and electromagnetic waves.			

Unit I

Scaler and Vector Fields: Concept of Field, Scalar and Vector Fields, Gradient of scalar field, Physical significance of Gradient, Divergence and Curl of a vector field, Cartesian co-ordinates system, Problems based on Gradient, Divergence and curl operators.

Concept of Solid angle, Gauss divergence and Stoke's theorem. Gauss law from inverse square law. Differential form of Gauss law.

Electric Field and Potential Energy: Invariance of Charge, Potential energy of system of (i) Discrete N-charges (ii) Continuous charge distribution, Energy required to built a uniformly charged sphere, classical radius of electron, Electric field due to a short electric dipole,

Interaction of electric dipole with external uniform and non-uniform electric field, potential due to a uniformly charged spherical shell.

Poisson's and Laplace equations in Cartesian co-ordinates and their applications to solve the problems of electrostatics, Electric field measured in moving frames, Electric field of a point charge moving with constant velocity. **(15 Lectures)**

Unit II

Electric field in matter: Multipole expansion, definition of moments of charge distribution, Dielectrics, Induced dipole moments, polar and non-polar molecules, Free and bound charges, Polarization, Atomic polarizability, electric displacement vector, electric susceptibility, dielectric constant, relation between them.

Electric potential and electric field due to a uniformly polarized sphere (i) outside the sphere (ii) at the surface of the sphere (iii) inside the sphere, Electric field due to a dielectric sphere placed in a uniform electric field (a) outside the sphere (b) inside the sphere, Electric field-due to a charge placed in dielectric medium and Gauss law, Clausius-Mossotti relation in dielectrics. **(15 Lectures)**

Unit III

Magnetostatics and Magnetic field in matter: Lorentz force, properties of magnetic field, Ampere's law, field due to a current carrying solid conducting cylinder (a) outside (b) at the surface and (ii) inside the cylinder, Ampere's law in differential form, Introduction of Magnetic Vector potential, Poisson's equation for vector potential, Deduction of Biot-Savart law using Magnetic Vector potentials, Atomic magnet, Gyromagnetic ratio, Bohr-magneton, Larmor frequency, induced magnetic moment and dia-magnetism, spin magnetic moment, para and ferro magnetism, Intensity of Magnetization, Magnetic permeability and Susceptibility, free and bound current densities, Magnetic field due to a uniformly magnetized material and Non-uniformly magnetized material. (15 Lectures)

Unit IV

Maxwell's Equations and Electromagnetic waves: Displacement current, Maxwell's Equations, Electromagnetic waves, Electromagnetic waves in an Isotropic medium, Properties

of electromagnetic waves, Energy density of Electromagnetic waves, Pointing vector, Radiation pressure of free space, Electromagnetic waves in Dispersive medium, Spectrum of Electromagnetic waves. **(15 Lectures)**

Suggested Books and References -

1. Berkeley Physics Course, Vol II
2. Feynman in Physics Vol. II
3. An Introduction to Electrodynamics by Griffiths
4. Fundamental University Physics Vol. II: Fields and Waves; M. Alonso and E.J. Finn: Addison-Wesley Publishing Company

Suggested
E-resources-

1. MIT OpenCourseWare: Electricity and Magnetism - This resource offers lecture notes, assignments, and exams for a complete course on electricity and magnetism: https://ocw.mit.edu/courses/physics/8-02sc-physics-ii-electricity-and-magnetism-spring- 2011/
2. HyperPhysics - This online resource provides concise explanations and interactive simulations for various topics in electrostatics and electric fields: http://hyperphysics.phy- astr.gsu.edu/hbase/hframe.html

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the concept of scalar and vector fields and their physical significance.
2. Demonstrate knowledge of gradient, divergence, and curl operators and their applications in electromagnetism.
3. Apply Gauss divergence and Stoke's theorems to analyze electric and magnetic fields.

4. Explain the behaviour of electric fields and potential energy in different charge distributions.
5. Analyze the interaction of electric dipoles with external electric fields and calculate the resulting potentials.
6. Solve problems related to Poisson's and Laplace's equations in electrostatics.
7. Describe the behaviour of electric fields in different types of matter, including dielectrics and polarized spheres.
8. Understand the concept of electric displacement, susceptibility, and dielectric constant.
9. Analyze the behaviour of magnetic fields in various materials and the effects of currents on magnetic fields.
10. Apply Ampere's law and the magnetic vector potential to calculate magnetic fields in different scenarios.
11. Explain the properties of electromagnetic waves and their behavior in isotropic and dispersive media.
12. Calculate the energy density and radiation pressure of electromagnetic waves

Syllabus

UG 0803-PHY-52P-104-Physics Lab-II

Semester	Code of the Course	Title of the Course / Paper	NHEQF Level	Credits
II	**UG 0803-PHY-52P-104**	**Physics Lab-II**	**5**	**2**
Level of Course	Type of Course	Delivery of the Course		
Introductory	Major/Minor	Lecture, Sixty Lectures (4 hrs in a week) including diagnostic and formative assessment during lecture hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			

Objectives of the Course	1. To provide hands-on experience in conducting experiments related to electricity and magnetism. 2. To develop practical skills in using various electrical components and instruments. 3. To reinforce theoretical concepts learned in the corresponding lecture course through practical applications. 4. To enhance problem-solving and analytical skills by analyzing experimental data and interpreting results. 5. To promote scientific inquiry, critical thinking, and the ability to design and execute experiments. 6. To foster teamwork and collaboration in conducting experiments and analyzing results. 7. To develop skills in accurately measuring and recording experimental data.

The colleges are free to set new experiments of equivalent standards. This should be intimated and approved by the Convener, Board of Studies before the start of the academic session. It is binding on the college to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the centre.

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	Experiments	Viva-voice	Record	Maximum marks
Regular Student	**20**	**10**	**10**	**40**
Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	Theory/formula	Figure/circuit	Observation	Calculation	Results/Error	Precautions
Regular	**3**	**2**	**6**	**5**	**3**	**1**
Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

List of Experiments -

1. To study the Faradays Law of electromagnetic induction.
2. To study the variation of power transfer by two different loads by a D.C. source and to verify the maximum power transfer theorem.
3. To study the variation of charge and current in an RC circuit with a different time constant (using a DC source).
4. To study the behaviour of an RC circuit with varying resistance and capacitance using AC mains as a power source and also to determine the impedance and phase relations.
5. To study the rise and decay of current in an LR circuit with a source of constant emf.
6. To study the voltage and current behaviour of an LR circuit with an AC power source. Also determine power factor, impedance and phase relations.
7. To study the magnetic field along the axis of a current-carrying circular coil. Plot the necessary graph and hence find the radius of the circular coil.
8. To study the frequency response of a series LCR series circuit and to estimate the resonant frequency and find out Q-factor and band width.
9. To study the frequency response and to find resonant frequencies of L-C-R parallel circuits. And find out Q-factor and band width.
10. To determine the specific resistance of a material and determine the difference between two small resistance using Carey Fosters Bridge.
11. To convert a galvanometer into an ammeter of a given range.
12. To convert a galvanometer into a voltmeter of a given range.

Suggested E-resources:

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Demonstrate proficiency in using various electrical components and instruments required for conducting experiments.
2. Apply theoretical concepts of electricity and magnetism to design and execute experiments.
3. Analyze experimental data using appropriate mathematical and statistical techniques.
4. Interpret experimental results and draw conclusions based on data analysis.
5. Develop skills in accurately measuring physical quantities and recording experimental observations.
6. Communicate experimental procedures, results, and conclusions effectively in written reports.

Syllabus

III-Semester

UG0803-PHY-63T-201-Optics

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
III	**UG0803-PHY-63T-201**	**Optics**	**6**	**4**
Level of Course	**Type of the Course**	**Delivery Type of the Course**		
Introductory	**Major/Minor**	**Lecture, Sixty Lectures (4 hours in week) including diagnostic and formative assessments during lecture hours.**		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The student will get an introduction to the discipline of optics and its role in daily life. They will learn basic knowledge of interference, diffraction, polarization, LASER, HOLOGRAPHY, and FIBRE OPTICS for future research purposes.			

Unit I

Interference: Concept of Spatial and temporal coherence, coherence length, coherence time, Definition and propagation of wavefront, Huygens principle of secondary wavelets, Young's Double Slit Experiment, Types of fringes, Interference by division of wavefront: Fresnel's Bi-Prism, Measurement of wavelength and thickness of a thin transparent sheet. Interference by division of amplitude– Thin films (parallel and wedge-shaped films), Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer, the shape of fringes, the Measurement of wavelength, the difference between two spectral lines, and the thickness of a thin transparent sheet. **(15 Lectures)**

Unit II

Diffraction: Fraunhofer diffraction: Single slit; Double slit. Multiple slits, missing order, Diffraction grating, Resolving power of grating, Rayleigh's criterion of resolution.

Fresnel Diffraction: Half-period zones. Zone plate. Multiple Foci of zone plate, comparison between zone plate and convex lens, Fresnel Diffraction pattern at a circular aperture, straight edge, and a rectangular slit using half-period zone analysis. **(15 Lectures)**

Unit III

Polarization: Polarisation (i) Plane polarized light (ii) Circularly polarized light (iii) Elliptically polarized light, Production of plane-polarized light (i) by reflection (ii) by refraction (iii) by double refraction, and (iv) by dichroism (Polaroid), Brewster's law, Law of Malus, Huygens' wave theory of double refraction, Analysis of Polarized light: Nicol prism, Quarter wave plate, and half-wave plate, Optical activity, Laws of optical activity, and Fresnel's explanation of optical activity; Specific rotation, Polarimeters: Laurent's half shade Polarimeter and Biquartz Polarimeter. **(15 Lectures)**

Unit IV

Quantum Optics and photonics

(i) **Laser:** Spontaneous and stimulated emission, Einstein's A & B coefficients, population inversion, methods of optical pumping. Ruby, He-Ne, and Semiconductor laser (Principle and working).

(ii) **Holography:** Principle of holography, Theory of construction and reconstruction of image, applications of holography.

(iii) **Fiber Optics:** Introduction to optical fiber, types of optical fiber, Total internal reflection, Explanation of propagation of light through an optical fiber

(15 Lectures)

REFERENCES:

1. F.A. Jenkins and H.E. White, Fundamentals of Optics, Tata McGraw Hill.
2. Brij Lal and N. Subrahmaniyam, Optics, S. Chand.
3. E.Hecht, Optics, Pearson.
4. A.K.Ghatak, Optics, Tata Mc Graw Hill.

Course outcomes:

1. The student will get an introduction to the discipline of optics and its role in daily life.

2. The optics course will give the student a basic knowledge of interference, diffraction, and polarization.

3. The student will be able to analyze and calculate interference between light waves and application of the theory to various interferometers along with their practical applications.

4. The student would know the conditions for near and far-field diffraction and be able to calculate the far-field diffraction from gratings and simple aperture functions.

5. The student would understand how the polarization of light changes at reflection and transmission at interfaces.

6.The students are able to understand theory of LASER,HOLOGRAPHY and FIBRE OPTICS for future research purpose.

Syllabus

UG0803-PHY-63P-202-Physics Lab-III

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
III	**UG0803-PHY-63P-202**	**Physics Lab-III**	**6**	**2**
Level of Course	**Type of the Course**	**Delivery Type of the Course**		
Introductory	**Major/Minor**	**Practical, Sixty hours of practical including diagnostic and formative assessment during practical hours.**		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	1.Ability to find the formation of Newton ring and calculate the wavelength of monochromatic source. 2. Develop an understanding of light dispersion through prisms 3. Proficiency in analyzing and calculating the wavelength of light by grating. 4. Learn to determine the thermal conductivity of band teeth. 5. Develop skills in designing and analyzing the value of inductance by Anderson Bridge. 6. Understand the principle of wavefront division and also learn how to determine the wavelength of sodium light by biprism. 7. Students learn about the sensitivity ballistic galvanometer and determine the value of ballistic constant			

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	Experiments	Viva-voice	Record	Maximum marks
Regular Student	**20**	**10**	**10**	**40**
Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	Theory/formula	Figure/circuit	Observation	Calculation	Results/Error	Precautions
Regular	**3**	**2**	**6**	**5**	**3**	**1**
Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

Practical lists-

1. Find the wavelength of the monochromatic source using the Newton ring method and find the refractive index of the liquid.
2. Determine the dispersive power of prism.
3. Determine the wavelength of sodium light using grating.
4. Study the light properties using a fiber optics trainer kit.
5. Measure the induction by the Anderson bridge coil.
6. Determine the wavelength of sodium light using bi-prism.
7. Calculate the ballistic constant of the ballistic galvanometer.
8. Find high resistance by the leakage method.
9. Study the coherent source and coherent time using a diode laser.
10. To study the preparation of air film using the air wedge method.
11. To study the resolving power of prism.
12. To study the resolving power of grating.
13. To study the Rydberg constant by using grating.

Suggested Books and References –

1. Practical Optics, by S. Naftali Men. First Edition (ISBN 13:978-0124909519)

Suggested e-Resources: http://msbahae.um.edu, University of New Mexico.

Course Learning Outcomes

1. Ability to find the formation of Newton ring and calculate the wavelength of monochromatic source. 2. Develop an understanding of light dispersion through prisms

3. Proficiency in analyzing and calculating the wavelength of light by grating.

4. Learn to determine the thermal conductivity of band teeth.

5. Develop skills in designing and analyzing the value of inductance by Anderson Bridge.

6. Understand the principle of wavefront division and also learn how to determine the wavelength of sodium light by biprism.

7. Students learn about the sensitivity ballistic galvanometer and determine the value of a ballistic constant.

Syllabus

IV-Semester

UG0803-PHY-64T-203-Thermodynamics & Statistical physics

Semester	**Code of the Course**	**Title of the Course/Paper**	**NHEQF Level**	**Credits**
IV	**UG0803-PHY-64T-203**	**Thermodynamics & Statistical Physics**	**6**	**4**
Level of Course	**Type of the Course**	**Delivery Type of the Course**		
Introductory	**Major/Minor**	**Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.**		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	By this course, students will have developed a strong understanding of thermal and statistical physics. They will be able to apply the principles and concepts learned to analyze and solve problems related to thermodynamic systems, phase transitions, transport phenomena, low-temperature production, and quantum statistics. Additionally, they will be able to interpret and explain various phenomena and			

	behaviors of macroscopic and microscopic systems using the principles of thermodynamics and statistical mechanics.

Unit I

Thermal and adiabatic interactions: Thermal interaction, Zeroth law of thermodynamics, systems in thermal contact with a heat reservoir (canonical distribution), Energy Fluctuations, Entropy of a system, Helmholtz free energy, Adiabatic interaction and enthalpy, General interaction and first of thermodynamics, Infinitesimal general interaction, Gibb's free energy, Phase transitions, Triple point, First and second-order phase transition, Clausius-Clapeyron equation, Vapour-pressure curve, transformation of disorder into order, Heat engine and efficiency of engine, carnot's Cycle; Thermodynamic scale as an absolute scale, Maxwell relations and their applications. **(15 Lectures)**

Unit II

Kinetic Theory: Derivation of Maxwell's law of distribution of velocities and its experimental verification, most probable, average and RMS velocities, Diffusion, Equipartition Theorem, Classical theory of Specific heat capacity, the specific heat of solid (Explanation on the basis of Einstein and Debye Theory.

Transport Phenomenon: Mean free path, Distribution of free path, Coefficients of viscosity, thermal conductivity and diffusion, Brownian motion, Langevin's and Einstein's theories, Experimental determination of Avogadro number. **(15 Lectures)**

Unit III

Production of low temperatures: Cooling by Adiabatic expansion, Coefficient of performance, Joule Thomson effect, J-T coefficient for ideal as well as-Vander Waal's gases, porous plug experiment, Temperature of inversion, Regenerative cooling, Air Liquefiers. Adiabatic demagnetization of paramagnetic substances: Nuclear Para-magnetism, Liquid He I and He II, Superfluidity, Quest for absolute zero, Third law of thermodynamics and Nernst Heat Theorem. **(15 Lectures)**

Unit IV

Quantum Statistics: Introduction to Phase space, Micro and Macro states, Thermodynamic probability, Entropy and probability, Bose-Einstein and Fermi-Dirac distribution laws, Calculation of the thermodynamic functions of weak degenerate gas, Strong degeneration, Calculation of the thermodynamic functions of an ideal Bose gas, Derivation of Plank law, Flux of radiation energy, radiation pressure, thermodynamic functions of an ideal Fermi electron gas, Free electron model for metals, Spectra of metals, Richardson's equation of thermionic emission, Relativistic fermi gas, White dwarf stars, Chandrasekhar mass limit.

(15 Lectures)

Suggested Books and References -

1. Kittle-Thermal Physics.
2. Berkeley Series, Vol. V, Statistical Physics
3. Reif-Thermodynamics and Statistical Physics.
4. Lokanathan and Khandelwal Thermodynamics and Statistical Physics.
5. Sears Thermodynamics, Kinetic Theory of Gases and Statistical Physics.

Suggested E-sources:

1. MIT OpenCourseWare: Statistical Mechanics 1: Statistical Mechanics of Particles- This resource offers lecture notes, assignments, and exams for a complete course on Statistical Mechanics I, https://ocw.mit.edu/courses/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/pages/syllabus/

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Understand the concepts of thermal interactions and the law of thermodynamics.
2. Calculation of the entropy of a system and analyze the Helmholtz free energy.
3. Study infinitesimal general interactions and Gibb's free energy.
4. Explore phase transitions, including first and second-order phase transitions. Understand the Clausius-Clapeyron equation and the vapour pressure curve.

5. Learn about the thermodynamic scale as an absolute scale and apply Maxwell relations.
6. Explore the classical theory of specific heat capacity and analyze the specific heat of solids.
7. Study the production of low temperatures and cooling by adiabatic expansion.
8. Explore regenerative cooling and air liquefiers.
9. Understand adiabatic demagnetization of paramagnetic substances and the properties of liquid He 1 and He II, including super-fluidity.
10. Study phase space, microstates, macrostates, thermodynamic probability, and entropy. Learn about quanturn statistics, including Bose-Einstein and Fermi-Dirac distribution laws.
11. Analyze the behavior of an ideal Bose gas.
12. Understand the free electron model for metals, the spectrum of metals, relativistic Fermi gas, and the Chandrasekhar mass limit for white dwarf stars.

By the end of this course, students will have developed a strong understanding of thermal and statistical physics. They will be able to apply the principles and concepts learned to analyze and solve problems related to thermodynamic systems, phase transitions, transport phenomena, low- temperature production, and quantum statistics. Additionally, they will be able to interpret and explain various phenomena and behaviours of macroscopic and microscopic systems using the principles of thermodynamics and statistical mechanics.

Syllabus

UG 0803-PHY-64P-204-Physics Lab-IV

Semester	Code of the Course	Title of the Course / Paper	NHEQF Level	Credits
IV	**UG 0803-PHY-64P-204**	**Physics Lab – IV**	**6**	**2**
Level of Course	Type of Course	Delivery of the Course		
Introductory	Major	Lecture, Sixty Lectures(4 hour in a week) including diagnostic and formative assessment during lecture hours.		

Prerequisites	Practical, sixty hours (4 hours in a week) of practical including diagnostic and formative assessment during practical hours
Objectives of the Course	To provide hands-on experience in conducting experiments related to Thermal and statistical Physics. To develop practical skills in using various experimental components and instruments. To reinforce theoretical concepts learned in the corresponding lecture course through practical applications. To enhance problem-solving and analytical skills by analyzing experimental data and interpreting results. To promote scientific inquiry, critical thinking, and the ability to design and execute experiments. To foster teamwork and collaboration in conducting experiments and analyzing results. To develop skills in accurately measuring and recording experimental data.

The colleges are free to set new experiments of equivalent standards. This should be intimated and approved by the Convener, Board of Studies before the start of the academic session. It is binding on the college to have an experimental set-up of at least ten experiments listed below. In case the number of experiments performed by the student is less than eight, his marks shall be scaled down in the final examination on a pro-rata basis. Laboratory examination paper will be set by the external examiner out of eight or more experiments available at the centre

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	**Experiments**	**Viva-voice**	**Record**	**Maximum marks**
Regular Student	**20**	**10**	**10**	**40**

Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	Theory/formula	Figure/circuit	Observation	Calculation	Results/Error	Precautions
Regular	**3**	**2**	**6**	**5**	**3**	**1**
Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

List of Experiments -

1. To find out the melting-point of a given substance using platinum resistance thermometer.
2. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer
3. To determine the Specific Heat of a Liquid using a Calorimeter.
4. Determination of Specific Heat Capacity of a Liquid using the Method of Cooling.
5. To Study the Variation of Thermo-emf with Temperature.
6. Determination of the Coefficient of Thermal Conductivity of a Bad Conductor by Lee and Charlton's Disc Method.
7. Determination of the Coefficient of Thermal Conductivity of Copper by Searle's Apparatus.
8. Determination of Stefan's Constant using Black Body Radiation.
9. Determination of Planck's Constant.
10. To Study the Linear expansion of different solid samples.
11. Determination of Thermal conductivity by Armstrong method.
12. Study of Phase Transitions and Interpretation of Cooling Curves.
13. To study the blackbody spectrum of light intensity for a light bulb.
14. Experimental Determination of γ using Clement and Desormes Method
15. Study of variation of total thermal radiation with temperature.
16. To investigate the rate of thermal conduction through some common materials.
17. Determine the specific heat capacity of the given solid by Ice Calorimetry

18. Plot thermo emf versus temperature graph and find the neutral temperature (Use sand bath).

Suggested Books and Reference-

Suggested E-resources:

http://egyankosh.ac.in//handle/123456789/67451

Course Learning Outcomes:

By the end of the course, students should be able to:

1. Demonstrate proficiency in using various thermodynamically components and instruments required for conducting experiments.
2. Apply theoretical concepts of thermodynamics and statistical dynamics to design and execute experiments.
3. Analyze experimental data using appropriate mathematical and statistical techniques.
4. Interpret experimental results and draw conclusions based on data analysis.
5. Develop skills in accurately measuring physical quantities and recording experimental observations.
6. Communicate experimental procedures, results, and conclusions effectively in written reports.

Syllabus

V-Semester

UG0803-PHY-75T-301 –Electronics and Solid State Devices

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
V	UG0803-PHY-75T-301	Electronics and Solid State Devices	7	4
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	Major/Minor	Lecture, Sixty Lectures including diagnostic and formative assessments during lecture hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The syllabus for Electronics and Solid-State Devices aims to equip undergraduate students with a comprehensive understanding of circuit analysis, semiconductor device operation, and digital logic. It covers DC and AC circuits, semiconductor characteristics, BJTs and FETs configurations, and biasing techniques essential for amplifier and oscillator design. Students will also explore operational amplifiers and the foundational principles of Boolean algebra and logic gates. The course prepares students for practical applications and theoretical analysis in modern electronics.			

Unit 1

Circuit Analysis:

- **Electric Networks:** Definitions, loop and nodal equations for D.C. and A.C. circuits (Kirchhoff's Laws).
- **Four-Terminal Electric Network:** Ampere-volt conventions, open, closed, and hybrid parameters of four-terminal networks; input, output, and mutual impedance for active four-terminal networks.
- **Circuit Theorems:** Superposition, Thevenin, Norton, reciprocity, compensation, maximum power transfer, and Miller theorems.

P-N Junction: Charge densities in N and P Semiconductors; conduction by drift and diffusion of charge carriers; P-N diode equation; capacitance effects.

Rectifiers: Half-wave, full-wave, and bridge rectifiers; Ripple factor, efficiency, Peak Inverse Voltage and regulation; Series inductor, shunt capacitor, L-section, and π-section filters.

Voltage Regulation: Zener diode**,** Voltage regulation using Zener diodes; voltage multipliers.

Unit 2

Transistor Fundamentals: Notations, Configurations: CB, CE, CC. operation and characteristic curves for bipolar junction transistors (BJTs); Concept of load line and operating point, hybrid parameters.

Transistor Biasing: Need for biasing and stability of Q point, stability factors; Types of bias circuits for thermal bias stability: fixed bias, collector-to-base feedback bias, and four-resistor bias.

Field Effect Transistors (FETs): Introduction and merits demerits over BJT, biasing, and volt-ampere characteristics; Source follower, operation of FET as a variable voltage resistor.

Unit 3

Amplifiers: Analysis of transistor amplifiers using hybrid parameters, gain-frequency response; Cascade amplifiers, basic ideas of direct-coupled and R-C coupled amplifiers and analysis, differential amplifiers.

Amplifiers with feedback: Concept of feedback, positive and negative feedback, voltage and current feedback circuits, Advantages of negative feedback

Operational Amplifier: Definition and history of operational amplifiers, Ideal Op-Amps, Input offset voltage and current, Common-mode rejection ratio (CMRR), Power supply rejection ratio (PSRR), Input and output impedance, Open-loop gain and frequency response, Slew rate; Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower (Buffer)

Unit 4

Oscillators: Criteria for self-excited and self-sustained oscillation, Circuit conditions for self-excited oscillations; Basic transistor oscillator circuit and its analysis; Colpitts's and Hartley oscillators, R.C. oscillators, crystal oscillators and their advantages.

Logic Operations: Fundamentals of Boolean Algebra, Boolean variables and functions, De Morgan's Theorems, basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR), symbols, truth tables, Boolean expressions, Diode-Transistor Logic (DTL) concept and configuration, Transistor-Transistor Logic (TTL) concept and evolution from DTL.

Textbooks:

1. Basic Electronics and Linear Circuits by N.N. Bhargava, D.C. Kulshreshtha; S.C. Gupta.
2. Solid State Electronic Devices" by Ben G. Streetman and Sanjay Kumar Banerjee
3. Introduction to Semiconductor Devices" by M.S. Tyagi

Reference books:

1. Electronic Principles" by Albert Malvino and David Bates
2. Semiconductor Physics and Devices" by Donald A. Neamen
3. Integrated Electronics: Analog and Digital Circuits and Systems" by Jacob Millman and Christos C. Halkias
4. "Electronic Devices" by Thomas L. Floyd
5. Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky

E-Resources:

1. **NPTEL (National Programme on Technology Enhanced Learning)**:
   Website: https://nptel.ac.in/courses
2. **MIT Open Course Ware**:
   Website:https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/;
   https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/video_galleries/video-lectures/
3. **Coursera**:
   Website: Coursera - Electronics Courses

4. **edX**: Electronics Courses

   Website: https://www.edx.org/learn/electronics
5. **IEEE Xplore Digital Library**:

   Website: IEEE Xplore Digital Library

Learning Outcomes:

1. Understand and apply Kirchhoff's laws for analyzing DC and AC circuits.
2. Analyze four-terminal networks and calculate open, short-circuited, and hybrid parameters.
3. Apply circuit theorems like Superposition, Thevenin, and Norton to simplify circuits.
4. Comprehend the behavior of P-N junctions and their application in rectifiers and voltage regulation.
5. Explain the operation and characteristics of BJTs and FETs, including biasing techniques.
6. Design and analyze transistor amplifiers and understand feedback in amplifiers.
7. Utilize operational amplifiers in various configurations and understand practical limitations.
8. Design oscillators and understand the conditions for sustained oscillations.
9. Understand Boolean algebra and logic gates, and apply them in digital logic circuits.

Syllabus

UG0803-PHY-75P-302-PHYSICS LAB-V

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
V	UG0803-PHY-75P-302	Physics Lab-V	7	2
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	Major/Minor	Practical, Sixty hours(4 hours per week) of practical including diagnostic and formative assessment during practical hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			
Objectives of the Course:	The objectives of the practical in the Electronics and Solid-State Devices syllabus aim to provide hands-on experience and deepen understanding of key electronics concepts. Students will verify Kirchhoff's laws and the maximum power transfer theorem, explore the characteristics of semiconductor devices such as transistors, junction diodes, Zener diodes, and FETs, and determine the band gap in semiconductors. Practical exercises will include the analysis of temperature dependence of resistance, designing single-stage transistor audio amplifiers, amplifiers with negative feedback, and studying power supply circuits, rectifiers with various filters, and Zener regulated power supplies. Advanced experiments will cover designing oscillators like Hartley and Colpitts oscillators, investigating			

	clipping and clamping circuits, and studying logic gates using discrete components compared with TTL integrated circuits. These practical prepare students to design, analyze, and troubleshoot various electronic circuits for further studies and professional work in electronics.

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	Experiments	Viva-voice	Record	Maximum marks
Regular Student	**20**	**10**	**10**	**40**
Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	Theory/formula	Figure/circuit	Observation	Calculation	Results/Error	Precautions
Regular	**3**	**2**	**6**	**5**	**3**	**1**
Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

List of Practical:

1. Verify Kirchhoff's laws using breadboard circuits with resistors and voltage sources.
2. Verify the maximum power transfer theorem.
3. Study the characteristics of a given transistor (PNP/NPN) in common emitter, common base, and common collector configurations.
4. Determine the band gap of a semiconductor using a junction diode.
5. Study the variation of gain with frequency in a single-stage transistor audio amplifier.
6. Study the temperature dependence of resistance in a semiconductor using the four-probe method.

7. Study the characteristics of a junction diode and a Zener diode.
8. Study the characteristics of a field effect transistor (FET) and design an amplifier with finite gain.
9. Study a power supply using full wave rectifier or a bridge wave rectifier with various filter circuits.
10. Study a half wave rectifier with L and π section filters.
11. Design a Zener regulated power supply and study the regulation with various loads.
12. Study the frequency response of a transistor amplifier and obtain the input and output impedance.
13. Design and study an R-C phase shift oscillator and measure the output impedance (frequency response with change of R and C components).
14. Study a voltage multiplier circuit to generate high voltage D.C. from A.C.
15. Study OR, AND, and NOT logic gates using discrete components and compare them with TTL integrated circuits (ICs).
16. Design a Hartley oscillator and study its frequency stability and waveform.
17. Design a Colpitts oscillator and study its frequency stability and waveform.
18. Investigate the effect of negative feedback on amplifier performance.

Reference books:

1. "Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky
2. "Microelectronic Circuits" by Adel S. Sedra and Kenneth C. Smith
3. "Solid State Electronic Devices" by Ben G. Streetman and Sanjay Kumar Banerjee
4. "The Art of Electronics" by Paul Horowitz and Winfield Hill
5. "Electronic Principles" by Albert Malvino and David Bates
6. "Electronic Devices and Circuits" by David A. Bell
7. "Basic Electronics for Scientists and Engineers" by Dennis L. Eggleston
8. "Foundations of Analog and Digital Electronic Circuits" by Anant Agarwal and Jeffrey H. Lang
9. "Electronic Instrumentation and Measurements" by David A. Bell
10. "Operational Amplifiers and Linear Integrated Circuits" by Robert F. Coughlin and Frederick F. Driscoll

Learning Outcomes:

Upon completion, students will be able to verify Kirchhoff's laws and the maximum power transfer theorem. They will analyze transistor characteristics in various configurations, determine semiconductor band gaps, and study the variation of amplifier gain with frequency. Students will measure temperature-dependent resistance, understand diode and FET characteristics, design power supplies and rectifiers, explore oscillator designs and voltage multipliers, and investigate the impact of negative feedback on amplifiers, effectively bridging theoretical concepts with practical skills.

Syllabus

VI-Semester

UG0803-PHY-76T-303 –Quantum Mechanics and Spectroscopy

Semester	Code of the Course	Title of the Course/Paper	NHEQF Level	Credits
VI	UG0803-PHY-76T-303	Quantum Mechanics and Spectroscopy	7	4
Level of Course	Type of the Course	Delivery Type of the Course		
Introductory	Major/Minor	Lecture, Sixty Lectures(4 hour per week) including diagnostic and formative assessments during lecture hours.		
Prerequisites	Physics and Mathematics courses of Central Board of Secondary Education or equivalent.			

Objectives of the Course:	This course aims to introduce the basic features of quantum mechanics and its applications in various physical phenomena. It will help students explore the core concepts, experiments, and the mathematical framework of quantum mechanics. • A central theme of the course is the Schrödinger wave equation, which explains the behavior of quantum systems. • Students will learn how to solve the Schrödinger wave equation for various types of potential, as well as for the hydrogen atom. • They will also learn about the concept of orbital angular momentum and its quantization. • The final section introduces students to rotational and vibrational energy levels and spectra.

Unit - I: Evolution of quantum physics

1. Difficulties of classical mechanics to explain: the black-body emission spectrum, specific heat of solids. Plank quanta concept and radiation law, Photo electric effect and Einstein's explanations. Compton Effect, de-Broglie hypothesis, diffraction experiments for wave particles (Davisson-Germer experiment).
2. Uncertainty principle: position and momentum, angle and angular moment, energy, and time. Application of uncertainty principle: (i) Ground state energy of hydrogen atom, (ii) ground state energy of simple harmonic oscillator. (iii) Natural width of spectral lines, (iv) Non-existence of electron in nucleus.
3. Operators: linear operators, product of two operators, commuting and non-commuting operators. Simultaneous eigenfunction and eigenvalues, orthogonal wave functions, Hermitian operators, their eigenvalues. Hermitian adjoint operators. eigenvalues and eigenfunction; expectation values of operators: position, momentum, energy; Ehrenfest theorem and complementarity, Concept of group and phase velocity, wave packet, Gaussian wave packet, bra-ket notation.

(15 Lectures)

Unit - II: Schrödinger wave equation and its solutions

1. Schrödinger wave equation: general equation of wave propagation, propagation of matter waves, time dependent and time-independent Schrödinger equation, wavefunction representation (ψ), physical meaning of ψ. properties and conditions on ψ, postulates of wave mechanics, operators, observable and measurements; probability current density.
2. Time independent Schrödinger equation, stationary state solution, one dimensional problem: particle in one dimensional box, eigenfunctions and eigenvalues, discrete levels, generalization into three dimension and degeneracy of energy levels, concept of a potential well and barrier, step potential, penetration through rectangular barrier, reflection and transmission coefficients, barriers with special shapes (graphical representation), quantum mechanical tunneling effect. (alpha decay). **(15 Lectures)**

Unit - III: Schrödinger equation solutions in special cases

1. Symmetric square well potential, reflection and transmission coefficients, resonant scattering, bound state problems: particle in one dimensional infinite potential well and finite depth potential well, energy eigenvalues and eigenfunctions, transcendental equation and its solution; Simple harmonic oscillator. Schrödinger equation for simple harmonic oscillator and its solution, eigenfunction, eigenvalues, zero-point energy, quantum and classical probability density, parity, symmetric and antisymmetric wave functions with graphical representation.
2. Schrödinger equation in spherical coordinates, Schrödinger equation for one electron atom in spherical coordinates, separation into radial and angular variables, solution of radial equation and angular equation, qualitative discussion of spherical harmonics, series solution and energy eigenvalues, stationary state wave function. Wave-functions of H-atom for ground and first excited states, average radius of H-atom, Bohr correspondence principle, orbital angular momentum and its quantization, commutation relation, eigenvalues and eigenfunctions **(15 Lectures)**

UNIT IV: H-atom, Atomic and Molecular spectroscopy

1 Energy level derivation for H-atom, quantum features of hydrogen spectra and hydrogen like spectra, Stern-Gerlach experiment, electron spin, spin magnetic moment. Spin-orbit coupling. Qualitative explanation of fine structure, Franck-Hertz experiment. Zeeman effect, normal Zeeman splitting, Qualitative explanation of Stark effect.

2. Molecular spectroscopy: concept of rigid rotator, rotational energy levels, rotational spectra, selection rules, intensity of spectral lines, isotopic effect; Vibrational energy levels, vibrational spectra, selection rules, isotopic effect, effect of anharmonicity in vibrational spectra, vibrational-rotational spectra of CO and HCl molecules. **(15 Lectures)**

Suggested Books and Reference-

1. Griffiths, Introduction to Quantum Mechanics, 2nd edition.
2. R. Shankar, Principles of Quantum Mechanics, 2nd edition.
3. Arthur Beiser, Perspective of modern Physics, 6th edition.
4. AK Ghatak and S Lokanathan, Quantum Mechanics: Theory and application.
5. HS Mani, GK Mehta, Introduction to modern Physics.
6. C.N. Banwell and E.M. McCash, Fundamental of Molecular Spectroscopy, 4th edition.
7. H.E. White, Introduction to atomic physics,

Suggested E-sources:

Video Lectures:

MIT OpenCourseware - 8.04 Quantum Physics I https://ocw.mit.edu/courses/8-04-quantum-physics-i-spring-2016/

Lecture Series on Quantum Physics by Prof.V.Balakrishnan, Department of Physics, IIT Madras.

Learning Outcomes for Quantum Physics Course

Upon successful completion, this course students will gain a comprehensive understanding of the fundamental principles of quantum mechanics and be able to apply them to various

problems in Solid state physics, Nuclear and particle physics, and atomic and molecular physics.

Syllabus

UG 0803-PHY-76P-304-Physics Lab-VI

Semester	Code of the Course	Title of the Course/Paper	NHEQFE Level	Credits

VI	**UG 0803-PHY-76P-304**	**Physics Lab-VI**	**7**	**02**
Level of Course	Type of Course	Delivery of the Course		
Introductory	Major	**Practical, Sixty hours(4 hours per week) of practical including diagnostic and formative assessment during practical hours.**		
Introductory	B.Sc. Semester I and II Practical			
Objectives of the Course	The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies. To achieve perfectness in experimental skills and Measure fundamental constants and probe material properties in the lab.			

Exam Scheme-

Students will have to perform one practical in the exam. The duration of practical exam will be 4 hours.

Marks distribution

Student category	Experiments	Viva-voice	Record	Maximum marks
Regular Student	**20**	**10**	**10**	**40**
Non-collegiate	**30**	**20**	**N\A**	**50**

Marking distribution in practical

Student category	Theory/formula	Figure/circuit	Observation	Calculation	Results/Error	Precautions
Regular	**3**	**2**	**6**	**5**	**3**	**1**
Non-collegiate	**5**	**3**	**8**	**7**	**5**	**2**

List of experiments

[1] Determination of Planck's constant by photo cell (retarding potential method using optical filters, preferably five wavelengths).

[2] Determination of Planck's constant using solar cell.

[3] Determination of Stefan's constant (Black body method).

[4] Study of the temperature dependence of resistivity of a semiconductor using four probe-methods.

[5] Study of Iodine spectrum with the help of grating and spectrometer and ordinary bulb light.

[6] Study of characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.

[7] Study of β-absorption in Al foil using GM Counter to find endpoint energy.

[8] To find the magnetic susceptibility of a paramagnetic solution using Quincke's method.

[9] Determination of coefficient of rigidity as a function of temperature using torsional oscillator (resonance method).

[10] Study of polarization by reflection from a glass plate with the help of Nicol's prism and photocell and verification of Brewster's Law and Malus's Law.

[11] e/m measurement by helical method.

[12] Measurement of magnetic field using ballistic galvanometers and search coil (using earth inductor for calibration of galvanometer). Study of variation of magnetic field of an electromagnet with current.

[13] Measurement of electric charge by Millikan's oil drop method.

Learning outcomes -

This course covers a wide range of topics in physics. Upon completion, students will be able to: i. Quantify fundamental physical constants ii. Characterize material properties iii. Analyze radiation and its interactions iv. Investigate light polarization v. Develop proficiency in handling laboratory instrumentation.