Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: B.Sc. (Physics, Chemistry & Mathematics) — Semester: First

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA UE	CA TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1.	LN104	Essential Professional Communication	Foundation	3	1	0	40	20	60	40	100	3:1:0	4	✓	✓	✓			✓	✓
2.	PY106	Mechanics and Wave Motion	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
3.	CH117	General Chemistry-I	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
4.	MT121	Algebra and Trigonometry	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT122	Calculus	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PRACTICALS																				
6.	PY107	Mechanics Lab	Core	0	0	6	40	20	60	40	100	0:0:3	3			✓				
7.	CH118	Chemistry Practical-I	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓	✓	✓				
		Total		**14**	**5**	**10**	**280**	**140**	**420**	**280**	**700**	**14:5:5**	**24**							

Program: B.Sc. (Physics, Chemistry & Mathematics) — Semester: Second

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA UE	CA TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1.	ES115	Fundamentals of Environmental Science	Foundation	3	1	0	40	20	60	40	100	3:1:0	4			✓		✓	✓	
2.	PY108	Physical Optics and Lasers	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
3.	CH119	General Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
4.	MT123	Vector Analysis and Geometry	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT124	Differential Equations	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PRACTICALS																				
6.	PY109	Optics Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2			✓				
7.	CH120	Chemistry Practical-II	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓	✓	✓				
		Total		**15**	**5**	**8**	**280**	**140**	**420**	**420**	**700**	**15:5:4**	**24**							

Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: B.Sc. (Physics, Chemistry & Mathematics) **Semester: Third**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA UE	CA TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1.	PY201	Circuit Fundamentals & Basic Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4			✓				
2.	PY202	Kinetic Theory & Thermodynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
3.	CH221	Inorganic and Physical Chemistry-I	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓						
4.	CH222	Organic and Physical Chemistry-I	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT211	Numerical Computing	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PRACTICALS																				
6.	PY203	Electronics and Thermal Physics Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2			✓				
7.	CH223	Chemistry Practical-III	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓		✓				
8.	MT212	Numerical Computing Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓		✓				
		Total		**14**	**5**	**12**	**320**	**160**	**480**	**320**	**800**	**14:5:6**	**25**							

Program: B.Sc. (Physics, Chemistry & Mathematics) **Semester: Fourth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA UE	CA TA	Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
THEORIES																				
1.	PY204	Electricity & Magnetism	Core	3	1	0	40	20	60	40	100	3:1:0	4			✓				
2.	CH224	Inorganic and Physical Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4			✓				
3.	CH225	Organic and Physical Chemistry-II	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
4.	MT213	Tensor Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT214	Abstract Algebra	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PRACTICALS																				
6.	PY205	Electricity & Magnetism Lab	Core	0	0	6	40	20	60	40	100	0:0:3	3	✓		✓				
7.	CH226	Chemistry Practical-IV	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓	✓	✓				
		Total		**15**	**5**	**10**	**280**	**140**	**420**	**280**	**700**	**15:5:5**	**25**							

Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: B.Sc. (PCM), Group (Physics & Mathematics) **Semester: Fifth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	PY301	Elements of Quantum Mechanics, Atomic & Molecular Spectra	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
2.	PY302	Classical Mechanics, Relativity & Statistical Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3			✓				
3.	PY303	Solid State, Nuclear & Particle Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
4.	MT301	Advanced Calculus	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT302	Mathematical Statistics	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
6.	MT303	Number Theory	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
PRACTICALS																				
7.	PY304	Advance Electricity &Magnetism Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2			✓				
8.	MT304	Statistical Techniques Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓		✓				
		Total		**14**	**6**	**8**	**320**	**160**	**480**	**320**	**800**	**14:6:4**	**24**							

Program: B.Sc. (PCM), Group (Physics & Mathematics) **Semester: Sixth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	PY305	Applied Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4			✓				
2.	PY307	Mathematical Methods in Physics	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
	PY308	Advanced Solid-State Physics	Elective	3	1	0	40	20	60	40	100			✓		✓				
3.	MT307	Basic Mathematical Modeling	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
	MT308	Linear Programming	Elective	3	1	0	40	20	60	40	100			✓		✓				
4.	MT305	Statics & Dynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT306	Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PROJECT																				
6.	PY309	UG Physics Project	Core	0	0	8	00	00	00	200	200	0:0:4	4	✓		✓				
		Total		**15**	**5**	**8**	**200**	**100**	**300**	**400**	**700**	**15:5:4**	**24**							

Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: B.Sc. (PCM), Group (Chemistry & Mathematics) **Semester: Fifth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	CH314	Advance Inorganic Chemistry	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓						
2.	CH315	Advance Organic Chemistry	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓	✓					
3.	CH319	Basics of Chromatographic Techniques	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓	✓	✓		✓		
4.	MT301	Advanced Calculus	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT302	Mathematical Statistics	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
6.	MT303	Number Theory	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓		✓				
PRACTICALS																				
7.	CH316	Chemistry Practical-V	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓	✓	✓			✓	✓
8.	MT304	Statistical Techniques Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓		✓				
		Total		**14**	**6**	**8**	**320**	**160**	**480**	**320**	**800**	**14:6:4**	**24**							

Program: B.Sc. (PCM), Group (Chemistry & Mathematics) **Semester: Sixth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	CH308	Spectroscopic Techniques	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓	✓	✓				
2.	CH309	Chemical Process Industry	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓	✓	✓				✓
	CH317	Chemistry of Polymers	Elective	3	1	0	40	20	60	40	100			✓	✓	✓				✓
3.	MT307	Basic Mathematical Modeling	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
	MT308	Linear Programming	Elective	3	1	0	40	20	60	40	100			✓		✓				
4.	MT305	Statics & Dynamics	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
5.	MT306	Analysis	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
PROJECT																				
6.	CH318	UG Chemistry Project	Core	0	0	8	00	00	00	200	200	0:0:4	4	✓	✓	✓				
		Total		**15**	**5**	**8**	**200**	**100**	**300**	**400**	**700**	**15:5:4**	**24**							

Integral University, Lucknow
Department of Chemistry

Study and Evaluation Scheme

Program: B.Sc. (PCM), Group (Physics & Chemistry) **Semester: Fifth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	PY301	Elements of Quantum Mechanics, Atomic & Molecular Spectra	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
2.	PY302	Classical Mechanics, Relativity & Statistical Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3			✓				
3.	PY303	Solid State, Nuclear & Particle Physics	Core	2	1	0	40	20	60	40	100	2:1:0	3			✓				
4.	CH314	Advance Inorganic Chemistry	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓						
5.	CH315	Advance Organic Chemistry	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓	✓					
6.	CH319	Basics of Chromatographic Techniques	Core	2	1	0	40	20	60	40	100	2:1:0	3	✓	✓	✓		✓		
PRACTICALS																				
7.	PY304	Advance Electricity &Magnetism Lab	Core	0	0	4	40	20	60	40	100	0:0:2	2			✓				
8.	CH316	Chemistry Practical-V	Core	0	0	4	40	20	60	40	100	0:0:2	2	✓	✓	✓			✓	✓
			Total	**14**	**6**	**8**	**320**	**160**	**480**	**320**	**800**	**14:6:4**	**24**							

Program: B.Sc. (PCM), Group (Physics & Chemistry) **Semester: Sixth**

S. No.	Course code	Course Title	Type of Paper	Period Per hr/week/sem			Evaluation Scheme				Sub. Tot.	Credit	Total Credits	Attributes						
				L	T	P	CA		Total	ESE				Employability	Entrepreneurship	Skill Development	Gender Equality	Environment & Sustainability	Human Value	Professional Ethics
							UE	TA												
THEORIES																				
1.	PY305	Applied Electronics	Core	3	1	0	40	20	60	40	100	3:1:0	4			✓				
2.	PY307	Mathematical Methods in Physics	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓		✓				
	PY308	Advanced Solid-State Physics	Elective	3	1	0	40	20	60	40	100			✓		✓				
3.	CH309	Chemical Process Industry	Elective	3	1	0	40	20	60	40	100	3:1:0	4	✓	✓	✓				
	CH317	Chemistry of Polymers	Elective	3	1	0	40	20	60	40	100			✓	✓	✓				
4.	CH310/PY306	Fundamentals of Food Chemistry /Physics of Materials	Core	3	1	0	40	20	60	40	100	3:1:0	4	✓	✓	✓			✓	
PROJECT																				
5.	PY 309/CH318	UG Physics Project/UG Chemistry Project	Core	0	0	8	00	00	00	200	200	0:0:4	4	✓	✓	✓				
			Total	**15**	**5**	**8**	**200**	**100**	**300**	**400**	**700**	**15:5:4**	**24**							

L= Lecture, **T**= Tutorial, P = Practical, **CA**= Continuous Assessment, **UE**= Unit Exam. **TA**= Teacher's Assessment, **ESE**= End Semester Examination;
Sessional=CT+TA; **Subject Total**= Sessional+ESE;

SEMESTER – I

1. Name of the Department: LANGUAGES						
2. Course Name	**ESSENTIAL PROFESSIONAL COMMUNICATION**			**L**	**T**	**P**
3. Course Code	**LN104**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE ( )**	**FC (√)**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:**

- Developing the art of communication and learning language though literature
- Knowledge of Professional, cultural and cross-cultural communication
- Basic concept of structural and functional grammar; meaning and process of communication, verbal and nonverbal communication
- Knowledge of reading and comprehension of general and technical articles, precise writing, summarizing, abstracting
- Basic concepts of group discussion, organizing seminars and conferences
- Development of Reading and Writing skills

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Basic Understanding of Communication and Professional Communication
CO2	Basic knowledge of structural and functional grammar. Learning Language through literature
CO3	Basic tools of communication and improvement in communicative competence
CO4	Understanding the basic grammar and basic structure of language
CO5	Enhancement of writing skills in English i.e. writing application, report and various

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Professional Communication: Its Meaning and Importance, Essentials of Effective Communication, Barriers to Effective Communication. The Cross Cultural Dimensions of Professional Communication.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Interpersonal Communication: Culture- Definition and Types, Communication and Culture including Cross Cultural Communication.

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Written Communication: Letter Writing- Informal and Formal - Letters of Enquiry, Letters of complaint, Response to complaints and enquiries, Self Exploration through description

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Grammar through Worksheets: Situational activities and modules- Parts of Speech, Tenses, Articles, Modals, Active and Passive, Subject-Verb Agreement, Direct and Indirect Speech, Degrees of comparison.

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Grammar through Worksheets Continued: Sentences: Simple, Compound, Complex, Declarative, Assertive, Negative, Interrogative, Exclamatory, Imperative

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Basic Understanding of Communication and Professional Communication	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Basic knowledge of structural and functional grammar. Learning Language through literature	**3**	**1**	**1**		**2**	**1**	**1**
CO3	Basic tools of communication and improvement in communicative competence	**3**	**1**	**2**		**2**	**1**	**1**
CO4	Understanding the basic grammar and basic structure of language	**3**	**1**	**2**		**2**	**1**	**1**
CO5	Enhancement of writing skills in English i.e. writing application, report and various	**2**	**1**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

1. Wren PC and Martin H, "High School Grammar and Composition", S. Chand and Co.
2. K. Floyd , "Interpersonal Communication: The Whole Story" (2009), McGraw Hill,
3. Greenbaum Sidney and Nelson Gerald, "An Introduction To English Grammar", Pearson Swan
4. Michael, "Practical English Usage" OUP, 2005
5. Raymond Murphy, " Intermediate English Grammar", (2007) Cambridge University Press

SEMESTER – I

1. Name of the Department: PHYSICS						
2. Course Name	**MECHANICS AND WAVE MOTION**			**L**	**T**	**P**
3. Course Code	**PY106**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of physical chemistry. By using the principal of physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Grasped the fundamentals of different types of frames of references and transformation laws Both Galilean and Lorentz and learned conservation laws of energy and linear and angular momentum and apply them to solve problems.
CO2	Students will gain an understanding of rotation motion and get the knowledge about forces help the students in their daily life.
CO3	Students will gain an understanding of gravitational forces and learn the basics of potentials and fields, central forces, and Kepler's laws
CO4	Students will understand the physical characteristics of SHM and obtaining solution of the oscillator using differential equations.
CO5	Students will gain basic knowledge of wave motion and ability to outline the physical properties of wave motion.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: CONSERVATION LAWS

Inertial reference frame, Newton's laws of motion, dynamics of particle in rectilinear and circular motion, conservative and non -conservative forces, conservation of energy, liner momentum and angular momentum, collision in one and two dimensions, cross section.

Unit-2	Number of lectures =08	Title of the unit: ROTATIONAL MOTION

Rotational energy and rotational inertia for simple bodies, the combined translation and rotational and motion of a rigid body on horizontal and inclined planes, simple treatment of the motions of a top, Relations between elastic constants, bending of beams and torsion of cylinder.

Unit-3	Number of lectures = 08	Title of the unit: GRAVITATION

Law of gravitation, gravitational field and potential, gravitational potential energy, gravitational field intensity, central forces, two particle central force problem, reduced mass, relative and centre of mass motion, law of gravitation, Kepler's laws, motions of planets and satellites, geo-stationary satellites.

Unit-4	Number of lectures = 08	Title of the unit: OSCILLATIONS

Simple harmonic motion, differential equation of S. H. M. and its solution, some examples (mass- spring, simple pendulum, and compound pendulum), damped oscillator: Equation of motion and its solution, forced oscillations and resonance: solution of differential equation of a forced oscillator and variation of amplitude with frequency and damping.

Unit-5	Number of lectures = 08	Title of the unit: WAVE MOTION

Classification of waves, expression for a plane progressive and transverse harmonic wave, particle velocity and acceleration, path difference and phase difference, velocity of transverse waves in a string, differential equation of wave motion, plane progressive waves in fluid media, reflection of waves, phase change on reflection, superposition, stationary waves, pressure and energy distribution, phase and group velocity.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Grasped the fundamentals of different types of frames of references and transformation laws Both Galilean and Lorentz and learned conservation laws of energy and linear and angular momentum and apply them to solve problems.	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Students will gain an understanding of rotation motion and get the knowledge about forces help the students in their daily life.	**3**	**1**	**2**		**3**	**1**	**1**
CO3	Students will gain an understanding of gravitational forces and learn the basics of potentials and fields, central forces, and Kepler's laws	**3**	**1**	**2**		**3**	**1**	**1**
CO4	Students will understand the physical characteristics of SHM and obtaining solution of the oscillator using differential equations.	**3**	**1**			**2**	**1**	
CO5	Students will gain basic knowledge of wave motion and ability to outline the physical properties of wave motion.	**2**	**1**			**2**	**1**	

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

1. E. M. Purcell, Ed: "Berkeley Physics Course, Vol. 1, Mechanics" (McGraw- Hill).
2. R. P. Feymman, R. B. Lighton and M Sands; The Feymman Lectures in Physics, Vol. 1 (BI Publications, Bombay, Delhi, Calcutta, Madras).
3. J. C. Upadhyay: 'Mechanics (Himalaya Publishing House)
4. D.S. Mathur "Mechanics" (S. Chand).
5. P. K. Srivastava: "Mechanics" (New Age International).

SEMESTER – I

1. Name of the Department: CHEMISTRY						
2. Course Name	**GENERAL CHEMISTRY - I**			**L**	**T**	**P**
3. Course Code	**CH117**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** To learn about simple quantum mechanical treatments of atoms and molecules, atomic structures, periodic properties of elements, various electronic displacement effects in organic compounds, mechanisms of organic reactions. States of matters with an emphasis on the gaseous state.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Explain the atomic structures based on quantum mechanics. Can write the electronic configuration of elements.
CO2	Justify the causes of periodicity and periodic properties of the different groups of elements.
CO3	Evaluate the state of hybridization, geometry of atoms, nucleophiles, electrophiles and various electron displacement effects
CO4	Investigate the mechanisms of organic reactions, design syntheses of organic molecules.
CO5	Explain various 'gas laws' governing the physical/chemical behaviour of gases.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: ATOMIC STRUCTURE

Idea of de Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrodinger wave equation, significance of Ψ and Ψ2, quantum numbers, radial and angular wave functions and probability distribution curves, shapes of s, p, d orbitals. Aufbau and Pauli exclusion principles, Hund's multiplicity rule. Electronic configurations of the elements.

Unit-2	Number of lectures =08	Title of the unit: PERIODIC PROPERTIES

Atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, effective nuclear charge, methods of determination or evaluation, trends in periodic table and applications in predicting and explaining the chemical behavior.

Unit-3	Number of lectures = 08	Title of the unit: BASIC CONCEPT OF CHEMICAL BONDING IN ORGANIC CHEMISTRY

Hybridisation, tetravalency of carbon, geometry of molecules; methane, ethane, ethylene, acetylene and benzene, Factors affecting covalent bond; Electron displacement effects, inductive, electromeric, resonance, hyperconjugation and steric effects.

Unit-4	Number of lectures = 08	Title of the unit: MECHANISM OF ORGANIC REACTIONS

Homolytic and heterolytic bond breaking. Types of reagents-electrophiles and nucleophiles, Types of organic reactions. Energy considerations. Reactive intermediates-carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges in intermediates and other ionic

Unit-5	Number of lectures = 08	Title of the unit: GASEOUS STATE

Postulates of kinetic theory of gases, deviation from ideal behavior, van der Waals equation of state. Critical Phenomena: PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Problems Molecular velocities: Root mean square, average and most probable velocities.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Explain the atomic structures based on quantum mechanics. Can write the electronic configuration of elements.	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Justify the causes of periodicity and periodic properties of the different groups of elements.	**3**	**1**	**1**		**2**	**1**	**1**
CO3	Evaluate the state of hybridization, geometry of atoms, nucleophiles, electrophiles and various electron displacement effects	**3**	**1**	**2**		**2**	**1**	**1**
CO4	Investigate the mechanisms of organic reactions, design syntheses of organic molecules.	**3**	**1**	**2**		**2**	**1**	**1**
CO5	Explain various 'gas laws' governing the physical/chemical behavior of gases.	**2**	**1**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101090/lec1.pdf
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106096/lec9.pdf
3. https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/
4. https://www.youtube.com/watch?v=ZNo6gfCAgWE
5. https://nptel.ac.in/content/syllabus_pdf/104105033.pdf

13. Books recommended:

1. New Concise Inorganic Chemistry by J.D. Lee Edition III Compton Printing Ltd London.
2. Principles of Inorganic Chemistry by HR Puri, R. Sharma & S.P. Jauhar, Vishal Publications Jalandhar.
3. Organic Chemistry, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
4. Modern Organic Chemistry, M. K. Jain and S.C. Sharma, Vishal Publications Jalandhar.
5. Physical Chemistry, P.W. Atkins, Oxford University Press.
6. Principles of Physical Chemistry, B.R. Puri& L.R. Sharma, Shoban Lal Nagin Chand & Co.

SEMESTER – I

1. Name of the Department: MATHEMATICS						
2. Course Name	**ALGEBRA AND TRIGONOMETRY**			**L**	**T**	**P**
3. Course Code	**MT121**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of Algebra and Trigonometry. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Describe and interpret Symmetric, Skew-symmetric, Hermitian and skew-Hermitian matrices, Elementary operations, Rank of Matrix, Linear independence of row and columns matrices, consistency and inconsistency of linear equations, eigen values and eigen vectors, Cayley Hamilton theorem and its applications
CO2	Evaluate and Interpret Relation between roots and coefficient of general polynomial equation in one variable, transformation of equations, Discrete rule of sign, solution of cubic(Cardon Method), biquadratic equations.
CO3	Explain and interpret Binary operations, algebraic structures, Definition of a group with examples and simple properties, subgroups, cyclic groups, Permutation groups
CO4	Explain and interpret Binary operations, algebraic structures, Definition of a group with examples and simple properties, subgroups, cyclic groups, Permutation groups
CO5	Find and interpret Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: MATRIX

Matrix: Symmetric, Skew-symmetric, Hermitian and skew-Hermitian, Elementary operations, Rank of Matrix, Linear independence of row and columns matrices, consistency and inconsistency of linear equations, characteristic equations, eigen values and eigen vectors, Cayley Hamilton theorem and applications.

Unit-2	Number of lectures =08	Title of the unit: POLYNOMIAL EQUATION

Relation between roots and coefficient of general polynomial equation in one variable, transformation of equations, Descarte rule of sign, solution of cubic (Cardon Method), biquadratic equations.

Unit-3	Number of lectures = 08	Title of the unit: BINARY OPERATIONS

Binary operations, algebraic structures, Definition of a group with examples and simple properties,subgroups,cyclic groups,Permutation groups

Unit-4	Number of lectures = 08	Title of the unit: BINARY OPERATIONS – 2

Binary operations, algebraic structures,Definition of a group with examples and simple properties,subgroups,cyclic groups,Permutation groups

Unit-5	Number of lectures = 08	Title of the unit: COMPLEX FUNCTIONS

Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Describe and interpret Symmetric, Skew-symmetric, Hermitian and skew-Hermitian matrices, Elementary operations, Rank of Matrix, Linear independence of row and columns matrices, consistency and inconsistency of linear equations, eigen values and eigen vectors, Cayley Hamilton theorem and its applications	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Evaluate and Interpret Relation between roots and coefficient of general polynomial equation in one variable, transformation of equations, Discrete rule of sign, solution of cubic(Cardon Method), biquadratic equations.	**3**	**1**	**1**		**2**	**1**	**1**
CO3	Explain and interpret Binary operations, algebraic structures, Definition of a group with examples and simple properties, subgroups, cyclic groups, Permutation groups	**3**	**1**	**2**		**2**	**1**	**1**
CO4	Explain and interpret Binary operations, algebraic structures, Definition of a group with examples and simple properties, subgroups, cyclic groups, Permutation groups	**3**	**1**	**2**		**2**	**1**	**1**
CO5	Find and interpret Complex functions and separation into real and imaginary parts, Exponential, direct and inverse trigonometric and hyperbolic functions, logarithmic function, Gregory's series, Summation of series	**2**	**1**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. http://nasc.ac.in/nasc/images/StudyMaterials/Physics/UGCGATEmatrix.pdf
2. https://nptel.ac.in/courses/111106113/
3. https://www.youtube.com/watch?v=WaNdQh0w6Xc

13. Books recommended:

1. Topics in Algebra; I.N. Hernstein, Wiley Eastern Ltd., New Delhi.
2. Matrix & Linear Algebra; K.B.Datta, Prentice Hall of India Pvt. Ltd. New Delhi.
3. Basic Abstract Algebra; P.B.Bhattacharya, S.K. Jain & S .R Nagpaul, Cambridge University Press, Indian Edition.
4. Higher Algebra; H.S. Hall, S.R. Knight, H.M. Publications.
5. Text Book on Algebra & theory of equations; Chandrika Prasad, Pothishala Private Ltd., Allahabad.
6. Plane Trigonometry Part II: S.L.Loney, Macmillan & company, London.

SEMESTER – I

1. Name of the Department: MATHEMATICS						
2. Course Name	**CALCULUS**			**L**	**T**	**P**
3. Course Code	**MT122**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. **COURSE OBJECTIVES:** The course is aimed to develop the skills in mathematics specially in calculus which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Take limits of algebraic and trigonometric expressions of the form 0/0 (that simplify), non-zero number over 0, including limits that go to (positive or negative) infinity, limits that don't exist and limits that are finite.
CO2	Use and understand the limit definitions of derivative for polynomial, rational and some trigonometric functions; understand definition of continuity and consequences.
CO3	Differentiate all polynomial, rational, radical, and trigonometric functions and compositions of those functions; perform implicit differentiation and compute higher order derivatives.
CO4	Compute indefinite integrals and find anti-derivatives, including finding constants of integration given initial conditions.
CO5	Apply the definite integral to compute area between two curves, volumes of solids of revolutions, arc length, surface area for surfaces of revolution and work problems.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit:

–δ definition of the limit of a function, Continuous functions and classification of discontinuities, Differentiability, Chain rule of differentiability, Rolle's theorem, First and second mean value theorems, Taylor's theorems with Lagrange's and Cauchy's forms of remainder, Successive differentiation and Leibnitz's theorem.

Unit-2	Number of lectures =08	Title of the unit:

Expansion of functions (in Taylor's and Maclaurin's series), Indeterminate forms, Partial differentiation and Euler's theorem, Jacobians.

Unit-3	Number of lectures = 08	Title of the unit:

Maxima and Minima (for functions of two variables), Tangents and normals (polar form only), Curvature, Envelopes and evolutes.

Unit-4	Number of lectures = 08	Title of the unit:

Asymptotes, Tests for concavity and convexity, Points of inflexion, Multiple points, Tracing of curves in Cartesian and polar co-ordinates. Integral Calculus Reduction formulae, Beta and Gamma functions.

Unit-5	Number of lectures = 08	Title of the unit:

Qudrature, Rectification, Volumes and surfaces of solids of revolution, Pappus theorem, Double and triple integrals, Change of order of integration, Dirichlet's and Liouville's integral formulae.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Take limits of algebraic and trigonometric expressions of the form 0/0 (that simplify), non-zero number over 0, including limits that go to (positive or negative) infinity, limits that don't exist and limits that are finite.	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Use and understand the limit definitions of derivative for polynomial, rational and some trigonometric functions; understand definition of continuity and consequences.	**3**	**1**	**1**		**2**	**1**	**1**
CO3	Differentiate all polynomial, rational, radical, and trigonometric functions and compositions of those functions; perform implicit differentiation and compute higher order derivatives.	**3**	**1**	**2**		**2**	**1**	**1**
CO4	Compute indefinite integrals and find anti-derivatives, including finding constants of integration given initial conditions.	**3**	**1**	**2**		**2**	**1**	**1**
CO5	Apply the definite integral to compute area between two curves, volumes of solids of revolutions, arc length, surface area for surfaces of revolution and work problems.	**2**	**1**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/content/storage2/courses/111101109/W3A1.pdf
2. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Core%20Science/Mathematics%20I/Course_home_27.2.html
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/111105121/lec19.pdf
4. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/111101109/lec35.pdf
5. https://www.youtube.com/watch?v=t4T0ru5LWa0

13. Books recommended:

1. Gabriel Kiambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York,
2. Murray R. Spiegel, Theory & Problem of Advanced Calculus, Schaum's outline series, Schaum's Publishing Co., New York
3. N.Piskunov, Differential & Integral Calculus, Peace publishers, Moscow.
4. P.K.Jain & S.K. Kaushik, An Introduction to Real Analysis, S.Chand & Co. New Delhi
5. Differential Calculus by Gorakh Prasad, Seventeenth Edition, Reprint 2007,
6. Integral Calculus by Gorakh Prasad, Fourteenth Edition, Reprint 2007, Pothishala Private Limited, Allahabad.

SEMESTER – I

1. Name of the Department: PHYSICS						
2. Course Name	**MECHANICS LAB**			**L**	**T**	**P**
3. Course Code	**PY107**			0	0	6
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart practical knowledge/measurements in mechanics through different experiments related to its theoreical course.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Determine elastic properties of rigid materials.
CO2	Demonstrate capillary rise and determine physical properties of water.
CO3	Demonstrate simple harmonic motion through damped and forced oscillators and measure related quantities.
CO4	Demonstrate uses of Sextant by measuring dimensions of a given object.

10. Syllabus

Exp – 01	Determination of Modulus of Rigidity of the material by Statistical method.
Exp – 02	Determination of Young's Modulus of the Material by Flexure Method.
Exp – 03	Determination of Coefficient of Viscosity of Water.
Exp – 04	Determination of Surface Tension of Water.
Exp – 05	Determination of Acceleration due to gravity by Compound Pendulum.
Exp – 06	Determination of frequency of A. C. Mains with the help of sonometer.
Exp – 07	Measurement of height of a tower with a sextant.
Exp – 08	Study of oscillations of mass under different combination of springs.
Exp – 09	To find the capacity of a condenser with electrical vibrator using A.C. supply of 50 Hz.
Exp – 10	To study of moment of inertia of a body with the help of inertia table.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Determine elastic properties of rigid materials.	**3**	**2**	**2**		**3**	**1**	**3**
CO2	Demonstrate capillary rise and determine physical properties of water.	**3**	**2**	**2**		**3**	**1**	**3**
CO3	Demonstrate simple harmonic motion through damped and forced oscillators and measure related quantities.	**3**	**2**	**2**		**3**	**1**	**3**
CO4	Demonstrate uses of Sextant by measuring dimensions of a given object.	**3**	**2**	**2**		**3**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.phywe.com/en/physics/university/mechanics/
2. www.youtube.com
3. https://nrrbeassistance.blogspot.com/2016/08/mechanics-by-r-k-shukla-and-a-srivastava-pdf-download.html
4. http://www.rossnazirullah.com/BSc/BSc.html.

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc.Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

SEMESTER – I

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – I**			**L**	**T**	**P**
3. Course Code	**CH118**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry
CO2	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO3	Able to detect presence of elements and functional group in organic compounds.
CO4	Remember to keep records of all performed experiments in the manner which is required in laboratory

10. Syllabus

Exp – 01	Preparation of standard solution related to normality & molarity.
Exp – 02	Preparation of buffer solution, pH measurement.
Exp – 03	Acid - base titration.
Exp – 04	Oxidation-reduction (redox) titrations. a) To determine the strength of oxalic acid.
Exp – 05	To determine the strength of potassium permanganate solution by using sodium thiosulphate solution. Iodometrically.
Exp – 06	To determine the strength of given copper sulphate solution by using sodium thiosulphate solution. Iodometrically.
Exp – 07	Complexometric titrations. a) To estimate the concentration of calcium ions with EDTA. b) To estimate the concentration of magnesium ions with EDTA.
Exp – 08	Detection of element present in the given organic compounds.
Exp – 09	Detection of functional group present in the given organic compounds. a) Carboxylic b) Phenolic c) Alcoholic d) Aldehydic e) Ketonic f) Ester g) Amine h) Amide
Exp – 10	To determine the strength of ferrous ammonium sulphate (Mohr's salt) solution by using external indicator.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understand the basic analytical and technical skills and technical skills to work effectively in the various fields of chemistry	**3**	**2**	**2**		**3**	**1**	**3**
CO2	Understand the basic titration methods and technical skills to work in the different fields of chemistry.	**3**	**2**	**2**		**3**	**1**	**3**
CO3	Able to detect presence of elements and functional group in organic compounds.	**3**	**2**	**2**		**3**	**1**	**3**
CO4	Remember to keep records of all performed experiments in the manner which is required in laboratory	**3**	**2**	**2**		**3**	**1**	**3**
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	**2**	**2**	**1**		**1**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Practical Organic Chemistry, A.I.Vogel.
3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.
4. Experimental Inorganic Chemistry –W.G.Palmer.

SEMESTER – II

1. Name of the Department: ENVIRONMENTAL SCIENCE						
2. Course Name	**FUNDAMENTAL OF ENVIRONMENTAL SCIENCE**			**L**	**T**	**P**
3. Course Code	**ES115**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE ( )**	**FC (√)**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. **COURSE OBJECTIVES:** The main objective of this course is to study various types of pollutants, their sources, control and their harmful effects on living species and environment.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Evaluate different types of air pollutants, their harmful effects on living and non living species; Study of Global Warming, Green House Effect and Ozone Layer Depletion. Oxygen, nitrogen and carbon cycle.
CO2	Analyze the various factors of water quality assessment parameters, water pollutants and Waste water treatment processes.
CO3	Understand the soil composition, soil pollutants, their control, National and International Standards.
CO4	Evaluate the various types waste and their toxicity aspects and management.
CO5	Understand the sources of heavy metals and their related toxicity.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: AIR POLLUTANTS

CO, CO2, ozone, CFC; ozone depletion; global warming & NOx; Harmful effects of pollutants on living and non-living species; Oxygen, nitrogen and CO2 cycle, Air quality standard, Bhopal gas tragedy, Chernobyl disaster.

Unit-2	Number of lectures =08	Title of the unit: QUALITY PARAMETERS AND WATER POLLUTION

Water quality parameters; international and national standards; Water quality assessment. Water pollution and its control; water pollutants; toxicity. Water sampling techniques, Preservation.

Unit-3	Number of lectures = 08	Title of the unit: AGRICULTURAL POLLUTANTS

Fertilizers, insecticides, pesticides, plastics, toxic metals, dyes, surfactants and their toxicity; international and national standards; control.

Unit-4	Number of lectures = 08	Title of the unit: INDUSTRIAL WASTE

Industrial waste: toxic aspects, management and disposal. Radioactive, municipal, and biomedical waste – toxicity hazards, management and disposal.

Unit-5	Number of lectures = 08	Title of the unit: CHEMICAL TOXICOLOGY

Toxic chemicals in the Environment, biochemical effects of Mercury and Lead, Carcinogens, Vector-borne disease, water-borne disease, Pollution and Public Health issues.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Evaluate different types of air pollutants, their harmful effects on living and nonliving species; Study of Global Warming, Green House Effect and Ozone Layer Depletion. Oxygen, nitrogen and carbon cycle.	**3**	**2**	**3**	**3**	**3**	**3**	**2**
CO2	Analyze the various factors of water quality assessment parameters, water pollutants and Waste water treatment processes.	**3**	**2**	**3**	**3**	**3**	**3**	**2**
CO3	Understand the soil composition, soil pollutants, their control, National and International Standards.	**3**	**2**	**3**	**3**	**3**	**3**	**2**
CO4	Evaluate the various types waste and their toxicity aspects and management.	**3**	**2**	**3**	**3**	**3**	**3**	**2**
CO5	Understand the sources of heavy metals and their related toxicity.	**3**	**2**	**3**	**3**	**2**	**3**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.britannica.com/science/pollution-environment
2. https://www.livescience.com/22728-pollution-facts.html
3. https://www.hindawi.com/journals/jeph/2012/341637/
4. https://www.conserve-energy-future.com/causes-and-effects-of-environmental-pollution.php

13. Books recommended:

1. Environmental Chemistry Manahan, Stanley E, 2004, Taylor & Francis Ltd
2. Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition, CRC-Press
3. Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy, Oxford Univ Pr (Sd)
4. Introduction To Environmental Chemistry, Reid, Brian J. Blackwell Science Ltd
5. Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hall publication.
6. Environmental Chemistry, Vanloon, Gary W Duffy, Stephen J., Oxford Higher Education publication

SEMESTER – II

1. Name of the Department: PHYSICS						
2. Course Name	**PHYSICAL OPTICS AND LASERS**			**L**	**T**	**P**
3. Course Code	**PY108**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** This course provides students with a working knowledge of optical physics, including diffraction, polarization and laser physics

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The student will be introduced to the design of optical systems and aberrations, with an emphasis on image forming systems.
CO2	The wave optics part of the course will give the student a thorough fundamental knowledge within interferometry and coherence. They will be able to determine the wavelengths of light sources using concepts of interference.
CO3	Students will be able to determine the wavelength of light using the phenomena of diffraction and Resolving power of various optical instruments.
CO4	Students will learn to analyse the polarization in optical systems and will be able to represent polarized light using Jones formalism.
CO5	The students will be introduced to lasers. They will be able to explain various applications and working of different types of lasers.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: GEOMETRICAL OPTICS AND NATURE OF LIGHT**

Fermat's principle and its application to obtain laws of reflection and refraction, cardinal points of an optical system, chromatic and spherical aberrations, coma, astigmatism. Idea of wave, electromagnetic and quantum theory of light, Definition and properties of wave front, Huygens' Principle

Unit-2	**Number of lectures =08**	**Title of the unit: INTERFERENCE OF LIGHT**

The principle of superposition, two-slit interference, coherence requirement for the sources, optical path retardations, lateral shift of fringe, thin films, applications for precision measurements for displacements, Haidinger fringes: Fringes of equal inclination, Michelson interferometer, its application for precisional determination of wavelength, wavelength difference, Newton's rings, Fabry- Perrot interferometer and etalon.

Unit-3	**Number of lectures = 08**	**Title of the unit: DIFFRACTION**

Fresnel half-period zones, plates, straight edge, rectilinear propagation, Fraunhoffer diffraction: diffraction at a slit, half-period zones, the intensity distribution, diffraction at a circular aperture and a circular disc, resolution of images, Rayleigh criterion, resolving power of telescope and microscopic systems, reflection grating, Resolving power of a grating and comparison with resolving powers of prism.

Unit-4	**Number of lectures = 08**	**Title of the unit: POLARIZATION**

Double refraction in uniaxial crystals, Nicol prism, polaroids and retardation plates, Babinet's compensator, Analysis of polarized light, Optical activity and Fresnel's explanation, Half shade and Biquartz polarimeters, Matrix representation of plane polarized waves, matrices for polarizers, retardation plates and rotators.

Unit-5	**Number of lectures = 08**	**Title of the unit: LASERS**

Purity of a special line, coherence length and coherence time, spatial coherence of a source, Einstein's A and B coefficients, spontaneous and induced emissions, conditions for laser action, population inversion, 3 and 4 Level Systems (Ruby, Nd:YAG, CO2, liquid dye and He-Ne laser), Properties and applications of laser.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	The student will be introduced to the design of optical systems and aberrations, with an emphasis on image forming systems.	**3**	**1**			**2**		**1**
CO2	The wave optics part of the course will give the student a thorough fundamental knowledge within interferometry and coherence. They will be able to determine the wavelengths of light sources using concepts of interference.	**3**	**2**			**2**		**1**
CO3	Students will be able to determine the wavelength of light using the phenomena of diffraction and Resolving power of various optical instruments.	**3**	**1**			**2**	**1**	**3**
CO4	Students will learn to analyse the polarization in optical systems and will be able to represent polarized light using Jones formalism.	**3**	**1**			**2**		**1**
CO5	The students will be introduced to lasers. They will be able to explain various applications and working of different types of lasers.	**2**	**1**			**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. http://textofvideo.nptel.ac.in/104105033/lec39.pdf.
2. http://nptel.ac.in/courses/104101006/downloads/lecture-notes/mod10/lec3.pdf
3. https://www.youtube.com/watch?v=1jRo5fTg0KY

13. Books recommended:

1. K. Ghatak, "Physical Optics" (Tata McGrew Hill).
2. D. P. Khandelwal; "Optics and Atomic Physics" (Himalaya, Publishing House, Bombay, 1988).
3. F. Smith and J.H Thomson; "Manchester Physics sries; Optics" (English Language Book Society and John Wiley, 1977).
4. Born and Wolf; "Optics" (University of Rochester, New York)
5. K. D. Moltey; "Optics" (Oxford University Press).
6. Jenkins and White; "Fundamental of Optics" (McGraw-Hill).
7. Smith and Thomson; "Optics" (John Wiley and Sons).
8. B.B. Laud; "Lasers" (New Age).

SEMESTER – II

1. Name of the Department: CHEMISTRY						
2. Course Name	**GENERAL CHEMISTRY-II**			**L**	**T**	**P**
3. Course Code	**CH119**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. COURSE OBJECTIVES: The purpose of this course is to learn the structure and properties of ionic solids, shapes & geometries of molecules and their stereochemistry. Types and properties of colloids, first law of thermodynamics and related calculations.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Analyze the properties, structure of ionic solids by applying Born-Haber cycle, Fajan's rule etc.
CO2	Predict the geometry and shape of molecules by applying VB & VSEPR theories. Predict the properties of molecules by applying MO theory
CO3	Interpret the reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry.
CO4	Able to prepare different types of colloids.
CO5	Understand the concepts of thermodynamics, different thermodynamic quantities such as heat and work and their measurements.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: IONIC SOLIDS

Ionic structures, radius ratio effect and coordination number, limitation of radius ratio rule, lattice defects, semiconductors, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule. Metallic bond-free electron, valence bond and band theories.

Unit-2	Number of lectures =08	Title of the unit: CHEMICAL BONDING:

Covalent Bond; Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions. Valence shell electron pair repulsion (VSEPR) theory to NH3, H3O+, SF4, ClF3, ICl2- and H2O. MO theory, homonuclear and heteronuclear (CO and NO) diatomicmolecules, bond strength and bond energy, percentage ionic character from dipole moment and electronegativity difference.

Unit-3	Number of lectures = 08	Title of the unit: INTRODUCTION TO STEREOCHEMISTRY OF ORGANIC COMPOUNDS

Concept of isomerism. Optical isomers, enantiomers and diastereomers, chiral and achiral moecules with two stereogenic centres, absolute configuration, sequences rules, D & L and R & S systems of nomenclature. Geometrical isomerism - E & Z system of nomenclature, in alkenes oximes and cyclopropane derivative compounds.

Unit-4	Number of lectures = 08	Title of the unit: COLLOIDAL STATE

Definition of colloids, classification of colloids. Sols: properties -kinetic, optical and electrical; stability of colloids, protectivecolloids, Hardy- Schulze rule, gold number. Emulsions: types of emulsions, preparation. Gels: classification, preparation and properties

Unit-5	Number of lectures = 08	Title of the unit: THERMODYNAMICS

First law of thermodynamics: statement, definition of internal energy and enthalphy, Heat capacity. Heat capacities at constant volume and pressure and their relationship. 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. Problems.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Analyze the properties, structure of ionic solids by applying Born-Haber cycle, Fajan's rule etc.	**3**	**2**	**1**	**1**	**2**	**2**	**3**
CO2	Predict the geometry and shape of molecules by applying VB & VSEPR theories. Predict the properties of molecules by applying MO theory	**3**	**1**	**1**	**1**	**2**	**2**	**3**
CO3	Interpret the reactivity and stability of an organic molecule based on structure, including conformation and stereochemistry.	**3**	**2**	**1**	**1**	**1**	**1**	**3**
CO4	Able to prepare different types of colloids.	**3**	**1**	**2**	**1**	**1**	**3**	**3**
CO5	Understand the concepts of thermodynamics, different thermodynamic quantities such as heat and work and their measurements.	**3**	**2**	**2**	**1**	**2**	**2**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=O82d8aiIS5Y
2. https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/
3. https://nptel.ac.in/courses/104103110/
4. https://nptel.ac.in/courses/104103023/
5. https://nptel.ac.in/courses/104105086/

13. Books recommended:

1. New Concise Inorganic Chemistry by J.D. Lee Edition III Compton Printing Ltd London.
2. Principles of Inorganic Chemistry by HR Puri, R. Sharma & S.P. Jauhar, Vishal Publications Jalandhar.
3. Basic Inorganic Chemistry F.A. Cotton and G. Willkinson III Edition.
4. Organic Chemistry, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International).
5. Modern Organic Chemistry, M. K. Jain and S.C. Sharma, Vishal Publications Jalandhar.
6. Physical Chemistry, P.W. Atkins, Oxford University Press.

SEMESTER – II

1. Name of the Department: MATHEMATICS						
2. Course Name	**VECTOR ANALYSIS AND GEOMETRY**			**L**	**T**	**P**
3. Course Code	**MT123**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of vector analysis and geometry. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Find and interpret Scalar & vector product of three vectors, Product of four vectors, Reciprocal Vectors, Vector Differentiation, gradient, divergence and curl for a function at a given point.
CO2	Evaluate and Interpret line, surface and volume integrals. Evaluate integrals by using Green's theorem, Stokes theorem, Gauss Divergence theorem.
CO3	Describe the General equation of second degree, System of conics, Confocal conics, Polar equation of a conic.
CO4	Find and Interpret the various forms of the equations of a line, Plane, Sphere, Cone and Cylinder.
CO5	Find the Central Conicoids, Paraboliods, Plane sections of conicoids, reduction of second degree equations.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Scalar & vector product of three vectors. Product of four vectors. Reciprocal Vectors. Vector Differentiation. Gradient, Divergence, Curl.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Vector integration. Line integral, Surface integral, Volume integral, Gauss divergence theorem, Stokes theorem, Greens theorem.

Unit-3	**Number of lectures = 08**	**Title of the unit:**

General equation of second degree. System of conics. Confocal conics. Polar equation of a conic.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Straight Line: Introduction, Various forms of the equations of a line Plane: Introduction, particular planes, various forms of the equations of a plane, Sphere, Cone ,Cylinder

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Central Conicoids, Paraboloids, Plane sections of conicoids, reduction of second degree equations

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Find and interpret Scalar & vector product of three vectors, Product of four vectors, Reciprocal Vectors, Vector Differentiation, gradient, divergence and curl for a function at a given point.	**3**	**1**	**1**	**1**	**2**	**3**	**3**
CO2	Evaluate and Interpret line, surface and volume integrals. Evaluate integrals by using Green's theorem, Stokes theorem, Gauss Divergence theorem.	**3**	**2**	**1**	**1**	**2**	**1**	**2**
CO3	Describe the General equation of second degree, System of conics, Confocal conics, Polar equation of a conic.	**3**	**2**	**1**	**1**	**2**	**1**	**1**
CO4	Find and Interpret the various forms of the equations of a line, Plane, Sphere, Cone and Cylinder.	**3**	**2**	**2**	**1**	**1**	**1**	**1**
CO5	Find the Central Conicoids, Paraboliods, Plane sections of conicoids, reduction of second degree equations.	**2**	**2**	**1**	**1**	**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=SZCsFS9izfQ
2. https://www.digimat.in/nptel/courses/video/111105122/L37.html
3. http://www.bhojvirtualuniversity.com/slm/bsc1_maths3.pdf
4. https://nptel.ac.in/courses/104103023/

13. Books recommended:

1. Murray R. Spiegel, Vector Analysis, Schaum Publishing Company, New York.
2. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Co. , New Delhi.
3. Gorakh Prasad & H.C.Gupta, Text Book on Coordinate Geometry, Pothishala Private Ltd., Allahabad.
4. R.J.T.Bill, Elementary Treatise on coordinate Geometry of three Dimensions, Macmillan India Ltd.
5. P.K.Jain & Khalil Ahmad, A Text Book of two dimensions , Wiley Eastern Ltd.
6. N.Saran & R.S.Gupta, Analytical Geometry of three dimensions, Pothishala Private Ltd., Allahabad.

SEMESTER – II

1. Name of the Department: MATHEMATICS						
2. Course Name	**DIFFERENTIAL EQUATIONS**			**L**	**T**	**P**
3. Course Code	**MT124**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of ordinary and partial differential equations and their solutions. Students will be able to apply different methods to solve the different categories of equations. After successful completion of course, the student will be able to explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding and formations of ordinary differential equations .They will be able to solve equations of first order and first degree homogeneous, linear and exact equations, along with higher order linear differential equations with constant coefficients & homogeneous linear differential equations.
CO2	Students will be able to understand and solve differential equations of the first order but not of the first degree, Clairaut's equations, simultaneous linear differential equations and linear differential equations of the second order (including the method of variation of parameters).
CO3	Students will gain an understanding of formations of partial differential equations and will be able to solve them by direct Integration, Lagrange's method for first order linear partial differential equations and first order nonlinear partial differential equations including Charpit's method.
CO4	Students will create the own understanding to classify of linear partial differential equations of second order and to obtain the solutions of linear partial differential equations with constant coefficients of second order.
CO5	Students will gain an understanding of power series and series solution of differential equations for ordinary point and singular points by Frobenius method.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit:

Formation of a differential equation (D.E.), Degree, order and solution of a D.E. Equations of first order and first degree : Separation of variables method, Solution of homogeneous equations, linear equations and exact equations, Linear differential equations with constant coefficients, Homogeneous linear differential equations

Unit-2	Number of lectures =08	Title of the unit:

Differential equations of the first order but not of the first degree, Clairaut's equations and singular solutions, Simultaneous linear differential equations, Linear differential equations of the second order (including the method of variation of parameters).

Unit-3	Number of lectures = 08	Title of the unit:

Partial differential equations, Order, Method of forming Partial Differential Equations, Solution of Equations by Direct Integration, First order Linear Partial Differential Equations, Lagrange's Method, First order non linear Partial differential equations, Charpit's method.

Unit-4	Number of lectures = 08	Title of the unit:

Classification of linear partial differential equations of second order, linear partial differential equations with constant coefficients of second order, Homogeneous & non homogeneous partial differential equations.

Unit-5	Number of lectures = 08	Title of the unit:

Power Series, Solution of Differential Equations, Ordinary Point, Singular point, Frobenius Method.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding and formations of ordinary differential equations .They will be able to solve equations of first order and first degree homogeneous, linear and exact equations, along with higher order linear differential equations with constant coefficients & homogeneous linear differential equations.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO2	Students will be able to understand and solve differential equations of the first order but not of the first degree, Clairaut's equations, simultaneous linear differential equations and linear differential equations of the second order (including the method of variation of parameters).	**3**	**1**	**2**	**1**	**1**	**1**	**2**
CO3	Students will gain an understanding of formations of partial differential equations and will be able to solve them by direct Integration, Lagrange's method for first order linear partial differential equations and first order nonlinear partial differential equations including Charpit's method.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO4	Students will create the own understanding to classify of linear partial differential equations of second order and to obtain the solutions of linear partial differential equations with constant coefficients of second order.	**3**	**1**	**2**	**1**	**1**	**1**	**2**
CO5	Students will gain an understanding of power series and series solution of differential equations for ordinary point and singular points by Frobenius method.	**3**	**1**	**2**	**1**	**1**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/111107111/
2. https://www.digimat.in/nptel/courses/video/111105093/L01.html
3. https://www.library.gscgandhinagar.in/assets/admin/images/MAT-102(UNIT1,2).pdf

13. Books recommended:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc.,New York.
2. D.A. Murray, Introductory Course on Differential Equations, Orient Longman,(India) .
3. A.R.Forsyth, A Treatise on Differential Equations, Macmillan & Co. Ltd., London.
4. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company.
5. D.G Zill, A First Course In Differential Equations with Modelling Applications, Cengage Learning
6. G.F Simmons Differential Equations with Applications and Historical Notes McGraw Hill Education; 2 edition
7. M.D Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publishing, Twentieth edition.

SEMESTER – II

1. Name of the Department: PHYSICS						
2. Course Name	**OPTICS LAB**			**L**	**T**	**P**
3. Course Code	**PY109**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart practical knowledge/measurements in mechanics through different experiments related to its theoreical course.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Determine wavelength of light.
CO2	Determine resolving power of telescope and dispersive power of prism and grating etc.
CO3	Demonstrate the use of lenses and measure the distance at which two lenses should be placed in order to get desired focal length.
CO4	Determine refractive index of given liquid and prism.

10. Syllabus

Exp – 01	Determination of wavelength of sodium light by Newton's Rings.
Exp – 02	Determination of Specific Rotation of Sugar solution by half shade Polarimeter.
Exp – 03	Determination of refractive index of a material of a prism by spectrometer.
Exp – 04	Verification of Brewster's law.
Exp – 05	Determination of wavelength of sodium light of by using Fresnel's Biprism.
Exp – 06	Determination of wavelength of mercury light by using Plane diffraction grating.
Exp – 07	To determine the dispersive power of a plane transmission diffraction grating.
Exp – 08	To determine the resolving power of a telescope.
Exp – 09	Determination of refractive index of water using laser.
Exp – 10	To determine the focal length of combination of two lenses separated by a distance d with the help of a nodal slide and to verify the formula: $\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{x}{f_1 f_2}$.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Determine wavelength of light.	**3**	**2**	**2**		**3**	**1**	**3**
CO2	Determine resolving power of telescope and dispersive power of prism and grating etc.	**3**	**2**	**2**		**3**	**1**	**3**
CO3	Demonstrate the use of lenses and measure the distance at which two lenses should be placed in order to get desired focal length.	**3**	**2**	**2**		**3**	**1**	**3**
CO4	Determine refractive index of given liquid and prism.	**3**	**2**	**2**		**3**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://ov-au.vlabs.ac.in/
2. https://lo-au.vlabs.ac.in/
3. http://vlab.amrita.edu/?sub=1&brch=281

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B. Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

SEMESTER – II

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – II**			**L**	**T**	**P**
3. Course Code	**CH120**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.

8. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Remember to keep records of all performed experiments in themanner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

10. Syllabus

Exp – 01	To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
Exp – 02	To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy of calcium chloride from its enthalpy data using Born Haber Cycle.
Exp – 03	To determine the heat of solution of KNO3 by solubility method.
Exp – 04	Estimation of hardness of water by EDTA.
Exp – 05	Determination of Rf values and identification of organic compounds
Exp – 06	Separation of green leaf pigments (spinach leaves may be used.
Exp – 07	Preparation of separation of 2, 4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2, and 3-one using toluene and light petroleum (40:60).
Exp – 08	Determination of Rf values and identification of organic compounds:Separation of a mixture of D, L – alanine, glycine, and L-Leucine using nbutanol: acetic acid:water (4:1:5), Spray reagent – ninhydrin.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.	**3**	**1**	**2**		**3**	**1**	**2**
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.	**3**	**1**	**1**		**2**		**2**
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.	**3**	**1**	**2**		**1**	**1**	**2**
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.	**3**	**1**	**1**		**1**	**1**	**2**
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	**2**	**1**	**1**		**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Practical Organic Chemistry, A.I.Vogel.
3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.
4. Experimental Inorganic Chemistry –W.G.Palmer.

SEMESTER – III

1. Name of the Department: PHYSICS						
2. Course Name	**CIRCUIT FUNDAMENTAL AND BASIC ELECTRONICS**			**L**	**T**	**P**
3. Course Code	**PY201**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:**

- To understand the basic concepts of Growth and decay of currents through inductive resistances, RC and RLC and explain principle of operation for various AC bridges.
- To understand the basic concepts of various semi-conductor material .
- To learn the concept of BJT and feedback amplifier .
- To understand the basic concepts of oscillators and op-amp .
- To understand the basic concepts of modulation and learn the working of electronic instruments.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Student will be able to solve complex circuit using theorems. Student will be able to measure the passive component through bridges.
CO2	Student will be able to design power supply. Student will be able to differentiate the semiconductor.
CO3	Learn the signal amplification through BJT and how to increase the gain.
CO4	Design the different oscillator circuits for various frequencies Student will be able to design the mathematical operation using op-amp.
CO5	Student will be able to 1. Use of different modulation and demodulation techniques used in analog communication 2. Identify and solve basic communication problems 3. Measure the voltage, phase and frequency using CRO 4. Measure the voltage, resistance, current and capacitance using multimeter.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: CIRCUIT FUNDAMENTALS

Growth and decay of currents through inductive resistances, charging and discharging in R.C. and R.L.C. circuits, Time constant, measurement of high resistance, A.C. Bridges, Maxwell's and Scherings Bridges, Wien Bridge, THEVENIN, NORTON and superposition theorems and their applications

Unit-2	Number of lectures =08	Title of the unit: THEORY OF SEMICONDUCTOR

Semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, unbiased diode forward bias and reverse bias diodes, diode as a rectifier, diode characteristics, zener diode, avalanche and zener breakdown, power supplies, rectifier, bridge rectifier, capacitor input filter, voltage regulation,

Unit-3	Number of lectures = 08	Title of the unit: TRANSISTOR BASICS

Bipolar transistors, three doped regions, forward and reverse bias, DC alpha, DC beta transistor curves. Transistor biasing circuits: base bias, emitter bias and voltage divider bias, DC load line, Basic AC equivalent circuits, low frequency model, small signal amplifiers, common collector amplifiers, and common base amplifiers, current and voltage gain, R.C. coupled amplifier, gain, frequency response, equivalent circuit at low, medium and high frequencies, feedback

Unit-4	Number of lectures = 08	Title of the unit: OSCILLATORS AND OPAMP

Input and output impedance, transistor as an oscillator, general discussion and theory of Hartley oscillator only. Operational amplifier (black box approach) and its ideal characteristics, virtual ground, inverting and non-inverting amplifiers, adder, integrator and differentiator.

Unit-5	Number of lectures = 08	Title of the unit: MODULATION AND INSTRUMENTATION

Elements of transmission and reception, basic principles of amplitude and frequency modulation and demodulation. Principle and design of linear multimeters and their application, cathode ray oscillograph and its simple applications.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will be able to solve complex circuit using theorems. Student will be able to measure the passive component through bridges.	**3**	**1**	**1**				**1**
CO2	Student will be able to design power supply. Student will be able to differentiate the semiconductor.	**3**	**1**	**1**				**1**
CO3	Learn the signal amplification through BJT and how to increase the gain.	**3**	**1**	**1**				**1**
CO4	Design the different oscillator circuits for various frequencies Student will be able to design the mathematical operation using op-amp.	**3**	**1**	**1**				**1**
CO5	Student will be able to 1. Use of different modulation and demodulation techniques used in analog communication 2. Identify and solve basic communication problems 3. Measure the voltage, phase and frequency using CRO 4. Measure the voltage, resistance, current and capacitance using multimeter.	**3**	**1**	**1**				**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in
2. www.youtube.com

13. Books recommended:

1. B. G. Streetman; "Solid State Electronic Devices", IInd Edition (Prentice Hall of India, New Delhi, 1986).
2. W.D. Stanley: "Electronic Devices, Circuits and Applications" (Prentice-Hall).
3. J.D. Ryder, "Electronics Fundamentals and Applications" 2nd Edition (Prentice-Hall of India, New Delhi, 1986).
4. Millman and A. Grabel, "Microelectronics", International Edition (McGraw Hill Book Company, New York, 1988).
5. Bollested, R. and Nashelksky, L. "Electronic Devices and Circuit Theory" (Prentice Hall).

SEMESTER – III

1. Name of the Department: PHYSICS						
2. Course Name	**KINETIC THEORY AND THERMODYNAMICS**			**L**	**T**	**P**
3. Course Code	**PY202**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** To provide the basic knowledge of ideal and real gases, thermodynamics of a system, basic principles and their applications. Thermodynamic potentials, heat engine and theory of radiation and to give the students a thorough understanding of the theory kinetic theory gases.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding of the basic properties of ideal and real gases like equation of state related to these gases.
CO2	Students will be able to develop a deep understanding of various transport phenomena in ideal and real gases and temperature dependence properties.
CO3	Students will be able to understand basic laws of thermodynamics methods and their effects, working of ideal and real engine.
CO4	Students will be able to develop a deep understanding of various thermodynamic potentials, effect and heat equations of various thermodynamic systems.
CO5	Students will be able to gain knowledge of theory of Radiation and basic laws of radiation.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: IDEAL AND REAL GASES

Ideal Gas: Kinetic model, deduction of Boyle's law, interpretation of temperature, estimation of r.m.s. speeds of molecules, Brownian motion, estimate of the Avogadro number, equipartition of energy, specific heat of monatomic gas, extension to di- and triatomic gases, adiabatic expansion of an ideal gas.

Real Gas: Vander Waals gas, equation of state, nature of Van der Waals forces, comparison with experimental P-V curves, Joule expansion of ideal gas and of a Vander Waals gas, Joule coefficient.

Unit-2	Number of lectures =08	Title of the unit: LIQUEFACTION OF GASES AND TRANSPORT PHENOMENON

Liquefaction of gases: Boyle temperature and inversion temperature, principle of regenerative cooling and of cascade cooling, liquefaction of hydrogen and helium gas, Refrigeration cycles, meaning of efficiency.

Transport phenomena in gases: Molecular collisions mean free path and collision cross sections. Transport of mass, momentum and energy and interrelationship.

Unit-3	Number of lectures = 08	Title of the unit: THE LAWS OF THERMODYNAMICS

The zeroth law, various indicator diagrams, work done by and on the system, first law of thermodynamics, internal energy as a state function and other applications, Reversible and irreversible changes, Carnot cycle and its efficiency, Carnot theorem and the second law of thermodynamics, different versions of the second law, Entropy, principle of increase of entropy, third law of thermodynamics, impossibility of attaining the absolute zero, Seebeck, Peltier and Thomson effect.

Unit-4	Number of lectures = 08	Title of the unit: THERMODYNAMIC POTENTIALS

Thermodynamic variables: Extensive and intensive, Enthalpy, Gibbs, Helmholtz and internal energy functions. Maxwell's thermo dynamical relations & applications - Joule-Thompson Effect, Clausius- Clapeyron heat Equation, Expression for (CP – CV), CP/CV, TdS equations.

Unit-5	Number of lectures = 08	Title of the unit: THEORY OF RADIATION

Blackbody radiation, pure temperature dependence, Stefan-Boltzmann law, pressure of radiation, spectral distribution of Black body radiation. Wien's displacement law, Rayleigh-Jean's law, Planck's law the ultraviolet catastrophy.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding of the basic properties of ideal and real gases like equation of state related to these gases.	**3**	**1**	**1**				**1**
CO2	Students will be able to develop a deep understanding of various transport phenomena in ideal and real gases and temperature dependence properties.	**3**	**1**	**1**				**1**
CO3	Students will be able to understand basic laws of thermodynamics methods and their effects, working of ideal and real engine.	**3**	**1**	**1**				**1**
CO4	Students will be able to develop a deep understanding of various thermodynamic potentials, effect and heat equations of various thermodynamic systems.	**3**	**1**	**1**				**1**
CO5	Students will be able to gain knowledge of theory of Radiation and basic laws of radiation.	**3**	**1**	**1**				**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=AKyJwI5jkjs
2. https://www.youtube.com/watch?v=ju7akwzEmAw
3. https://www.youtube.com/watch?v=4G_dLx4M76A

13. Books recommended:

1. G. G. Agarwal and H.P. Sinha "Thermal Physics".
2. S. K. Agarwal and B.K. Agarwal "Thermal Physics".
3. M.W. Zemansky, "Heat and thermodynamics (6th Edition Mcgraw Hill).

SEMESTER – III

1. Name of the Department: CHEMISTRY						
2. Course Name	**INORGANIC AND PHYSICAL CHEMISTRY – I**			**L**	**T**	**P**
3. Course Code	**CH221**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** To learn about simple quantum mechanical treatments of atoms and molecules, atomic structures, periodic properties of elements, various electronic displacement effects in organic compounds, mechanisms of organic reactions. States of matters with an emphasis on the gaseous state.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Explain the properties of alkali and alkaline earth metals, and their oxides, hydrides etc. Diagonal relationship
CO2	Discuss the structure of diborane, Lewis acid nature of boron trihalides, preparation of carbides & silicones, preparation & industrial applications of nitride,hydrazine & hydroxylamine.
CO3	Explain types of oxides and oxyacids, their structure and of interhalogen compounds, pseudo halogens &clatherate compounds
CO4	Use thermochemical equations to relate the amount of heat energy transferred in reactions in reactions at constant pressure (ΔH) to the amount of substance involved in the reaction
CO5	Demonstrate understanding of key concepts related to the second law of thermodynamics, including alternative statements of the second law, the internally reversible process, and the Kelvin temperature scale

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: CHEMISTRY OF s-BLOCK ELEMENTS

General characteristics: melting point, flame colour, reducing nature, diagonal relationships and anomalous behavior of first member of each group. Reactions of alkali and alkaline earth metals with oxygen, hydrogen, nitrogen and water. solvation and complex formation by S- block.

Unit-2	Number of lectures =08	Title of the unit: CHEMISTRY OF p-BLOCK ELEMENTS

Comparative study (including diagonal relationship) of groups 13-17 elements, compounds like oxides, oxyacids and of group 13-16, hydrides of boron-diborane and higher boranes, borazine, fluorocarbons, silicates (structural principle), tetrasulphur tetra nitride, basic properties of halogens, interhalogens and polyhalides.

Unit-3	Number of lectures = 08	Title of the unit: CHEMISTRY OF NOBLE GASES

Chemical properties of the noble gases, discovery of O2 + Chemistry $PtF6^-$ and O2XeF6. of xenon, structure, and bonding in xenon compounds.

Unit-4	Number of lectures = 08	Title of the unit: 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

Unit-5	Number of lectures = 08	Title of the unit: SECOND LAW OF THERMODYNAMICS

Need for the law, different statements of the law, Cornot's cycle and its efficiency, Carnot's theorem. Thermodynamic scale of temperature. 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, entropy as a criteria of spontaneity and equilibrium. Gibbs and Helmholtz functions: Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Explain the properties of alkali and alkaline earth metals, and their oxides, hydrides etc. Diagonal relationship	**3**	**1**	**1**	**1**	**2**	**1**	**3**
CO2	Discuss the structure of diborane, Lewis acid nature of boron trihalides, preparation of carbides & silicones, preparation & industrial applications of nitride,hydrazine & hydroxylamine.	**3**	**2**	**1**	**1**	**1**	**1**	**3**
CO3	Explain types of oxides and oxyacids, their structure and of interhalogen compounds, pseudo halogens &clatherate compounds	**3**	**1**	**1**	**1**	**1**	**1**	**3**
CO4	Use thermochemical equations to relate the amount of heat energy transferred in reactions in reactions at constant pressure (ΔH) to the amount of substance involved in the reaction	**3**	**1**	**2**	**2**	**2**	**2**	**3**
CO5	Demonstrate understanding of key concepts related to the second law of thermodynamics, including alternative statements of the second law, the internally reversible process, and the Kelvin temperature scale	**3**	**2**	**2**	**2**	**2**	**2**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104101090/lec1.pdf
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104106096/lec9.pdf
3. https://ocw.mit.edu/high-school/chemistry/exam-prep/structure-of-matter/chemical-bonding/

13. Books recommended:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles ofStructure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry,Oxford, 1970.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma &Pathania. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

SEMESTER – III

1. Name of the Department: CHEMISTRY						
2. Course Name	**ORGANIC AND PHYSICAL CHEMISTRY – I**			**L**	**T**	**P**
3. Course Code	**CH222**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. **COURSE OBJECTIVES**: Students will be able to understand the about the chemistry of aliphatic hydrocarbons, properties, mechanism of addition and elimination reactions, conformational analysis of alkanes and cycloalkanes, stability and reactivity, aromaticity and substitution reactions of homocyclic & heterocyclic compounds, solutions and colligative properties and chemical Equilibrium.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understanding of Mechanism of eliminations, oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation, Allylic and benzylic bromination.
CO2	Comprehension of Conformational analysis, Relative stability and Energy diagrams of alkanes, Chair, Boat and Twist boat forms of cyclohexane with energy diagrams, analyse and compare relative stability of mono substituted cycloalkanes.
CO3	To create basics for the aromaticity, Hückel's rule, of homocyclic & heterocyclic compounds, electrophillic and substitution reactions & their mechanism, Directing effects of the groups.
CO4	Able to evaluate different types Colligative Properties like relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and amount of solute.Know about lowering of vapour pressure, Raoult's and Henry's Laws and their applications,
CO5	Analyze the criteria of thermodynamic equilibrium, chemical equilibria in ideal gases, Le Chatelier Principle, equilibrium between ideal gases and a pure condensed phase.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: CHEMISTRY OF ALIPHATIC HYDROCARBONS

General methods of preparation, physical and chemical properties of alkenes and alkynes, Mechanism of E1, E2, E1CB reactions. Saytzeff and Hofmann eliminations. Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1, 2 and 1,4-addition reactions in conjugated dienes and Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Unit-2	Number of lectures =08	Title of the unit: CONFORMATIONAL ANALYSIS OF ALKANES AND CYCLOALKANES

Conformational analysis of alkanes: Relative stability and Energy diagrams. Types of cycloalkanes and their relative stability, Baeyer strain theory: Chair, Boat and Twist boat forms of cyclohexane with energy diagrams; Relative stability of mono substituted cycloalkanes, cyclopropane ring, banana bonds.

Unit-3	Number of lectures = 08	Title of the unit: AROMATIC HYDROCARBONS

Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups: Activating and deactivating substituents, orientation and ortho/para ratio, Side chain reactions of benzene derivatives, Birch reduction; Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and Anthracene..

Unit-4	Number of lectures = 08	Title of the unit: SOLUTIONS AND COLLIGATIVE PROPERTIES

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties (i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) depression of freezing point, (iv) osmotic pressure and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Unit-5	Number of lectures = 08	Title of the unit: CHEMICAL EQUILIBRIUM

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration (Le Chatelier Principle, Quantitatively). Free energy of mixing and spontaneity. equilibrium between ideal gases and a pure condensed phase .

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understanding of Mechanism of eliminations, oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation, Allylic and benzylic bromination.	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Comprehension of Conformational analysis, Relative stability and Energy diagrams of alkanes, Chair, Boat and Twist boat forms of cyclohexane with energy diagrams, analyse and compare relative stability of mono substituted cycloalkanes.	**3**	**1**	**1**		**2**	**1**	**1**
CO3	To create basics for the aromaticity, Hückel's rule, of homocyclic & heterocyclic compounds, electrophillic and substitution reactions & their mechanism, Directing effects of the groups.	**3**	**1**	**2**		**2**	**1**	**1**
CO4	Able to evaluate different types Colligative Properties like relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure and amount of solute.Know about lowering of vapour pressure, Raoult's and Henry's Laws and their applications,	**3**	**1**	**2**		**2**	**1**	**1**
CO5	Analyze the criteria of thermodynamic equilibrium, chemical equilibria in ideal gases, Le Chatelier Principle, equilibrium between ideal gases and a pure condensed phase.	**3**	**1**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/115101003/
2. https://nptel.ac.in/courses/115105100/
3. https://www.freebookcentre.net/physics-books-download/Atomic-and-Molecular-Physics-NPTEL.html

13. Books recommended:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.
3. Francis Carey Organic Chemistry, Published by McGraw-Hill Education.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma & Pathania.
6. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

SEMESTER – III

1. Name of the Department: MATHEMATICS						
2. Course Name	**NUMERICAL COMPUTING**			**L**	**T**	**P**
3. Course Code	**MT211**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The course is aimed to develop the skills in mathematics specially in numerical computing which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	The course is aimed to develop the skills in mathematics especially in Numerical Computing which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.
CO2	Apply different interpolation methods and finite difference concepts
CO3	Apply central interpolation methods and interpolation techniques for unequal intervals
CO4	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
CO5	Work numerically on the ordinary differential equations using different method through the theory of finite differences.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Solution of Algebraic and Transcendental Equations: Bisection Method, Method of False Position, Iteration Method, Secant Method, Newton-Raphson's Method and their convergence. Linear System of Equations: LU decomposition Method, Gauss- Seidel Method.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Finite Differences: Forward and Backward Difference Operators, Difference Table, Shift and Averaging operators, Relation between Operators, Factorial polynomials. Interpolation: Polynomial interpolation, Newton-Gregory forward and backward interpolation formulae.

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Central Interpolation: Gauss forward and backward formula, Stirling's, Bessel's and Laplace-Everett's formulae.
Interpolation for Unequal Intervals: Lagrange's interpolation formula, divided differences and Newton's divided difference interpolation formula.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Numerical Differentiation and Integration: Numerical differentiation and errors in Numerical differentiation, Newton-Cotes formula, Trapezoidal rule, Simpson's rule, Boole's, Weddle's and Euler Maclaurin's formulae.

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Numerical Solutions of Ordinary Differential Equations: Picard's and Taylor's Series, Euler's Method, Runge-Kutta fourth order Method, Solution of Boundary value problem by finite difference Method .

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	The course is aimed to develop the skills in mathematics especially in Numerical Computing which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.	**3**	**2**	**2**	**1**	**3**	**3**	**3**
CO2	Apply different interpolation methods and finite difference concepts	**3**	**2**	**2**	**1**	**2**	**2**	**2**
CO3	Apply central interpolation methods and interpolation techniques for unequal intervals	**3**	**2**	**3**	**1**	**3**	**2**	**3**
CO4	Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.	**3**	**2**	**3**	**1**	**3**	**3**	**2**
CO5	Work numerically on the ordinary differential equations using different method through the theory of finite differences.	**2**	**2**	**1**	**1**	**3**	**2**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=_f_Pu7t9eP8
2. https://www.youtube.com/watch?v=3B3lGO7wERE
3. https://www.youtube.com/watch?v=1g0G_kjA560&list=PLq-Gm0yRYwTguDcfylj1ZicXxzdZCAr5S&index=4
4. https://www.youtube.com/watch?v=K193avJMCd4&list=PLq-Gm0yRYwTguDcfylj1ZicXxzdZCAr5S&index=5

13. Books recommended:

1. Qazi Shoeb Ahmad, Zubair Khan and Shadab Ahmad Khan, Numerical and Statistical Techniques, Ane Books India, 2015.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 7th Ed., New Age International Publishers, 2007.
3. Numerical Methods by P. Kandasamy, S. Chand Publication, New Delhi.
4. Introduction to Numerical Analysis, by S.S. Sastry, Prentice Hall of India.

SEMESTER – III

1. Name of the Department: PHYSICS						
2. Course Name	ELECTRONICS AND THERMAL PHYSICS LAB			L	T	P
3. Course Code	PY203			0	0	4
4. Type of Course (use tick mark)				Core (√)	DE ( )	FC ( )
5. Pre-requisite (if any)	10+2 with Physics	6. Frequency (use tick marks)	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		Tutorials = 00		Practical = 10		

8. **COURSE OBJECTIVES:**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	
CO2	
CO3	
CO4	

10. Syllabus

Exp – 01	
Exp – 02	
Exp – 03	
Exp – 04	
Exp – 05	
Exp – 06	
Exp – 07	
Exp – 08	
Exp – 09	
Exp – 10	

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1								
CO2								
CO3								
CO4								

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

SEMESTER – III

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – III**			**L**	**T**	**P**
3. Course Code	**CH223**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of the undergraduate chemistry Lab program at the Integral University is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry, and various other industries.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Remember to keep records of all performed experiments in themanner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

10. Syllabus

Exp – 01	**Volumetric Analysis:** (Execute any two of the following) Determination of acetic acid in commercial vinegar using NaOH. Determination of alkali content – antacid tablet using HCl. Estimation of calcium content in chalk as calcium oxalate by permanganometry. Estimation of ferrous and ferric by dichromate method. Estimation of copper using thiosulphate.
Exp – 02	Determination of alkali content – antacid tablet using HCl.
Exp – 03	Estimation of calcium content in chalk as calcium oxalate by permanganometry.
Exp – 04	Gravimetric Analysis: Analysis of Cu as CuSCN and Ni as Ni (dimethylglyoxime).
Exp – 05	Detection of following functional groups present in the given mono-functional organic compounds: a) Carboxylic acid , b) Phenol
Exp – 06	To determine the enthalpy of neutralization of a weak acid/weak base versus strong base/ strong acid and determine the enthalpy of ionization of the weak acid/weak base.
Exp – 07	Chemical Equilibrium: The equilibrium between Fe3+ and Fe(CNS)2+.
Exp – 08	Determination of molecular weight of a non-volatile solute by Rast method/ Beckmann freezing point method.
Exp – 09	To study the effect of concentration on equilibrium.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Remember to keep records of all performed experiments in themanner which is required in laboratory.	**3**	**1**	**2**		**3**	**1**	**2**
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.	**3**	**1**	**1**		**2**		**2**
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.	**3**	**1**	**2**		**1**	**1**	**2**
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.	**3**	**1**	**1**		**1**	**1**	**2**
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	**2**	**1**	**1**		**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Practical Organic Chemistry, A.I.Vogel.
3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.
4. Experimental Inorganic Chemistry –W.G.Palmer.

SEMESTER – III

1. Name of the Department: MATHEMATICS						
2. Course Name	**NUMERICAL COMPUTING LAB**			**L**	**T**	**P**
3. Course Code	**MT212**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	
CO2	
CO3	
CO4	
CO5	

10. Syllabus	
Exp – 01	
Exp – 02	
Exp – 03	
Exp – 04	
Exp – 05	
Exp – 06	
Exp – 07	
Exp – 08	
Exp – 09	
Exp – 10	

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1								
CO2								
CO3								
CO4								
CO5								

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

SEMESTER – IV

1. Name of the Department: PHYSICS						
2. Course Name	**ELECTRICITY AND MAGNETISM**			**L**	**T**	**P**
3. Course Code	**PY204**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of electricity and magnetism by using the principal of physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion, of course, the student will able explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	To learn basic mathematical tools with their physical significance as a prerequisite for the course.
CO2	To understand and explain the principles/methods of evaluation of electric field, potential due to charge distribution and apply them to practical systems.
CO3	To learn the principles and methods of evaluation of magnetic field and scalar magnetic potential due to due to current or magnetic dipoles. Thereby apply them to analyse magnetic properties of dia, para and ferromagnetic materials.
CO4	To describe the principles of electromagnetic induction and study the devices based upon, to investigate their experimental working.
CO5	To formulate Maxwell's equations and apply them to investigate the propagation of electromagnetic waves in free space, dielectric and conducting medium.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: VECTOR ANALYSIS AND ELECTROSTATICS – I

Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their physical significance, vector integration, electrostatic field, electric flux, Coulomb's law, electric field and potentials, Field due to a uniform charged sphere, derivations of Poisson and Laplace Equations with applications, Uniqueness theorem.

Unit-2	Number of lectures =08	Title of the unit: ELECTROSTATICS – II

Gauss law and its application: The Field of a conductor, electric dipole, field and potential due to an electric dipole, Dipole approximation for an arbitrary charge distribution, method of electrical images, electric quadruple, field due to a quadruple, electrostatic energy of a charged uniform sphere, energy of a condenser.

Unit-3	Number of lectures = 08	Title of the unit: MAGNETOSTATICS AND MAGNETIC PROPERTIES OF MATERIALS

Magnetic field and force of a current, Magnetic Induction and Biot-Savart Law, Lorentz Force, Vector and Scalar Magnetic potentials, Magnetic Dipole, Magnetomotive force and Ampere's Circuital theorem and its applications to calculate magnetic field due to wire carrying current and solenoid. Intensity of magnetization and magnetic susceptibility, Properties of Dia, Para and Ferromagnetic materials, Curie temperature, Hysteresis and its experimental determination

Unit-4	Number of lectures = 08	Title of the unit: ELECTROMAGNETIC INDUCTION

Faraday's laws of electromagnetic induction, Lenz's law, self-inductance (L) of single coil, mutual inductance (M) of two coils, Energy stored in magnetic field. Motion of electron in changing magnetic field, Betatron, Magnetic energy, Induced magnetic field (Time varying electric field), theory and working of moving coil ballistic galvanometer.

Unit-5	Number of lectures = 08	Title of the unit: MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES

Idea of displacement current and Maxwell's modification of Ampere's law, Integral and differential forms of Maxwell's equations and their physical significance, skin effect. The wave: (equation satisfied by E and B, plane electromagnetic waves in vacuum), Poynting vector, reflection at a plane boundary of dielectrics, EM waves in a conducting medium, reflection and refraction by the ionosphere.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To learn basic mathematical tools with their physical significance as a prerequisite for the course.	**3**	**2**	**1**		**1**	**1**	**1**
CO2	To understand and explain the principles/methods of evaluation of electric field, potential due to charge distribution and apply them to practical systems.	**3**	**2**	**2**		**3**	**1**	**1**
CO3	To learn the principles and methods of evaluation of magnetic field and scalar magnetic potential due to due to current or magnetic dipoles. Thereby apply them to analyse magnetic properties of dia, para and ferromagnetic materials.	**3**	**2**	**2**		**3**	**1**	**1**
CO4	To describe the principles of electromagnetic induction and study the devices based upon, to investigate their experimental working.	**3**	**2**	**2**		**3**	**1**	**1**
CO5	To formulate Maxwell's equations and apply them to investigate the propagation of electromagnetic waves in free space, dielectric and conducting medium.	**2**	**2**	**1**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/115104088/
2. http://library.iul.ac.in/ELibrary.aspx
3. https://www.youtube.com/watch?v=XJYY4jlwZzo
4. https://www.youtube.com/user/imperialcollegevideo/search?query=eric+laithwaite

13. Books recommended:

1. Berkeley Physics Course; Electricity and Magnetism, Ed. E.M. Purcell (McGraw Hill).
2. D. J. Griffith; "Introduction to Electrodynamics" (Prentice-Hall of India).
3. Reitz and Milford; "Electricity and Magnetism (Addison-Wesley).
4. S. Mahajan and A. A. Rangwala; "Electricity and Magnetism" (Tata McGraw- Hill).
5. M. Portis; "Electromagnetic Fields".
6. Pugh and Pugh; "Principles of Electricity and Magnetism" (Addison-Welsley).
7. Panofsky and Phillips; "Classical Electricity and Magnetism" (India Book House),
8. S. S. Atwood; "Electricity and Magnetism" (Dover).

SEMESTER – IV

1. Name of the Department: CHEMISTRY						
2. Course Name	**INORGANIC AND PHYSICAL CHEMISTRY-II**			**L**	**T**	**P**
3. Course Code	**CH224**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The purpose of this course is to develop the deep understanding of general characteristic properties of transition elements, nomenclature and isomerism in coordination compounds, organometallic chemistry of transition elements , chemistry of Lanthanide and actanides, solid state chemistry and to gain the knowledge of basics of electrochemistry and construction of cells for the calculation of EMF/ Gibbs free energy value.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Student will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and the bonding models, structures, reactivity, and applications of coordination complexes, boron hydrides, metal carbonyls, and organometallics.
CO3	Students will be able to understand about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.
CO4	Students will be able to understand about the key concepts of solid state chemistry, structure elucidation through X ray diffractions methods.
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: CHEMISTRY OF ELEMENTS OF TRANSITION SERIES

Chemistry of Elements of First Transition Series: Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.
Chemistry of Elements of Second and Third Transition Series: General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry

Unit-2	Number of lectures =08	Title of the unit: COORDINATION COMPOUNDS

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Unit-3	Number of lectures = 08	Title of the unit: CHEMISTRY OF ELEMENTS OF INNER TRANSITION SERIES

Chemistry of Lanthanide Elements: Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, cerie ammonium sulphate and its analytical uses. Chemistry of Actinides: configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

Unit-4	Number of lectures = 08	Title of the unit: SOLID STATES

Definition of space lattice, unit cell. X-ray diffraction by crystals, Derivation of Bragg equation, Determination of crystal structure of NaCl, KCl and CsCl (Laue's method and powder method). Defects in crystals.

Unit-5	Number of lectures = 08	Title of the unit: ELECTROCHEMISTRY – I

Electrical transport - Conduction in metals and in electrolyte solutions, specific conductance, equivalent conductance, variation of equivalent and specific conductance with dilution. Kohlrausch's law, weak and strong electrolyte, Arrhenius theory of electrolyte dissociation and its limitations. Ostwald's dilution law its uses and limitations.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will be able to understand the approaches to the development of d block fundamental with CFT/VBT/MOT and its widespread applications.	**3**	**1**	**1**		**2**	**1**	**2**
CO2	Students will have a firm foundation in the IUPAC nomenclatures of the complexes and the bonding models, structures, reactivity, and applications of coordination complexes, boron hydrides, metal carbonyls, and organometallics.	**3**	**1**	**1**		**2**	**1**	**2**
CO3	Students will be able to understand about the key concepts of inorganic and organometallic chemistry including those related to synthesis, reaction chemistry, and structure and bonding.	**3**	**1**	**2**		**2**	**1**	**3**
CO4	Students will be able to understand about the key concepts of solid state chemistry, structure elucidation through X ray diffractions methods.	**3**	**1**	**2**		**2**	**1**	**3**
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.	**3**	**1**	**2**		**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

13. Books recommended:

1. Lee, J.D. Concise Inorganic Chemistry, Pearson Education.
2. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
3. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma & Pathania.
6. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

SEMESTER – IV

1. Name of the Department: CHEMISTRY						
2. Course Name	ORGANIC AND PHYSICAL CHEMISTRY-II			L	T	P
3. Course Code	CH225			3	1	0
4. Type of Course (use tick mark)				Core (√)	DE ( )	FC ( )
5. Pre-requisite (if any)	10+2 with Chemistry	6. Frequency (use tick marks)	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	Tutorials = 10	Practical = Nil

8. COURSE OBJECTIVES: Students will be able to understand Alkyl and Aryl Halides, Alcohols, phenols, Aldehydes and Ketones, Chemical Kinetics, Phase Equilibrium.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Comprehension of classification, methods of formation and chemical reactions of alkyl halides, Mechanism of nucleophilic substitution reaction of alkyl halides (SN1 and SN2 reactions) with energy profile diagrams.
CO2	To create basic knowledge of nomenclature, methods of formation, Hydrogen bonding. Acidic nature, Reactions of alcohols, Dihydric alcohols and phenols.
CO3	Able to evaluate different types of Synthesis of aliphatic aldehydes and ketones, alcohols, carboxylic acids and named reactions as Reimer-Tiemann reaction, gattermann-koch reaction and aromatic ketones by Friedel craft acylation.
CO4	Analyze and compare Theories of chemical kinetics, Molecularity and order of reaction, concept of activation energy method of integration, half-life method and isolation method, Thermodynamics aspect of transition state theory.
CO5	Understand the terms-phase, component and degree offreedom, derivation of Gibb's phase rule, one component system-water, two component system solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: ALKYL AND ARYL HALIDES

Methods of formation, chemical reactions. Mechanism of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams, Aryl halides - Methods of formation, nuclear and side chain reactions. Mechanisms of nucleophilic aromatic substitutions.

Unit-2	Number of lectures =08	Title of the unit: ALCOHOLS AND PHENOLS

Monohydric alcohols- nomenclature, methods of formation, reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature, Reactions of alcohols and pinacol-pinacolone rearrangement. Preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Fries rearrangement, Claisen rearrangement, & Reimer-Tiemann reaction.

Unit-3	Number of lectures = 08	Title of the unit: ALDEHYDES AND KETONES

Synthesis of aliphatic aldehydes and ketones with particular reference to acid chlorides, alcohols, carboxylic acids, Grignard reagent, alkenes and 1, 3-dithianes. Synthesis of aromatic aldehydes by oxidation of alkyl benzene, Reimer-Tiemann reaction, Gattermann-Koch reaction and aromatic ketones by Friedal Craft Acylation, Aldol condensation, Cannizzaro reaction, Clemmensen reduction and Wolff-Kishner reduction.

Unit-4	Number of lectures = 08	Title of the unit: CHEMICAL KINETICS

(i)Molecularity and order of reaction, concentration dependence of rates, integrated rate expression for- zero order, first order, second order, pseudo order reactions, half-life.

(ii) Determination of the order of reaction: Differential method, method of integration, half-life method and isolation method.

(iii) Theories of chemical kinetics: Arrhenius theory of reaction rate, effect of temperature on rate of reaction, concept of activation energy. Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis).Thermodynamics aspect of transition state theory.

Unit-5	Number of lectures = 08	Title of the unit: PHASE EQUILIBRIUM

Statement and meaning of the terms-phase, component and degree of freedom, derivation of Gibb's phase rule, phase equilibria of one component system-water, 'CO2' and 'S' systems. Phase equilibria of two component system – solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Comprehension of classification, methods of formation and chemical reactions of alkyl halides, Mechanism of nucleophilic substitution reaction of alkyl halides (SN1 and SN2 reactions) with energy profile diagrams.	3	1	1		2	1	1
CO2	To create basic knowledge of nomenclature, methods of formation, Hydrogen bonding. Acidic nature, Reactions of alcohols, Dihydric alcohols and phenols.	3	1	1		2	1	1
CO3	Able to evaluate different types of Synthesis of aliphatic aldehydes and ketones, alcohols, carboxylic acids and named reactions as Reimer-Tiemann reaction, gattermann-koch reaction and aromatic ketones by Friedel craft acylation.	3	1	2		2	1	1
CO4	Analyze and compare Theories of chemical kinetics, Molecularity and order of reaction, concept of activation energy method of integration, half-life method and isolation method, Thermodynamics aspect of transition state theory.	3	1	2		2	1	1
CO5	Understand the terms-phase, component and degree offreedom, derivation of Gibb's phase rule, one component system-water, two component system solid liquid equilibria simple eutectic – Bi-Cd, Pb-Ag systems, desilverisation of lead	3	1	2		2	1	1

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf

13. Books recommended:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. Published by Pearson Education.
3. Francis Carey Organic Chemistry, Published by McGraw-Hill Education.
4. Castellan, G. W. Physical Chemistry, Published by Narosa.
5. Physical Chemistry, Puri Sharma & Pathania.
6. Peter, A. & Paula, J. de. Physical Chemistry 9th Ed., Oxford University Press.

SEMESTER – IV

1. Name of the Department: MATHEMATICS						
2. Course Name	**TENSOR ANALYSIS**			**L**	**T**	**P**
3. Course Code	**MT213**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart basic and key knowledge of vector analysis and geometry. By using the principal of applied mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will be able to understand Vector Spaces, dual spaces, tensor product of vector spaces, and also about transformation formulae for tensors.
CO2	Students will gain an understand of Tensors and their types: Contravariant and covariant vectors and tensors, mixed tensors, Symmetric and skewsymmetric tensors, Associated tensors, Reciprocal tensors.
CO3	Students will be able to learn and implement Algebra of tensors, Contraction and inner product. They will also study about Quotient law & Riemannian metric tensor
CO4	Students will create the own understanding of Christoffel Symbols. They will learn covariant differentiation of tensors and also study about Gradient, divergence and curl in tensor notation.
CO5	Students will gain an understanding of The fundamental theorem of local Riemannian geometry, Differential operators, curvature tensor, Geodesics, geodesics coordinate system, geometrical interpretation of the curvature tensor.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit:
Vector Spaces, dual spaces, tensor product of vector spaces, transformation formulae.		
Unit-2	**Number of lectures =08**	**Title of the unit:**
Tensor, Contravariant and covariant vectors and tensors, mixed tensors, Symmetric and skewsymmetric tensors, Associated tensors		
Unit-3	**Number of lectures = 08**	**Title of the unit:**
Algebra of tensors, Contraction and inner product, Quotient law, Reciprocal tensors, Riemannian metric tensor		
Unit-4	**Number of lectures = 08**	**Title of the unit:**
Christoffel Symbols, covariant differentiation, Gradient, divergence and curl in tensor notation.		
Unit-5	**Number of lectures = 08**	**Title of the unit:**
The fundamental theorem of local Riemannian geometry, Differential operators, curvature tensor, Geodesics, geodesics coordinate system, geometrical interpretation of the curvature tensor.		

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to understand Vector Spaces, dual spaces, tensor product of vector spaces, and also about transformation formulae for tensors.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO2	Students will gain an understand of Tensors and their types: Contravariant and covariant vectors and tensors, mixed tensors, Symmetric and skewsymmetric tensors, Associated tensors, Reciprocal tensors.	**3**	**1**	**2**	**1**	**1**	**1**	**2**
CO3	Students will be able to learn and implement Algebra of tensors, Contraction and inner product. They will also study about Quotient law & Riemannian metric tensor	**3**	**1**	**2**	**1**	**1**	**1**	**2**
CO4	Students will create the own understanding of Christoffel Symbols. They will learn covariant differentiation of tensors and also study about Gradient, divergence and curl in tensor notation.	**3**	**1**	**2**	**1**	**1**	**1**	**2**
CO5	Students will gain an understanding of The fundamental theorem of local Riemannian geometry, Differential operators, curvature tensor, Geodesics, geodesics coordinate system, geometrical interpretation of the curvature tensor.	**2**	**1**	**2**	**1**	**1**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://cosmolearning.org/video-lectures
2. https://content.kopykitab.com/ebooks/2016/02/5649/sample/sample_5649.pdf
3. https://www.win.tue.nl/casa/education/AntWiskDict/_3/e.%20Algebra,%20Meetkunde%20en%20Discrete%20Wiskunde/TENSOR--Dictaat-2004-

13. Books recommended:

1. Tensor Calculus, Zafar Ahsan, Anamaya Publication, New Delhi.
2. Differential Geometry of manifolds, U.C.De & A.A.Shaikh, Narosa Publishing House Pvt. Ltd, 2007.
3. Schaum's Outlines of Tensor Calculus.
4. Tensor Calculus & Riemannian Geometry, D.C. Agarwal, Krishna Publications.

SEMESTER – IV

1. Name of the Department: MATHEMATICS						
2. Course Name	**ABSTRACT ALGEBRA**			**L**	**T**	**P**
3. Course Code	**MT214**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. **COURSE OBJECTIVES:** The objective is to introduce the basic concept to the subject of algebra. The course deals with the some algebraic structures namely groups, rings, fields and some related structures. Abstract algebra enables students to build mathematical thinking and skill.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will be able to explain the fundamental concept of Group and its well behaved subsets.
CO2	Students will be able to describe fundamental properties of Ring and its related structures.
CO3	Students will be an understanding of Elementary row operations and their applications to solution of a system of linear equations.
CO4	Students will be able to describe Vector spaces and its properties.
CO5	Students will be able to explain Linear transformation and its properties as well as applications.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit:

Group, homomorphism, isomorphism, conjugacy relation, normalizer, centre of group.

Unit-2	Number of lectures =08	Title of the unit:

Ring, ring homomorphism, ideals, integral domain, introduction to field.

Unit-3	Number of lectures = 08	Title of the unit:

Vector spaces, Subspaces, Span of a set, Linear dependence and independence, Dimension and basis.

Unit-4	Number of lectures = 08	Title of the unit:

Vector spaces, Subspaces, Span of a set, Linear dependence and independence, Dimension and basis.

Unit-5	Number of lectures = 08	Title of the unit:

Linear transformation and their matrix representation, rank nullity theorem.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to explain the fundamental concept of Group and its well behaved subsets.	**3**	**1**	**1**	**2**	**3**	**1**	**3**
CO2	Students will be able to describe fundamental properties of Ring and its related structures.	**3**	**2**	**2**	**2**	**3**	**1**	**2**
CO3	Students will be an understanding of Elementary row operations and their applications to solution of a system of linear equations.	**3**	**2**	**2**	**2**	**2**	**1**	**2**
CO4	Students will be able to describe Vector spaces and its properties.	**3**	**2**	**2**	**2**	**2**	**1**	**3**
CO5	Students will be able to explain Linear transformation and its properties as well as applications.	**2**	**2**	**1**	**2**	**3**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/111/105/111105112/
2. https://nptel.ac.in/courses/111/101/111101115/Partial%20Translation.pdf

13. Books recommended:

1. University Algebra by N.S. Gopalakrishnan,New Age International publishing house, New Delhi.
2. Modern Algebra by Surjeet Singh, Vikas Publishing House Pvt. Ltd., New Delhi.
3. An introduction to Linear Algebra by V. Krishnamurthy, V.P. Mainra & J. L. Arora, East West Press Pvt. Ltd., New Delhi.

SEMESTER – IV

1. Name of the Department: PHYSICS						
2. Course Name	**ELECTRICITY AND MAGNETISM LAB**			**L**	**T**	**P**
3. Course Code	**PY205**			0	0	6
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** The purpose of this undergraduate course is to impart practical knowledge/measurements in electricity and magnetism through different experiments related to its theoretical course.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Determine the energy band gap of a given semiconductor.
CO2	Measurement of high and low resistance and capacitance of a capacitor.
CO3	Determine the coefficient of self and mutual inductance between two given coils.
CO4	Study the characteristics of Ballistic Galvanometer.

10. Syllabus

Exp – 01	Study of characteristics of a ballistic Galvanometer.
Exp – 02	Measurement of low resistance by Carey-Foster Bridge
Exp – 03	Measurement of inductance using impedance at different frequencies.
Exp – 04	Determination of energy band gap of a semiconductor using p-n junction diode.
Exp – 05	To measure high Resistance by the method of Leakage of a condenser.
Exp – 06	To determine the coefficient of Mutual Inductance between two coils.
Exp – 07	To determine the coefficient of Self Inductance of a single coil.
Exp – 08	To determine the capacity of condenser by absolute method.
Exp – 09	To study of characteristic of a choke.
Exp – 10	Measurement of inductance by Anderson's bridge.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Determine the energy band gap of a given semiconductor.	**3**	**2**	**2**		**2**	**1**	**1**
CO2	Measurement of high and low resistance and capacitance of a capacitor.	**3**	**2**	**2**		**2**	**1**	**1**
CO3	Determine the coefficient of self and mutual inductance between two given coils.	**3**	**2**	**2**		**2**	**1**	**1**
CO4	Study the characteristics of Ballistic Galvanometer.	**3**	**2**	**2**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.exploratorium.edu/snacks/subject/electricity-and-magnetism
2. https://ocw.mit.edu/courses/physics/8-02-physics-ii-electricity-and-magnetism-spring-2007/experiments/
3. www.youtube.com
4. http://www.rossnazirullah.com/BSc/BSc.htm

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B. Sc. Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

SEMESTER – IV

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – IV**			**L**	**T**	**P**
3. Course Code	**CH226**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in analytical, inorganic, organic and physical chemistry along with the laboratory safety, use of an analytical balance for mass measurement, use of thermometers and temperature probes, use of graduated cylinders, graduated pipettes, and volumetric pipettes for volumetric measurement, titrations, the calibration and use simple spectrophotometers, pH meters, centrifuges**.**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Student will be able to understand the approaches to sample analysis with acid base titrimetric method.
CO2	Students will have a firm foundation in the preparation of coordination complexes and duble salts.
CO3	Students will be able to understand about the key concepts of conductometric titrations.
CO4	Students will be able to understand about the key concepts of compexometric titrations.
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.

10. Syllabus

Exp – 01	Acetylation of salicylic acid, aniline, glucose and hydroquinone, Benzoylation of aniline and phenol
Exp – 02	Oxidation: Preparation of benzoic acid from toluence Reduction: Preparation of aniline from nitrobenzene
Exp – 03	To study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid.
Exp – 04	To determine the pKa of acetic acid
Exp – 05	Determination Critical Solution Temperature (CST) for the Phenol – Water System.
Exp – 06	Inorganic Chemistry: Preparation of the following: 1. Chrome Alum, 2.Potash Alum , 3.Sodium Ferrioxalate 1. Chrome Alum 2. Potash Alum
Exp – 07	Aliphatic electrophlic substitution: Preparation of iodoform from ethanol and acetone
Exp – 08	To determine the strength of given acetic acid solution conductometrically by titrating against a standard solution.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will be able to understand the approaches to sample analysis with acid base titrimetric method.	**3**	**1**	**2**		**3**	**1**	**2**
CO2	Students will have a firm foundation in the preparation of coordination complexes and duble salts.	**3**	**1**	**1**		**2**		**2**
CO3	Students will be able to understand about the key concepts of conductometric titrations.	**3**	**1**	**2**		**1**	**1**	**2**
CO4	Students will be able to understand about the key concepts of compexometric titrations.	**3**	**1**	**1**		**1**	**1**	**2**
CO5	Students will have a firm foundation in the basic of the electrochemistry, transport phenomenon and conduction approaches to the development of electron transfer process for the cell reactions.	**2**	**1**	**1**		**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Advance Practical Chemistry: Jagdamba Singh, L.D.S Yadav, Jaya Singh, I.R. Siddiqui, PragatiEdition.
2. Practical Organic Chemistry, A.I.Vogel.
3. Practical Physical Chemistry: B. Viswanathan and P.S.Raghavan.
4. Experimental Inorganic Chemistry –W.G.Palmer.

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**ADVANCE INORGANIC CHEMISTRY**			**L**	**T**	**P**
3. Course Code	**CH314**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to understand the bonding in coordination compounds, electronic spectra and magnetic behaviour of the coordination compounds and some important inorganic compounds. The other important objective is to study the reaction mechanism in coordination compounds and importance of inorganic metals in Bio-inorganic chemistry.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the concept of coordination chemistry with different theories.
CO2	Understand and evaluate the electronic spectra and magnetism of transition metal complexes.
CO3	Study of some important inorganic compounds and their applications
CO4	Understand the different reaction mechanisms in coordination compounds.
CO5	Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: BONDING IN COORDINATION COMPOUNDS**

Electronic configuration (3d, 4d, 5d) and general periodic trends, comparative study of first/second/third transition series elements, IUPAC nomenclature of coordination compounds, VBT (hybridization/magnetism/geometry) of Ni(CN)42-, NI(CO)4, Ni(Cl)42-, Fe(CN)63-, Fe(CN)64-.

Elementary Crystal Field Theory: splitting of dn configurations in octahedral, square planar and tetrahedral fields, factioras affecting 10 Dq value, crystal field stabilization energy, pairing energy, Magnetic moment from crystal field theory, high spin and low spin complexes, Static and Dynamic Jahn-Tellar distortion.

Unit-2	**Number of lectures =08**	**Title of the unit: SPECTRA AND MAGNETISM OF TRANSITION METALS**

Spectro-chemical series of ligands, Laporte's selection rule, colour of complexes, spectroscopic ground states, selection rules for electronic spectral transitions, charge transfer spectra, LS coupling. Types of magnetism and temperature dependence of magnetic susceptibility, Curie and Curie-Weiss law, Measurement of magnetic susceptibility by Gouy method, Faraday method.

Unit-3	**Number of lectures = 08**	**Title of the unit: SELECTED TOPICS IN ADVANCED INORGANIC COMPOUNDS**

Structure/synthesis/various chemical reactions of potassium dichromate, potassium permanganate, potassium chromate, sodium thiosulphate. Structure/synthesis/various chemical reactions of fluorides and oxides of xenon, Zeise's salt, silicones, borazine, phosphazine. S4N4, P4, P4O6, P4O10. Extractive metallurgy for self reduction method (Copper and lead), cyanide process and chemical reactions (silver and gold).

Unit-4	**Number of lectures = 08**	**Title of the unit: REACTION MECHANISM OF LIGAND DISPLACEMENT REACTIONS**

Substitution reaction in square planar complexes (Trans effect), mechanism of substitution reaction, Electron transfer reactions and its classification. Outer sphere electron transfer mechanism, chemical activation, Marcus theory, cross-reactions, thermodynamical/kinetic parameters, inner-sphere electron transfer mechanisms, effect of the nature of metal/ligandss, bridging group effects, cross reactions.

Unit-5	**Number of lectures = 08**	**Title of the unit: BIOINORGANIC CHEMISTRY**

Biological role of inorganic metals in human body (description only), Electron transfer proteins, Metal ion transport and storage, Feritin and its structure, Oxygen transport by heme proteins, hemoglobin and myoglobin, Dioxygen transport (hemoglobin, hemocyanin and Blue copper proteins), Biomineralization (ferritin), zinc finger protein, Carbonic anhydrase, carboxy peptidase, carboxypeptidase A/B.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understand the concept of coordination chemistry with different theories.	**3**	**2**	**1**		**1**		**3**
CO2	Understand and evaluate the electronic spectra and magnetism of transition metal complexes.	**2**	**2**	**1**		**2**		**3**
CO3	Study of some important inorganic compounds and their applications	**3**	**3**	**1**		**1**		**3**
CO4	Understand the different reaction mechanisms in coordination compounds.	**2**	**3**	**1**		**1**		**3**
CO5	Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.	**2**	**2**	**1**		**1**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/104/105/104105033/
2. https://ocw.mit.edu/courses/chemistry/5-112-principles-of-chemical-science-fall-2005/video-lectures/lecture-32-coordination-complexes-and-ligands/
3. https://www.chem.tamu.edu/rgroup/marcetta/chem362/lectures/Lecture%2029%20subset%20of%20TM%20lecture%20notes.pdf

13. Books recommended:

1. Inorganic Chemistry: Structure and Reactivity, James E. Huheey, Harper and Row Publishers, New York
2. Advanced Inorganic Chemistry: F.A. Cotton and G. Wilkinson, Interscience.
3. Inorganic Reaction Mechanism, Basolo and R.G. Pearson, John Willey.

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**ADVANCE ORGANIC CHEMISTRY**			**L**	**T**	**P**
3. Course Code	**CH315**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the nomenclature of organic compounds, structure and bonding of organic molecules considering inductive effect, hyperconjugation, mesomeric effects, hydrogen bonding etc., and mechanism of various types of organic reactions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..
CO5	Understand and analyze the structure and classification of dyes.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: ORGANOMETALLIC AND ORGANOSULPHUR COMPOUNDS**

Organomagnesium Compounds: the Grignard reagents, structure and chemical reactions Organolithium Compounds :formation and chemical reactions. Nomenclature, methods of formation and chemical reaction of thiols, sulphonic acids.

Unit-2	**Number of lectures =08**	**Title of the unit: HETEROCYCLIC COMPOUNDS**

Molecular orbital picture and aromatic charecteristics of pyrrole, furan, thiophene and pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Methods of synthesis and chemical reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis.

Unit-3	**Number of lectures = 08**	**Title of the unit: CARBOHYDRATES**

Carbohydrates: classification and configuration and conformation of monosaccharides, Erythro and threodiastereomers, mechanism of osazone formation, Interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Formation of glycosides, ether and esters. Cyclic structure of D(+) glucose. An introduction to disaccharides (maltose, sucrose, lactose) and polysaccharides/starch and cellulose.

Unit-4	**Number of lectures = 08**	**Title of the unit: ACIDS, PEPTIDES, PROTIENS AND NUCLEIC ACID**

Classification, structure and stereochemistry of amino acids, isoelectric point. Classification of protiens, peptides, structure determination, and end group analysis. Nucleic acids: Introduction –Classification of Nucleic Acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA.

Unit-5	**Number of lectures = 08**	**Title of the unit: DYES**

Dyes: Introduction of the history of dyes. Landmarks in the historical development from Natural to synthetic dyes. Introduction and classification of dyes on the basis of structure Colour and chemical constitution of dyes. Structure and uses of phenolphthalein, fluorescein , Eosin, Malachite green, Methylene blue , Indigo. Napthol yellow-S, Crystal violet.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.	**3**	**2**	**1**		**1**		**3**
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.	**2**	**2**	**1**		**2**		**3**
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.	**3**	**3**	**1**		**1**		**3**
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..	**2**	**3**	**1**		**1**		**3**
CO5	Understand and analyze the structure and classification of dyes.	**2**	**2**	**1**		**1**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.khanacademy.org/science/organic-chemistry
2. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/Chapter_06%3A_Understanding_Organic_Reactions
3. https://www.dummies.com/education/science/biology/the-basics-of-organic-chemistry/
4. https://www.toppr.com/guides/chemistry/organic-chemistry/

13. Books recommended:

1. Advanced Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.
2. Organic Chemistry Vol.I& II, I.L. Finar
3. Fundamentals of Organic Chemistry, NafisHaider, S. Chand & Co. Ltd.
4. A text book of Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.
5. Organic Chemistry Vol.I, II & III, Dr. Jagdamba Singh, L.D.S. Yadav, PragatiPrakashan.

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**BASICS OF CHROMATOGRAPHIC TECHNIQUES**			**L**	**T**	**P**
3. Course Code	**CH319**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: Students able to understand Separation techniques such as Thin layer chromatography, Paper chromatography, Gas chromatography, High performance Liquid Chromatography and Ion exchange chromatography**.**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the chromatographic techniques and its classification.
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SEPARATION TECHNIQUES**

Chromatography, Classification of Chromatographic methods, Elution in column chromatography, chromatograms, distribution constant, retention time, stationary phase, mobile phase, principle of adsorption and partition chromatography, column chromatography; principle, adsorbents used, preparation of column, adsorption, elution.

Unit-2	**Number of lectures =08**	**Title of the unit: THIN LAYER CHROMATOGRAPHY**

Principle, choice of adsorbent and solvent, Rf value, applications. Paper chromatography; solvents used, principle, Rf value, factors influencing Rf value, applications. Separation of amino acid mixture.

Unit-3	**Number of lectures = 08**	**Title of the unit: GAS CHROMATOGRAPHY**

Introduction, Principles of gas-liquid chromatography, Instrumentation; Carrier gas system, Sample injection, Columns, Stationary phase, Detectors (Flame Ionization, Electron capture and Thermal conductivity) and Industrial applications.

Unit-4	**Number of lectures = 08**	**Title of the unit: HIGH PERFORMANCE LIQUID CHROMATOGRAPHY**

Introduction of HPLC, Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector (UV-visible absorption, Electrochemical) and Industrial applications of HPLC.

Unit-5	**Number of lectures = 08**	**Title of the unit: ION EXCHANGE CHROMATOGRAPHY**

Principle, resins, action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understand the chromatographic techniques and its classification.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.	**3**	**1**	**1**	**2**	**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://microbenotes.com/chromatography-principle-types-and-applications/
2. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography
3. https://www.slideshare.net/nadeemakhter7374/chromatography-34247423
4. http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730

13. Books recommended:

1. Chemical Thermodynamics by R.P.Rastogi et al
2. Principles of physical chemistry by Puri Sharma and Pathan
3. Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
5. Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
6. Atkin's Physical Chemistry, Atkin, Oxford Press.

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**ADVANCED CALCULUS**			**L**	**T**	**P**
3. Course Code	**MT301**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The course is aimed to develop the skills in mathematics especially in Numerical Computing which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field. The purpose of this undergraduate course is to impart basic and key knowledge of differential & integral calculus. Students will be able to evaluate derivative of several functions using different techniques. They will also learn to evaluate different types of integrals. After successful completion of course, the student will be able to explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding of Function of several variables, Domains and Range, Functional notation, Limits and continuity and differentiability. They will also learn to find Partial derivatives, Differential of functions of n variables, Differentials of composite functions by using the chain rule.
CO2	Students will be able to understand Implicit functions, Inverse functions, They will also study directional derivatives and will be able to find Partial derivatives of higher order, Higher derivatives of composite functions. They will learn to find Maxima and minima of functions of several variables.
CO3	Students will gain an understanding of Line integrals in the plane, Basic properties of Line integrals, Line integrals as integrals of vectors and will be able to solve line integral by Green's theorem , and get knowledge of independence of path, simply connected domains , Extension of result of multiply connected domains.
CO4	Students will create the own understanding and used to find Double integral over a rectangular region, Double integral as volume, Area of a region in a plane., Transformation of double integral from Cartesian to polar co - ordinate and vice versa. They will study triple integral and learn to solve them in Cartesian , cylindrical and spherical co – ordinate.
CO5	Students will gain an understanding of solution of Improper integrals, convergence of Camparison test, convergence of Abel's test, Dirichlet's test, convergence of . They will also study convergence of beta and gamma functions.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Function of several variables, Domains and Range, Functional notation, Limits and continuity and differentiability, Partial derivatives, Differential of functions of n variables, Differentials of composite functions, chain rule.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Implicit functions, Inverse functions, The directional derivatives, Partial derivatives of higher order, Higher derivatives of composite functions, Maxima and minima of functions of several variables.

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Line integrals in the plane, Basic properties of Line integrals, Line integrals as integrals of vectors, Green's theorem , independence of path, simply connected domains , Extension of result of multiply connected domains.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Double integral over a rectangle region, Double integral as volume, Area of a region in a plane , Transformation of double integral from Cartesian to polar co - ordinate and vice versa, Triple integral in Cartesian , cylindrical and spherical co - ordinate.

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Improper integrals, convergence of Camparison test, convergence of Abel's test, Dirichlet's test, convergence of , convergence of beta and gamma functions.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding of Function of several variables, Domains and Range, Functional notation, Limits and continuity and differentiability. They will also learn to find Partial derivatives, Differential of functions of n variables, Differentials of composite functions by using the chain rule.	**3**	**2**	**2**	**1**	**3**	**3**	**3**
CO2	Students will be able to understand Implicit functions, Inverse functions, They will also study directional derivatives and will be able to find Partial derivatives of higher order, Higher derivatives of composite functions. They will learn to find Maxima and minima of functions of several variables.	**3**	**2**	**2**	**1**	**2**	**2**	**2**
CO3	Students will gain an understanding of Line integrals in the plane, Basic properties of Line integrals, Line integrals as integrals of vectors and will be able to solve line integral by Green's theorem , and get knowledge of independence of path, simply connected domains , Extension of result of multiply connected domains.	**3**	**2**	**3**	**1**	**3**	**2**	**3**
CO4	Students will create the own understanding and used to find Double integral over a rectangular region, Double integral as volume, Area of a region in a plane., Transformation of double integral from Cartesian to polar co - ordinate and vice versa. They will study triple integral and learn to solve them in Cartesian , cylindrical and spherical co – ordinate.	**3**	**2**	**3**	**1**	**3**	**3**	**2**
CO5	Students will gain an understanding of solution of Improper integrals, convergence of Camparison test, convergence of Abel's test, Dirichlet's test, convergence of . They will also study convergence of beta and gamma functions.	**2**	**2**	**1**	**1**	**3**	**2**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. file:///C:/Users/Admin/Downloads/Vector%20Calculus%20by%20Krishna%20Series.pdf
2. https://www.academia.edu/8509213/Advanced_Calculus._Fifth_Edition-Wifred_Kaplan

13. Books recommended:

1. G. B. Thomas, M.D. Wier, J. Hass: Calculus, Pearsons Education.
2. S. C . Malik and S. Arora : Mathematical analysis, Wiley Eastern Ltd.
3. D. V. Widder: Advanced Calculus, Prentice Hall of India Pvt. Ltd.

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**MATHEMATICAL STATISTICS**			**L**	**T**	**P**
3. Course Code	**MT302**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The course explores the basic concepts of modern statistics and its applications for decision-making in economics, business, and other fields of sciences. Our everyday lives, as well as economic and business activities, are full of data analysis and distribution theory offer useful techniques for quantifying these uncertainties. The course is heavily oriented towards the formulation of mathematical statistics and practical applications.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	To understand the definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, primary and secondary sources of data collection, scales of measurement- nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical form including bar diagram, histogram, pie chart, frequency curve and frequency polygon
CO2	Able to solve Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation and variance, coefficient of variation and coefficient of skewness
CO3	To understand Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation Spearman coefficient rank correlation and tied ranks. Simple linear regression, principle of least squares
CO4	To understand Definitions of Probability – classical, statistical, and axiomatic, random experiments, sample space and events, laws of addition and multiplication, independent events, conditional Probability and Bayes' theorem
CO5	To understand Mathematical expectation, Probability mass function (pmf) and Probability density function (pdf). Binomial Probability distributions, Poisson Probability distributions, and Normal Probability distributions.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

The definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, primary and secondary sources of data collection, scales of measurement- nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical form including bar diagram, histogram, pie chart

Unit-2	**Number of lectures =08**	**Title of the unit:**

Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation and variance, coefficient of variation and coefficient of skewness

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation Spearman coefficient rank correlation and tied ranks. Simple linear regression, principle of least squares

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Definitions of Probability – classical, statistical, and axiomatic, random experiments, sample space and events, laws of addition and multiplication, independent events, conditional Probability and Bayes' theorem

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Mathematical expectation, Probability mass function (pmf) and Probability density function (pdf). Binomial Probability distributions, Poisson Probability distributions, and Normal Probability distributions

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	To understand the definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, primary and secondary sources of data collection, scales of measurement-nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical form including bar diagram, histogram, pie chart, frequency curve and frequency polygon	**2**	**2**	**2**	**1**	**3**	**3**	**3**
CO2	Able to solve Measures of Central Tendency: Arithmetic mean, median, mode, geometric mean and harmonic mean, quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation and variance, coefficient of variation and coefficient of skewness	**2**	**2**	**2**	**1**	**2**	**2**	**2**
CO3	To understand Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation Spearman coefficient rank correlation and tied ranks. Simple linear regression, principle of least squares	**2**	**2**	**3**	**1**	**3**	**2**	**3**
CO4	To understand Definitions of Probability – classical, statistical, and axiomatic, random experiments, sample space and events, laws of addition and multiplication, independent events, conditional Probability and Bayes' theorem	**2**	**2**	**3**	**1**	**3**	**3**	**2**
CO5	To understand Mathematical expectation, Probability mass function (pmf) and Probability density function (pdf). Binomial Probability distributions, Poisson Probability distributions, and Normal Probability distributions.	**2**	**2**	**1**	**1**	**3**	**2**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=be9e-Q-jC-0
2. https://www.youtube.com/watch?v=bQ5_PPRPjG4
3. https://www.youtube.com/watch?v=jauhoR7w1YM

13. Books recommended:

1. Sampling techniques: W.G. Cochran, Wiley
2. Sampling methodologies and applications: P.S.R.S. Rao, Chapman and Hall/CRC 2000
3. Elements of sampling theory and methods: Z. Govindrajalu, Prentice Hall, 1999
4. Theory of sample surveys with applications: P.V.Sukhatme, B.V.Sukhatme, S. Sukhatme and C. Asok, IASRI, Delhi, 1984.
5. Sampling Techniques: Daroga Singh & Chaudhry, F.S New age International

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**NUMBER THEORY**			**L**	**T**	**P**
3. Course Code	**MT303**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The course is intended to allow students to be exposed to some foundational ideas in number theory without the technical baggage often associated with a more advanced courses. The course provides students an opportunity to develop an appreciation of pure mathematics while engaged in the study of number theoretic results. The course is also designed to provide students an opportunity to work with conjectures, proofs, and analysing mathematics.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Can be able to demonstrate Cartesian product of sets, Equivalence relation and partition, Fundamental theorem of equivalence of relation, Equivalence sets.
CO2	Demonstrate knowledge and understanding of topics including, but not limited to divisibility, cardinal numbers, congruence's, quadratic reciprocity, Diophantine equations and cantor's theorem
CO3	Can analyse hypotheses and conclusions of mathematical statements of divisibility, congruence, greatest common divisor, prime, and prime factorization
CO4	Can apply different techniques of congruence to verify mathematical assertions, including proof by induction, by contrapositive and by contradiction
CO5	Can solve systems of Diophantine equations using the Chinese Remainder Theorem & the Euclidean algorithm and Lagrange's theorem

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Cartesian product of sets, Equivalence relation and partition, Fundamental theorem of equivalence of relation, Equivalence sets.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Cardinal numbers, power of continuum, cardinal arithmetic, Inequalities in cardinals, Cantor's theorem, Schrodar Berntien Theorem

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Division Algorithm, greatest common divisor, least common multiplier, prime number, unique factorisation theorem.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Congruence, Complete residue theorem, Euler's theorem

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Linear congruence, Chinese remainder theorem, problem based on Chinese remainder theorem, Lagrange's theorem

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Can be able to demonstrate Cartesian product of sets, Equivalence relation and partition, Fundamental theorem of equivalence of relation, Equivalence sets.	**2**	**2**	**2**	**1**	**3**	**3**	**3**
CO2	Demonstrate knowledge and understanding of topics including, but not limited to divisibility, cardinal numbers, congruence's, quadratic reciprocity, Diophantine equations and cantor's theorem	**2**	**2**	**2**	**1**	**2**	**2**	**2**
CO3	Can analyse hypotheses and conclusions of mathematical statements of divisibility, congruence, greatest common divisor, prime, and prime factorization	**2**	**2**	**3**	**1**	**3**	**2**	**3**
CO4	Can apply different techniques of congruence to verify mathematical assertions, including proof by induction, by contrapositive and by contradiction	**2**	**2**	**3**	**1**	**3**	**3**	**2**
CO5	Can solve systems of Diophantine equations using the Chinese Remainder Theorem & the Euclidean algorithm and Lagrange's theorem	**2**	**2**	**1**	**1**	**3**	**2**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=SCvtxjpVQms
2. https://www.youtube.com/watch?v=-Qtl4nn7R4A

13. Books recommended:

1. J Hunter: Number Theory
2. David M. Burton: Elementary Number Theory
3. Seymour Lipschutz: Set theory and related topics

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – V**			**L**	**T**	**P**
3. Course Code	**CH316**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** Student will be able to work effectively and safely in a laboratory environment, practical/technical/ communication skills, concepts to solve qualitative and quantitative problems,transferable skills like ability to work in teams as well as independently.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

10. Syllabus

Exp – 01	Synthesis and Analysis of the Potassium trioxalatoferrate (III), K3[Fe(C2O4)3] and determination of its composition by permagnometry. (a) Potassium trioxalatoferrate (III), K3[Fe(C2O4)3] and determination of its composition by permagnometry.
Exp – 02	Preparation of cis-and trans –bisoxalatodiaqua chromate (III) ion.
Exp – 03	To verify Beer-Lambert law for KMnO4/K2Cr2O7 and determine the concentration of the given solution
Exp – 04	Determination of Fe3+ content by thiocyanate method.
Exp – 05	Separation of Fluorescein and methylene blue by column chromatography.
Exp – 06	Separation of leaf pigments from leaves
Exp – 07	Resolution of racemic mixture of (+) mandelic acid
Exp – 08	Diazotization/coupling: Preparation of methyl orange and methyl red
Exp – 09	Oxidation: Preparation of benzoic acid from toluence
Exp – 10	Reduction: Preparation of aniline from nitrobenzene

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.	**3**	**2**	**2**		**3**	**1**	**3**
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.	**3**	**2**	**2**		**3**	**1**	**3**
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.	**3**	**2**	**2**		**3**	**1**	**3**
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.	**3**	**2**	**2**		**3**	**1**	**3**
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	**3**	**2**	**2**		**3**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc.Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

SEMESTER – V (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**STATISTICAL TECHNIQUES LAB**			**L**	**T**	**P**
3. Course Code	**MT304**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	
CO2	
CO3	
CO4	
CO5	

10. Syllabus	
Exp – 01	
Exp – 02	
Exp – 03	
Exp – 04	
Exp – 05	
Exp – 06	
Exp – 07	
Exp – 08	
Exp – 09	
Exp – 10	

11. CO-PO mapping

COs	**Attributes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1								
CO2								
CO3								
CO4								
CO5								

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**SPECTROSCOPIC TECHNIQUES**			**L**	**T**	**P**
3. Course Code	**CH308**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: Students able to understand the interaction of electromagnetic radiation with the materials, spectroscopic techniques like Ultraviolet, FT-IR, Nuclear Magnetic Resonance spectroscopy and mass spectrometry.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), Mclafferty rearrangements.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: UV SPECTROSCOPY**

Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated dienes and polyenes.

Unit-2	**Number of lectures =08**	**Title of the unit: IR SPECTROSCOPY**

Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.

Unit-3	**Number of lectures = 08**	**Title of the unit: NMR SPECTROSCOPY**

Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling,, Interpretation of NMR spectra of some representative compounds.

Unit-4	**Number of lectures = 08**	**Title of the unit: MASS SPECTROSCOPY**

Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters, acids, anhydrides), molecular ion peak, metastable peak, Mclafferty rearrangements, Nitrogen rule.

Unit-5	**Number of lectures = 08**	**Title of the unit: ATOMIC ABSORPTION SPECTROPHOTOMETRY**

Introduction, Principle, Instrumentation, Sample preparation, Internal standard and standard addition, calibration and applications of AAS.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.	**3**	**1**	**2**		**2**	**1**	**2**
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.	**3**	**1**	**2**		**2**	**1**	**2**
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.	**3**	**1**	**2**		**2**	**1**	**3**
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.	**3**	**1**	**1**		**2**	**1**	**3**
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), Mclafferty rearrangements.	**3**	**1**	**1**		**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=2Y8pSoS0d1g
2. http://www.infocobuild.com/education/audio-video-courses/chemistry/ApplicationOfSpectroscopicMethods-IIT-Madras/lecture-25.html
3. https://scrippslabs.com/summary-of-spectroscopic-techniques/
4. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf

13. Books recommended:

1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.
2. Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V Edition Tata Mc Grawhills
3. Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications.
4. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.
5. Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication.
6. Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.
7. Spectrometric identification of organic compounds, R. M. Silverstein, 6th edition, John Wiley and sons.
8. Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMICAL PROCESS INDUSTRY**			**L**	**T**	**P**
3. Course Code	**CH309**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the composition, preparation, properties and uses of ammonia, nitric acid, phosphorus chemical, glass, cement, ceramics and refractories and their related toxic hazards on the health of consumer.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.
CO3	Understand the composition of glass and their types, properties and uses.
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.
CO5	Understand the classification, properties and uses of ceramics and refractoriness and their respective characteristics.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SYNTHETIC NITROGEN PRODUCTS**

Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control, Hazards and safety and Effluent management.

Unit-2	**Number of lectures =08**	**Title of the unit: CHLOR-ALKALI INDUSTRIAL PRODUCTS**

Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammonium phosphate, superphosphate, triple superphosphate. Lime, gypsum, Silicon, calcium carbide.

Unit-3	**Number of lectures = 08**	**Title of the unit: GLASS**

Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.

Unit-4	**Number of lectures = 08**	**Title of the unit: CEMENT**

Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.

Unit-5	**Number of lectures = 08**	**Title of the unit: CERAMICS AND REFRACTORIES**

Introduction, Types of ceramics materials, properties and applications. Refractories, classification of refractories, characteristics of refractories materials, properties of refractories. Neutral refractories; Silicon carbide. Acid refractories; High Alumina refractories.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.	**3**	**2**	**3**	**3**	**2**	**3**	**2**
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO3	Understand the composition of glass and their types, properties and uses.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO5	Understand the classification, properties and uses of ceramics and refractoriness and their respective characteristics.	**3**	**2**	**3**	**3**	**1**	**3**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://encyclopedia2.thefreedictionary.com/chemical+process+industry
2. https://www.youtube.com/watch?v=RjZJjneJ5fk
3. https://www.chemicalprocessing.com/
4. https://www.britannica.com/science/phosphorus-chemical-element

13. Books recommended:

1. Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.
2. Groggins P.M., Unit Process in Organic Synthesis, 5th edition, International student edition, Pubs: McGraw-Hill Book Co., New York, 1998.
3. Dryden's outlines of Chemical Technology, edited and revised by Gopala Rao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.
4. Industrial Chemistry B.K.Sharma, goel publishing house.
5. Chemical process industries N.R Nerris shreve.
6. Chemical process principales: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)
7. Shrev's Chemical process Industries: 5th edition – George T. Austin, Mc Graw Hill.

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY OF POLYMERS**			**L**	**T**	**P**
3. Course Code	**CH317**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the mechanism of polymer preparation, their processing techniques, commercial uses, identification techniques and preparation process of vinyl polymers, polyamides, polyesters, synthetic rubbers, cellulose and copolymer resins.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Student will be able to evaluate the different mechanisms of polymer preparation and their classification.
CO2	Student will be able explain various polymer reactions such as hydrolysis, acidolysis, crosslinking etc.
CO3	Understand the colligative properties of Polymers and evaluate the identification techniques such as NMR and FTIR of Polymers.
CO4	Understand the degradation and its types.
CO5	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubbers.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: INTRODUCTION**

Basic concepts of polymer science, Classification of polymers, Average molecular weight and Molecular weight distribution. Polymerization: Mechanism and kinetics of: Free radical addition polymerization, Ionic addition polymerization, Coordination polymerization, Step growth polymerization.

Unit-2	**Number of lectures =08**	**Title of the unit: POLYMER REACTIONS**

Introduction; types- hydrolysis, acidolysis, addition, substitution, halogenation, hydrogenation, crosslinking, curing, (brief mechanism and usefulness of each reaction to be highlighted with examples).

Unit-3	**Number of lectures = 08**	**Title of the unit: STRUCTURE AND PROPERTIES**

Thermal transitions, Crystallinity, Molecular weight characterization, Nuclear Magnetic Resonance (NMR) and Fourier Transform Infrared (FTIR) techniques.

Unit-4	**Number of lectures = 08**	**Title of the unit: POLYMER DEGRADATION**

Introduction, Types of degradation- thermal degradation, mechanical degradation, degradation by ultrasonic waves, photo degradation, degradation by high-energy radiation, oxidative degradation and hydrolytic degradation and biodegradation.

Unit-5	**Number of lectures = 08**	**Title of the unit: SYNTHESIS, PROPERTIES AND APPLICAIONS**

Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethylmethacrylate, Polyethene, Polybutadiene, Polyvinylidene, Polycarbonates, Polyesters, Polyurethanes, Phenolic polyesters, Polyamides, Polysulphones.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will be able to evaluate the different mechanisms of polymer preparation and their classification.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO2	Student will be able explain various polymer reactions such as hydrolysis, acidolysis, crosslinking etc.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO3	Understand the colligative properties of Polymers and evaluate the identification techniques such as NMR and FTIR of Polymers.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO4	Understand the degradation and its types.	**1**	**1**	**2**	**2**	**3**	**1**	**2**
CO5	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubbers.	**1**	**1**	**2**	**2**	**3**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=kMHYNuyKQ2Q&list=PLBAcrca02tZdHmbDFvnOA6ZYTJPnF5sMe
2. https://www.youtube.com/watch?v=Gzin6mP-tUM&list=PLLy_2iUCG87CbDZMn4eP_XT09XTJOVooJ
3. https://www.youtube.com/watch?v=68fF7Tnl0wE
4. https://www.youtube.com/watch?v=YZf5q-ICf8Y

13. Books recommended:

1. Principles of polymer chemistry: A Ravve, 2nd Edition, Kluwer Academic publications
2. Polymer Science and technology: Joll. R. Fried, Prentice – Hall.
3. Principles of polymer systems: F. Rodriguez, Claude Cohen, C.K. Ober, L.A. Archer, Vth Edition, Taylor & Francis
4. Introduction to polymers: R.J. Young and P.A. Lovell, 2nd Edition, Netron Thornes publications
5. Polymer chemistry – an introduction, Malcolm D. Stevens, Oxford University press.

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**BASIC MATHEMATICAL MODELING**			**L**	**T**	**P**
3. Course Code	**MT307**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The course is aimed to develop the skills in mathematics especially in mathematical modeling which is necessary for grooming them into successful science graduate. The topics introduced will serve as basic tools for specialized studies in science field.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Assess and articulate what type of modeling techniques are appropriate for a given physical system
CO2	Construct a Mathematical model of a given physical system and analyze it.
CO3	Make predictions of the behavior of a given physical system based on the analysis of its Mathematical Model.
CO4	Demonstrate understanding of powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory
CO5	Recognize the power of mathematical modeling and analysis and be able to apply their understanding to their further studies.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Simple situations requiring mathematical modeling, techniques of mathematical modeling, classifications of mathematical modeling, characteristics of mathematical models. Mathematical modeling through geometry, algebra, trigonometry and calculus. Limitations of methodical modeling.

Unit-2	**Number of lectures =08**	**Title of the unit:**

Mathematical modeling through ordinary differential equations first order linear growth and decay models, compartment models, mathematical modeling in dynamics through first order ODE. Mathematics modeling through Systems of ODE of first order

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Mathematical modeling in population dynamics, mathematical modeling of epidemic, Compartment model through system of ODE. Mathematical Modeling of circular motion, Planetary motions and motions of satellite.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Mathematics modeling in economics, in medicine, Arms race, Battles, international trade in terms of system of ODE and dynamic through ordinary differential equations. Mathematical Modeling through ODE of second order**.**

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Mathematical modeling through difference equations: The need, basic theory, modeling in Economics and finance, modeling in population dynamics and Genetics, Modeling in probability theory. Examples of Mathematical modeling through difference equations

11. CO-PO mapping

COs	**Attributes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	Assess and articulate what type of modeling techniques are appropriate for a given physical system	**3**	**2**	**2**	**1**	**1**	**1**	**3**
CO2	Construct a Mathematical model of a given physical system and analyze it.	**2**	**2**	**2**	**1**	**1**	**1**	**2**
CO3	Make predictions of the behavior of a given physical system based on the analysis of its Mathematical Model.	**3**	**2**	**3**	**1**	**1**	**1**	**2**
CO4	Demonstrate understanding of powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory	**3**	**2**	**3**	**3**	**1**	**1**	**1**
CO5	Recognize the power of mathematical modeling and analysis and be able to apply their understanding to their further studies.	**2**	**3**	**1**	**2**	**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=-uCwgZUz51o
2. https://nptel.ac.in/courses/111107113/
3. https://study.com/academy/lesson/types-of-mathematical-models.html
4. https://www.frontiersin.org/articles/10.3389/fgene.2015.00354/fullpdf
5. https://www.youtube.com/watch?v=jV4Hlh8gHLs

13. Books recommended:

1. J.N. Kapur: Mathematical modeling Wiley Eastern limited, 1990.
2. Principles of Mathematical Modeling, 2nd Edition, Clyve L. Dym, Elsevier Academic Press.
3. A Course in Mthematical Modeling, Douglus Munee 4. Concepts in Mathematical Modeling, Walter J Meyer

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**LINEAR PROGRAMMING**			**L**	**T**	**P**
3. Course Code	**MT308**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: To teach the basic concepts of Linear Programming, Integer Linear Programming, Multi-objective and Stochastic linear programming. To make students able for Post optimal analysis and optimal decision making problem. This is a great beginner course for those interested in Mathematical Programming Optimization.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Formulation of real life problems in the form of linear programming problem and various method to solve the formulated LPP
CO2	Can obtain the problem when changing the parameters of the problem in later stages.
CO3	Understanding pure and mixed integer programming problems with different methods of solving those problems.
CO4	Understand Multi-objective and Stochastic programming problem and various methods to make them deterministic in order to solve efficiently.
CO5	Learn decision making problems under various environment explicitly the theory of games

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Formulation of linear programming problem, simplex algorithm, Primal Dual relationship, Economical interpretation of the dual, Dual Simplex method. Revised simplex method. Bounded variable simplex method

Unit-2	**Number of lectures =08**	**Title of the unit:**

Sensitivity Analysis: Change in values of objective function coefficient, Change in right hand side values, Change in coefficient of coefficient, Adding a new product and adding a constraint

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Integer programming formulation, all integers and mixed integer programming problems, Gomory's cutting plane algorithm, Branch and bound algorithm. Knapsack problem

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Stochastic programming models, Chance constraints optimization, two stage problems. Goal Programming methods and applications

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Decision Theory: Introduction, Elements of decision problem, Types of decision making environment, Decision tree. Game Theory: Basic definitions, Two-person Zero-sum games, Pure and mixed strategy, Principle of Dominance, Graphical method, Solution of games by linear programming method.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Formulation of real life problems in the form of linear programming problem and various method to solve the formulated LPP	**3**	**2**	**1**	**2**	**2**	**1**	**3**
CO2	Can obtain the problem when changing the parameters of the problem in later stages.	**3**	**1**	**1**	**1**	**2**	**1**	**3**
CO3	Understanding pure and mixed integer programming problems with different methods of solving those problems.	**3**	**1**	**1**	**2**	**2**	**1**	**3**
CO4	Understand Multi-objective and Stochastic programming problem and various methods to make them deterministic in order to solve efficiently.	**3**	**2**	**3**	**1**	**1**	**1**	**3**
CO5	Learn decision making problems under various environment explicitly the theory of games	**3**	**2**	**1**	**2**	**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=TwAvQJAM9Hk
2. https://www.youtube.com/watch?v=M8POtpPtQZc
3. https://www.youtube.com/watch?v=KLHWtBpPbEc
4. https://www.youtube.com/watch?v=o-N0jFUpdWo
5. https://www.youtube.com/watch?v=56-iiZEjqnU
6. https://www.youtube.com/watch?v=LAC212ZwBB4
7. https://www.youtube.com/watch?v=gkm6WljmbOk
8. https://www.youtube.com/watch?v=EyVYAngxkPA
9. https://www.youtube.com/watch?v=hibV5YbZvBw

13. Books recommended:

1. Mokhtar S. Bazara, John J. Jarvis "Linear Programming and Network Flows" Fourth Edition. WILEY A John Wiley & Sons, Inc., Publication
2. H.A. TAHA "Operations Research- An Introduction" Pearson.
3. K.Swarup, P.K.Gupta and A. Manmohan, "Operations Research", S. Chand.
4. Hiller And Liebarman, "Introduction to Operations Research", McGraw Hill Company.
5. David K. J. Mtetwa, "Linear Programming" Paradise publishers, US

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**STATICS AND DYNAMICS**			**L**	**T**	**P**
3. Course Code	**MT305**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of motion of body on various types of surfaces. Students will be able to learn about equilibrium and bodies acted upon by forces under different conditions. After successful completion of course, the student will be able to explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will be able to understand Velocity and acceleration along radial and transverse directions and along Tangential and normal directions. They will also study Simple harmonic motion in various situations and about Motion under other laws of forces, Earth attraction, Elastic strings.
CO2	Students will gain an understanding of Motion of bodies in resisting medium, Constrained motion (circular and cycloidal only).
CO3	Students will gain an understanding of motion of particle on smooth and rough plane curves, Rocket motion and also study about Central orbits and Kepler's law, Motion of a particle in three dimensions.
CO4	Students will create the own understanding of Common catenary, Centre of gravity and get knowledge of Stable and unstable equilibrium, Virtual work.
CO5	Students will learn about Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**

Velocity and acceleration along radial and transverse directions, and along Tangential and normal directions, Simple harmonic motion, Motion under other laws of forces, Earth attraction, Elastic strings

Unit-2	**Number of lectures =08**	**Title of the unit:**

Motion in resisting medium, Constrained motion (circular and cycloidal only).

Unit-3	**Number of lectures = 08**	**Title of the unit:**

Motion on smooth and rough plane curves, Rocket motion, Central orbits and Kepler's law, Motion of a particle in three dimensions.

Unit-4	**Number of lectures = 08**	**Title of the unit:**

Common catenary, Centre of gravity, Stable and unstable equilibrium, Virtual work.

Unit-5	**Number of lectures = 08**	**Title of the unit:**

Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will be able to understand Velocity and acceleration along radial and transverse directions and along Tangential and normal directions. They will also study Simple harmonic motion in various situations and about Motion under other laws of forces, Earth attraction, Elastic strings.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO2	Students will gain an understanding of Motion of bodies in resisting medium, Constrained motion (circular and cycloidal only).	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO3	Students will gain an understanding of motion of particle on smooth and rough plane curves, Rocket motion and also study about Central orbits and Kepler's law, Motion of a particle in three dimensions.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO4	Students will create the own understanding of Common catenary, Centre of gravity and get knowledge of Stable and unstable equilibrium, Virtual work.	**3**	**2**	**2**	**1**	**1**	**1**	**2**
CO5	Students will learn about Forces in three dimensions, Poinsot's central axis, Wrenches, Null line and null plane.	**3**	**2**	**2**	**1**	**1**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/112/106/112106180/
2. https://www.mathcity.org/bsc/notes_of_mechanics/tariq_mahmood_qadri
3. https://www.fisica.net/mecanicaclassica/introduction_to_statics_and_dynamics_by_rudra_pratap.pdf
4. https://www.msuniv.ac.in/Download/Pdf/2c2167ab44cf4fc

13. Books recommended:

1. R.S. Verma - A Text Book on Statics., Pothishala Pvt. Ltd., Allahabad
2. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
3. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
4. M.A. Pathan: Statics
5. Jhonson and Beer: Vector Mechanics for Engineers
6. Zafar Ahsan: Lectures Notes on Mechanics

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: MATHEMATICS						
2. Course Name	**ANALYSIS**			**L**	**T**	**P**
3. Course Code	**MT306**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: This is an introductory course on analysis for mathematics students. The aim of this course is to introduce and develop basic analytic concepts of limit, convergence, integration and differentiation.
This course is aimed to provide an introduction to the theories for functions of a complex variable. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced.

9. COURSE OUTCOMES (CO):
After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
CO2	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration
CO3	Understand and be able to use notions of convergence involving sequences of functions, including the difference between point wise and uniform convergence. Apply the Weierstrass M-test and the uniform convergence theorem for integrals to examples.
CO4	Demonstrate understanding of the basic concepts underlying complex analysis.
CO5	Find Laurent series about isolated singularities, and determine residues and use the residue theorem to compute several kinds of real integrals.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: TOPOLOICAL SPACES**

Axiomatic study of real numbers, Completeness property in , Archimedean property, Countable and uncountable sets, Neighborhood, Interior points, Limit points, Open and closed sets, Derived sets, Dense sets, Perfect sets, Bolzano – Weierstrass theorem.

Unit-2	**Number of lectures =08**	**Title of the unit: HOMEOMORPHISM AND SEPARATION AXIOMS**

Sequence of real numbers, Subsequence, Bounded and monotonic sequences, Convergent sequences, Cauchy's theorems on limit, Cauchy sequence, Cauchy general principle of convergence.

Unit-3	**Number of lectures = 08**	**Title of the unit: COMPACTNESS**

Uniform convergence of sequences and series of functions, Weierstrass - test, Abel's and Dirichlet's test, Boundedness and intermediate value properties of continous functions, Uniform continuity, Meaning of sign of derivative, Darboux theorem

Unit-4	**Number of lectures = 08**	**Title of the unit: CONNECTEDNSS**

Functions of Complex variables, Limit, Continuity and differentiability, CR – equations , Analytic functions, Harmonic functions, Construction of analytic function.

Unit-5	**Number of lectures = 08**	**Title of the unit: PRODUCT TOPOLOGY**

Cauchy fundamental theorem, Cauchy integral formula, Derivatives of analytic functions, Morera's and Lioville's theorem, Zeros of analytic function, Singularities, Residues and theorem of Residue

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Describe fundamental properties of the real numbers that lead to the formal development of real analysis.	**3**	**1**	**1**		**2**	**1**	**1**
CO2	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration	**3**	**1**	**2**		**3**	**1**	**1**
CO3	Understand and be able to use notions of convergence involving sequences of functions, including the difference between point wise and uniform convergence. Apply the Weierstrass M-test and the uniform convergence theorem for integrals to examples.	**3**	**1**	**2**		**3**	**1**	**1**
CO4	Demonstrate understanding of the basic concepts underlying complex analysis.	**3**	**1**	**1**		**2**	**1**	**1**
CO5	Find Laurent series about isolated singularities, and determine residues and use the residue theorem to compute several kinds of real integrals.	**3**	**1**	**1**		**2**	**1**	**1**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://swayam.gov.in/nd1_noc20_ma03/preview
2. https://www.youtube.com/watch?v=gJ1pYz1k0qM
3. https://www.youtube.com/watch?v=t9xW7UaZwZ0

13. Books recommended:

1. Robert G. Bartle and Donald R. Sherbert : Introduction to Real Analysis,Wiley Student Edition.
2. S. C . Malik and S. Arora : Mathematical analysis, Wiley Eastern Ltd.
3. R . V. Churchill and J.W. Brown: Complex Variable & Applications, McGrow Hill, International Book Company, London Goyal and Gupta : Function of a Complex Variable, Pragati Prakashan.

SEMESTER – VI (Chemistry, Mathematics)

1. Name of the Department: CHEMISTRY						
2. Course Name	**UG CHEMISTRY PROJECT**			**L**	**T**	**P**
3. Course Code	**CH318**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective is to enhance the technical skills and to provide students industrial exposure.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Hands on training
CO2	Integrate class room theory with laboratory scale practice.
CO3	Understanding professional ethics of industry and code of conduct.

10. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Hands on training	**3**	**2**	**3**	**2**	**3**	**3**	**3**
CO2	Integrate class room theory with laboratory scale practice.	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO3	Understanding professional ethics of industry and code of conduct.	**3**	**2**	**2**	**2**	**3**	**3**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**ELEMENTS OF QUANTUM MECHANICS, ATOMIC AND MOLECULAR SPECTRA**			**L**	**T**	**P**
3. Course Code	**PY301**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = Nil**

8. COURSE OBJECTIVES: To provide working knowledge of the Quantum Mechanics postulates on the physical systems and to introduce some of the basic systems in atomic physics. To gain greater familiarity with quantum mechanics by studying its application to atomic systems.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Would be able to analyze the inadequacies of classical mechanics in atomic domain and provide the understanding of quantum theory of light in order to analyze Blackbody Radiation.
CO2	Provided with the wavefunction of a system students would be able to normalize it and determine the expectation values.
CO3	To solve the Schrodinger's equation for time independent problems like free particle, particle in an infinite potential well, square potential well, the step potential and potential barrier.
CO4	It includes an understanding of LS and JJ coupling in order to be able to use appropriate quantum numbers for labelling of energy levels.
CO5	To analyze the origin of electronic, vibrational and rotational energy levels and undertake simple calculations of energy levels.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: MATTER WAVES**

Inadequacies of classical mechanics, black body radiation, theoretical laws of black body radiation, photoelectric phenomenon, Compton effect, Planck's quantum hypothesis, development of quantum mechanics, Bohr's quantization condition, wave particle duality, de- Broglie hypothesis, velocity of de- Broglie waves, phase and group velocities and their relationship for a non-relativistic particle.

Unit-2	**Number of lectures =08**	**Title of the unit: SCHRODINGER EQUATION – I**

Heisenberg's uncertainty principle with derivation and its applications, ground state energy of Hydrogen atom & linear harmonic oscillator Basic postulates of quantum mechanics, Schrodinger Equation: time dependent and time independent form, Physical interpretation of the wave function, orthogonality and normalization of wave functions, basic problem related to wave function, probability current density, Ehrenfest theorem.

Unit-3	**Number of lectures = 08**	**Title of the unit: SCHRODINGER EQUATION – II**

Applications of Schrodinger wave equation: (free particle, a particle in 1-D infinitely deep potential well, a particle in 3-D infinitely deep potential well, 1-D linear harmonic oscillator, one dimensional motion in step potential, rectangular potential barrier, square well potential), expectation values of dynamical quantities, momentum space wave function.

Unit-4	**Number of lectures = 08**	**Title of the unit: ATOMIC SPECTRA**

Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d, and f states, selection rules, Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt's law. Characteristics X-rays, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

Unit-5	**Number of lectures = 08**	**Title of the unit: MOLECULAR SPECTRA**

Discrete set of electronic energies of molecules, quantization of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation-vibration spectra, Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra.

11. CO-PO mapping

COs	**Attributes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	Would be able to analyze the inadequacies of classical mechanics in atomic domain and provide the understanding of quantum theory of light in order to analyze Blackbody Radiation.	**3**	**2**			**1**		**3**
CO2	Provided with the wavefunction of a system students would be able to normalize it and determine the expectation values.	**3**	**1**			**2**		**3**
CO3	To solve the Schrodinger's equation for time independent problems like free particle, particle in an infinite potential well, square potential well, the step potential and potential barrier.	**3**	**1**			**2**		**3**
CO4	It includes an understanding of LS and JJ coupling in order to be able to use appropriate quantum numbers for labelling of energy levels.	**3**	**1**			**2**		**3**
CO5	To analyze the origin of electronic, vibrational and rotational energy levels and undertake simple calculations of energy levels.	**3**	**1**			**2**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/115/101/115101107/
2. https://nptel.ac.in/courses/122/106/122106034/
3. https://nptel.ac.in/courses/115/101/115101003/

13. Books recommended:

1. H. S. Mani and G. K. Mehta; "Introduction to Modern Physics" (Affiliated East- West Press 1989).
2. A. Beiser, "Perspectives of Modern Physics (McGraw Hill).
3. H. E. White; "Introduction to Atomic Physics (D. Van Nostrand Company)
4. Barrow; "Introduction to Molecular Physics (McGraw Hill).
5. R. P. Feymann, R. B. Leighton and M. Sands; "The Feynman Lectures on Physics, Vol. III (B I Publications. Bombay. Delhi, Calcutta, Madras).
6. T. A. Littlefield and N Thorley; "Atomic and Nuclear Physics" (Engineering Language Book Society).
7. Eisenberg and Resnick; "Quantum Physics of Atoms, 'Molecules, Solids, Nuclei and Particles" (John Wiley).

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**CLASSICAL MECHANICS, RELATIVITY AND STATISTICAL PHYSICS**			**L**	**T**	**P**
3. Course Code	**PY302**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: To provide the dynamics of system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation of mechanics and to give the students a thorough understanding of the theory and methods of statistical physics.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding of the Classical Mechanics and basic theories of Physics like Lagrangian and Hamiltonian Dynamics.
CO2	Students will be able to develop a deep understanding of various phenomena of Special Theory of Relativity and concept of mass-energy equivalence.
CO3	Students will be able to master basic statistical methods and concepts like probability, random variables, expected value, variance, estimators and common probability distributions.
CO4	Students will be able to write the distribution function of various systems and further calculate various thermodynamic potentials.
CO5	Interpretation of Maxwellian distribution. Analysis of statistical mechanical description of Fermi- and Bose- statistics for electron and photon.

10. Unit wise detailed content

Unit-1	Number of lectures = 08	Title of the unit: LAGRANGIAN AND HAMILTONIAN DYNAMICS

Constraints: holonomic and non-holonomic, time independent and time dependent, Generalized coordinates, Lagrange equations from D'Alembert's principle, velocity dependent potentials, Variational principle: Technique of the calculus of variation, Hamilton's variational principle, Lagrange equations using Hamilton's principle, Generalized momenta, cyclic coordinates. Definition of Hamiltonian and its physical significance, Hamilton's equations of motion from variational principle.

Unit-2	Number of lectures =08	Title of the unit: SPECIAL THEORY OF RELATIVITY

Reference systems, inertial frames, Galilean invariance and conservation laws, propagation of light, Michelson-Morley experiment; search for ether, Postulates for the special theory of relativity, Lorentz transformations, length contraction, time dilation, velocity addition theorem, variation of mass with velocity, mass-energy equivalence, particle with a zero rest mass.

Unit-3	Number of lectures = 08	Title of the unit: THE STATISTICAL BASIS OF THERMODYNAMICS

Probability and thermodynamic probability, principle of equal a priori probabilities, probability distribution and its narrowing with increase in number of particles.

Unit-4	Number of lectures = 08	Title of the unit: SOME UNIVERSAL LAWS

The μ (mu)- space representation, division of μ (mu)- space into energy sheets and into phase cells of arbitrary size, applications to one-dimensional harmonic oscillator and free particles, Equilibrium before two systems in thermal contact, Probability and entropy, Boltzmann entropy relation, Statistical interpretation of second law of thermodynamics.

Unit-5	Number of lectures = 08	Title of the unit: QUANTUM STATISTICAL MECHANICS

Maxwellian distribution of speeds in an ideal gas: Distribution of speeds and of velocities, experimental verification, distinction between mean, r.m.s. and most probable speed values.

Transition to quantum statistics: 'h' as a natural constant and' its implications, cases of particle in a one-dimensional box and one-dimensional harmonic oscillator, Indistinguishability of particles and its consequences, Bose-Einstein, and Fermi-Dirac distributions, photons in black body chamber, free electrons in a metal, Fermi level and Fermi energy.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding of the Classical Mechanics and basic theories of Physics like Lagrangian and Hamiltonian Dynamics.	**3**	**2**	**1**	**1**		**1**	**2**
CO2	Students will be able to develop a deep understanding of various phenomena of Special Theory of Relativity and concept of mass-energy equivalence.	**3**	**2**	**1**	**1**		**1**	**2**
CO3	Students will be able to master basic statistical methods and concepts like probability, random variables, expected value, variance, estimators and common probability distributions.	**3**	**1**	**1**				**1**
CO4	Students will be able to write the distribution function of various systems and further calculate various thermodynamic potentials.	**3**	**1**				**2**	**1**
CO5	Interpretation of Maxwellian distribution. Analysis of statistical mechanical description of Fermi- and Bose-statistics for electron and photon.	**3**						**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/115/105/115105098/
2. https://nptel.ac.in/courses/115/106/115106111/

13. Books recommended:

1. A. Beiser, "Concepts of Modern Physics" (McGraw-Hill).
2. B. B. Laud, "Introduction to Statistical Mechanics" (Macmillan 1981).
3. F. Reif, "Statistical Physics" (McGraw-Hill 1988).
4. K. Haung, "Statistical Physics" (Wiley Eastern, 1988).
5. H. Goldstein, "Classical Mechanics, 2nd Edition (Narosa).

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**SOLID STATE, NUCLEAR AND PARTICLE PHYSICS**			**L**	**T**	**P**
3. Course Code	**PY303**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = Nil**

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of solid state, nuclear and particle physics. By using the principal of physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	Students will gain an understanding of crystal structure, diffraction and reciprocal lattice which help in determine the crystal structure of any material.
CO2	Students will gain an understanding of crystal bonding and the vibrations involved in crystal Lattice which help them to understand the concept of vibrational dynamics.
CO3	Students will gain an understanding of materials (metals and semiconductors) and able to find the band gap based on which they define the material type.
CO4	Students will understand the basic properties of nucleus, know about Nuclear Forces and Nuclear Reactions which helps in defining the type of nuclear reaction.
CO5	Students will gain basic knowledge of particle physics and ability to outline the physical origins of particle physics.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: CRYSTAL STRUCTURE**

Lattice translation vectors and lattice, Symmetry operations, Basis and Crystal structure, Primitive Lattice cell, Two-dimensional lattice types, systems, Number of lattices, Number of Lattices, Index system for crystal planes, Miller indices, Simple crystal structures, NaCl, hcp, diamond. Bragg's law, experimental diffraction method, Laue method, rotating crystal method, powder method.

Unit-2	**Number of lectures =08**	**Title of the unit: CRYSTAL BONDING AND LATTICE STRUCTURE**

Crystal of inert gases, Van der Walls-London interaction, repulsive interaction, Equilibrium lattice constants, Cohesive energy, compressibility and bulk modulus, ionic crystal, Madelung energy, evaluation of Madelung constant, Covalent crystals, Hydrogen-bonded crystals, Atomic radii.
Lattice Heat capacity, Einstein model. Vibrations of monatomic lattice, derivation of dispersion relation, Force constants, Lattice with two atoms per primitive cell.

Unit-3	**Number of lectures = 08**	**Title of the unit: BAND THEORY**

Hall effect (metals and semiconductors), Origin of band theory, Kronig-Penney model, Number of orbitals in a band, conductor, Semi- conductor and insulators, Effective mass, Concept of holes.

Unit-4	**Number of lectures = 08**	**Title of the unit: NUCLEAR PHYSICS**

General Properties of Nucleus: Brief survey of general Properties of the Nucleus, Mass defect and binding energy, charges, Size, Spin and Magnetic moment.
Nuclear Forces: Saturation phenomena and Exchange forces, Deuteron ground state properties.
Nuclear Reactions: Nuclear reactions and their conservation laws, Cross section of nuclear reactions, Theory of fission (Qualitative), Nuclear reactors and Nuclear fusion.

Unit-5	**Number of lectures = 08**	**Title of the unit: PARTICLE PHYSICS**

Basic particle interactions (gravitational, Electromagnetic, week and strong interactions), Basic classification based on rest mass, Spin and half-life, particles and antiparticles, idea of resonances, conservation rules in fundamental interactions, determination of spin and parity of pions, strange particles.

11. CO-PO mapping

COs	**Attributes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	Students will gain an understanding of crystal structure, diffraction and reciprocal lattice which help in determine the crystal structure of any material.	**3**	**2**	**1**		**3**	**1**	**1**
CO2	Students will gain an understanding of crystal bonding and the vibrations involved in crystal Lattice which help them to understand the concept of vibrational dynamics.	**3**	**2**	**2**		**3**	**1**	**1**
CO3	Students will gain an understanding of materials (metals and semiconductors) and able to find the band gap based on which they define the material type.	**3**	**1**	**2**		**3**	**1**	**1**
CO4	Students will understand the basic properties of nucleus, know about Nuclear Forces and Nuclear Reactions which helps in defining the type of nuclear reaction.	**3**	**1**			**3**	**1**	
CO5	Students will gain basic knowledge of particle physics and ability to outline the physical origins of particle physics.	**3**	**1**			**3**	**1**	

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

1. Puri and Babbar, "Solid State Physics" (S. Chand).
2. C. Kittel, "Introduction to Solid State Physics"- Vth Edition (John Wiley &Sons).
3. H. S. Mani and G. K. Mehta, "Introduction to Modern Physics" (Affiliated East-West Press— 1989).
4. A. Beiser, "Perspectives of Modern Physics" (McGraw-Hill).
5. Martin, B.R. and Shaw, Particle Physics (John Wiley).

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**ADVANCE INORGANIC CHEMISTRY**			**L**	**T**	**P**
3. Course Code	**CH314**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to understand the bonding in coordination compounds, electronic spectra and magnetic behaviour of the coordination compounds and some important inorganic compounds. The other important objective is to study the reaction mechanism in coordination compounds and importance of inorganic metals in Bio-inorganic chemistry.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the concept of coordination chemistry with different theories.
CO2	Understand and evaluate the electronic spectra and magnetism of transition metal complexes.
CO3	Study of some important inorganic compounds and their applications
CO4	Understand the different reaction mechanisms in coordination compounds.
CO5	Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.

10. Unit wise detailed content

Unit-1 | **Number of lectures = 08** | **Title of the unit: BONDING IN COORDINATION COMPOUNDS**

Electronic configuration (3d, 4d, 5d) and general periodic trends, comparative study of first/second/third transition series elements, IUPAC nomenclature of coordination compounds, VBT (hybridization/magnetism/geometry) of Ni(CN)42-, NI(CO)4, Ni(Cl)42-, Fe(CN)63-, Fe(CN)64-.
Elementary Crystal Field Theory: splitting of dn configurations in octahedral, square planar and tetrahedral fields, factioras affecting 10 Dq value, crystal field stabilization energy, pairing energy, Magnetic moment from crystal field theory, high spin and low spin complexes, Static and Dynamic Jahn-Tellar distortion.

Unit-2 | **Number of lectures =08** | **Title of the unit: SPECTRA AND MAGNETISM OF TRANSITION METALS**

Spectro-chemical series of ligands, Laporte's selection rule, colour of complexes, spectroscopic ground states, selection rules for electronic spectral transitions, charge transfer spectra, LS coupling. Types of magnetism and temperature dependence of magnetic susceptibility, Curie and Curie-Weiss law, Measurement of magnetic susceptibility by Gouy method, Faraday method.

Unit-3 | **Number of lectures = 08** | **Title of the unit: SELECTED TOPICS IN ADVANCED INORGANIC COMPOUNDS**

Structure/synthesis/various chemical reactions of potassium dichromate, potassium permanganate, potassium chromate, sodium thiosulphate. Structure/synthesis/various chemical reactions of fluorides and oxides of xenon, Zeise's salt, silicones, borazine, phosphazine. S4N4, P4, P4O6, P4O10. Extractive metallurgy for self reduction method (Copper and lead), cyanide process and chemical reactions (silver and gold).

Unit-4 | **Number of lectures = 08** | **Title of the unit: REACTION MECHANISM OF LIGAND DISPLACEMENT REACTIONS**

Substitution reaction in square planar complexes (Trans effect), mechanism of substitution reaction, Electron transfer reactions and its classification. Outer sphere electron transfer mechanism, chemical activation, Marcus theory, cross-reactions, thermodynamical/kinetic parameters, inner-sphere electron transfer mechanisms, effect of the nature of metal/ligandss, bridging group effects, cross reactions.

Unit-5 | **Number of lectures = 08** | **Title of the unit: BIOINORGANIC CHEMISTRY**

Biological role of inorganic metals in human body (description only), Electron transfer proteins, Metal ion transport and storage, Feritin and its structure, Oxygen transport by heme proteins, hemoglobin and myoglobin, Dioxygen transport (hemoglobin, hemocyanin and Blue copper proteins), Biomineralization (ferritin), zinc finger protein, Carbonic anhydrase, carboxy peptidase, carboxypeptidase A/B.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understand the concept of coordination chemistry with different theories.	**3**	**2**	**1**		**1**		**3**
CO2	Understand and evaluate the electronic spectra and magnetism of transition metal complexes.	**2**	**2**	**1**		**2**		**3**
CO3	Study of some important inorganic compounds and their applications	**3**	**3**	**1**		**1**		**3**
CO4	Understand the different reaction mechanisms in coordination compounds.	**2**	**3**	**1**		**1**		**3**
CO5	Understand the concept of Bio-inorganic chemistry and the role of metal ions in human body.	**2**	**2**	**1**		**1**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/104/105/104105033/
2. https://ocw.mit.edu/courses/chemistry/5-112-principles-of-chemical-science-fall-2005/video-lectures/lecture-32-coordination-complexes-and-ligands/
3. https://www.chem.tamu.edu/rgroup/marcetta/chem362/lectures/Lecture%2029%20subset%20of%20TM%20lecture%20notes.pdf

13. Books recommended:

1. Inorganic Chemistry: Structure and Reactivity, James E. Huheey, Harper and Row Publishers, New York
2. Advanced Inorganic Chemistry: F.A. Cotton and G. Wilkinson, Interscience.
3. Inorganic Reaction Mechanism, Basolo and R.G. Pearson, John Willey.

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**ADVANCE ORGANIC CHEMISTRY**			**L**	**T**	**P**
3. Course Code	**CH315**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the nomenclature of organic compounds, structure and bonding of organic molecules considering inductive effect, hyperconjugation, mesomeric effects, hydrogen bonding etc., and mechanism of various types of organic reactions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..
CO5	Understand and analyze the structure and classification of dyes.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: ORGANOMETALLIC AND ORGANOSULPHUR COMPOUNDS**

Organomagnesium Compounds: the Grignard reagents, structure and chemical reactions Organolithium Compounds :formation and chemical reactions. Nomenclature, methods of formation and chemical reaction of thiols, sulphonic acids.

Unit-2	**Number of lectures =08**	**Title of the unit: HETEROCYCLIC COMPOUNDS**

Molecular orbital picture and aromatic charecteristics of pyrrole, furan, thiophene and pyridine. Comparison of basicity of pyridine, piperidine and pyrrole. Methods of synthesis and chemical reactions of indole, quinoline and isoquinoline with special reference to Fisher indole synthesis, Skraup synthesis and Bischler-Nepieralski synthesis.

Unit-3	**Number of lectures = 08**	**Title of the unit: CARBOHYDRATES**

Carbohydrates: classification and configuration and conformation of monosaccharides, Erythro and threodiastereomers, mechanism of osazone formation, Interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Formation of glycosides, ether and esters. Cyclic structure of D(+) glucose. An introduction to disaccharides (maltose, sucrose, lactose) and polysaccharides/starch and cellulose.

Unit-4	**Number of lectures = 08**	**Title of the unit: ACIDS, PEPTIDES, PROTIENS AND NUCLEIC ACID**

Classification, structure and stereochemistry of amino acids, isoelectric point. Classification of protiens, peptides, structure determination, and end group analysis. Nucleic acids: Introduction –Classification of Nucleic Acids Ribonucleosides and Ribonucleotides. The double helical structure of DNA.

Unit-5	**Number of lectures = 08**	**Title of the unit: DYES**

Dyes: Introduction of the history of dyes. Landmarks in the historical development from Natural to synthetic dyes. Introduction and classification of dyes on the basis of structure Colour and chemical constitution of dyes. Structure and uses of phenolphthalein, fluorescein , Eosin, Malachite green, Methylene blue , Indigo. Napthol yellow-S, Crystal violet.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Analyze structure and chemical reactions of organomagnesium and organolithium compounds.	**3**	**2**	**1**		**1**		**3**
CO2	Understand and evaluate the structure and related reactions of heterocyclic compounds.	**2**	**2**	**1**		**2**		**3**
CO3	Understand and analyze the classification, configuration and conformation of carbohydrates.	**3**	**3**	**1**		**1**		**3**
CO4	Understand and evaluate the structure of amino acids, peptides, proteins and nucleic acids..	**2**	**3**	**1**		**1**		**3**
CO5	Understand and analyze the structure and classification of dyes.	**2**	**2**	**1**		**1**		**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.khanacademy.org/science/organic-chemistry
2. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(Smith)/Chapter_06%3A_Understanding_Organic_Reactions
3. https://www.dummies.com/education/science/biology/the-basics-of-organic-chemistry/
4. https://www.toppr.com/guides/chemistry/organic-chemistry/

13. Books recommended:

1. Advanced Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.
2. Organic Chemistry Vol.I& II, I.L. Finar
3. Fundamentals of Organic Chemistry, NafisHaider, S. Chand & Co. Ltd.
4. A text book of Organic Chemistry, Bahl&Bahl, S. Chand & Co. Ltd.
5. Organic Chemistry Vol.I, II & III, Dr. Jagdamba Singh, L.D.S. Yadav, PragatiPrakashan.

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**BASICS OF CHROMATOGRAPHIC TECHNIQUES**			**L**	**T**	**P**
3. Course Code	**CH319**			2	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: Students able to understand Separation techniques such as Thin layer chromatography, Paper chromatography, Gas chromatography, High performance Liquid Chromatography and Ion exchange chromatography**.**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understand the chromatographic techniques and its classification.
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SEPARATION TECHNIQUES**

Chromatography, Classification of Chromatographic methods, Elution in column chromatography, chromatograms, distribution constant, retention time, stationary phase, mobile phase, principle of adsorption and partition chromatography, column chromatography; principle, adsorbents used, preparation of column, adsorption, elution.

Unit-2	**Number of lectures =08**	**Title of the unit: THIN LAYER CHROMATOGRAPHY**

Principle, choice of adsorbent and solvent, Rf value, applications. Paper chromatography; solvents used, principle, Rf value, factors influencing Rf value, applications. Separation of amino acid mixture.

Unit-3	**Number of lectures = 08**	**Title of the unit: GAS CHROMATOGRAPHY**

Introduction, Principles of gas-liquid chromatography, Instrumentation; Carrier gas system, Sample injection, Columns, Stationary phase, Detectors (Flame Ionization, Electron capture and Thermal conductivity) and Industrial applications.

Unit-4	**Number of lectures = 08**	**Title of the unit: HIGH PERFORMANCE LIQUID CHROMATOGRAPHY**

Introduction of HPLC, Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector (UV-visible absorption, Electrochemical) and Industrial applications of HPLC.

Unit-5	**Number of lectures = 08**	**Title of the unit: ION EXCHANGE CHROMATOGRAPHY**

Principle, resins, action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understand the chromatographic techniques and its classification.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO2	Evaluate Thin layer chromatography; principle and its applications. Paper chromatography and its applications. Separation of amino acid mixture.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO3	Comprehension of Principles of gas-liquid chromatography, Instrumentation and its Industrial applications.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO4	Able to discuss Normal and reverse phase HPLC, Isocratic and gradient elution, Instrumentation; mobile phase reservoir, column and detector and Industrial applications of HPLC.	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO5	Analyze the action of resins, experimental techniques, applications, separation of metal ions, separation of chloride and Bromide ions - removal of interfering radicals.	**3**	**1**	**1**	**2**	**2**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://microbenotes.com/chromatography-principle-types-and-applications/
2. https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography
3. https://www.slideshare.net/nadeemakhter7374/chromatography-34247423
4. http://www.biologydiscussion.com/biochemistry/chromatography-techniques/top-12-types-of-chromatographic-techniques-biochemistry/12730

13. Books recommended:

1. Chemical Thermodynamics by R.P.Rastogi et al
2. Principles of physical chemistry by Puri Sharma and Pathan
3. Essentials of Physical Chemistry, Bahl & Tuli, S. Chand & Co. Ltd.
4. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
5. Simplified course in Physical Chemistry, Madan & Tuli, S. Chand & Co. Ltd.
6. Atkin's Physical Chemistry, Atkin, Oxford Press.

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**ADVANCE ELECTRICITY AND MAGNETISM LAB**			**L**	**T**	**P**
3. Course Code	**PY304**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:**

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	
CO2	
CO3	
CO4	
CO5	

10. Syllabus	
Exp – 01	
Exp – 02	
Exp – 03	
Exp – 04	
Exp – 05	
Exp – 06	
Exp – 07	
Exp – 08	
Exp – 09	
Exp – 10	

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1								
CO2								
CO3								
CO4								
CO5								

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

SEMESTER – V (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY PRACTICAL – V**			**L**	**T**	**P**
3. Course Code	**CH316**			0	0	4
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even ( )	Odd (√)	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 00		**Tutorials = 00**		**Practical = 10**		

8. **COURSE OBJECTIVES:** Student will be able to work effectively and safely in a laboratory environment, practical/technical/ communication skills, concepts to solve qualitative and quantitative problems,transferable skills like ability to work in teams as well as independently.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.

10. Syllabus

Exp – 01	Synthesis and Analysis of the Potassium trioxalatoferrate (III), K3[Fe(C2O4)3] and determination of its composition by permagnometry. (a) Potassium trioxalatoferrate (III), K3[Fe(C2O4)3] and determination of its composition by permagnometry.
Exp – 02	Preparation of cis-and trans –bisoxalatodiaqua chromate (III) ion.
Exp – 03	To verify Beer-Lambert law for KMnO4/K2Cr2O7 and determine the concentration of the given solution
Exp – 04	Determination of Fe3+ content by thiocyanate method.
Exp – 05	Separation of Fluorescein and methylene blue by column chromatography.
Exp – 06	Separation of leaf pigments from leaves
Exp – 07	Resolution of racemic mixture of (+) mandelic acid
Exp – 08	Diazotization/coupling: Preparation of methyl orange and methyl red
Exp – 09	Oxidation: Preparation of benzoic acid from toluence
Exp – 10	Reduction: Preparation of aniline from nitrobenzene

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Remember to keep records of all performed experiments in the manner which is required in laboratory.	**3**	**2**	**2**		**3**	**1**	**3**
CO2	Able to Evaluate water quality parameters like chloride content and alkalinity.	**3**	**2**	**2**		**3**	**1**	**3**
CO3	Understand the basic titration methods and technical skills to work in the different fields of chemistry.	**3**	**2**	**2**		**3**	**1**	**3**
CO4	Know about the principles of qualitative and quantitative analysis of inorganic mixtures.	**3**	**2**	**2**		**3**	**1**	**3**
CO5	Analyze the importance of personal safety and care of equipment's and chemicals.	**3**	**2**	**2**		**3**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.fandm.edu/uploads/files/79645701812579729-genchem-reference-for-web.pdf
2. http://file.akfarmahadhika.ac.id/E-BOOK/12-1213-akfarmahad-16-1-vogelqu-d.pdf
3. https://faculty.psau.edu.sa/filedownload/doc-6-pdf-f06110ef2e1e1ae119cbacf71dd17732-original.pdf
4. https://www.stem.org.uk/resources/collection/3959/practical-chemistry

13. Books recommended:

1. Practical Physics. by R. K. Shukla, New Age International Private Limited; Third edition.
2. B.Sc.Practical Physics by Harnam Singh and Hemme, S. Chand.
3. B. Sc. Practical Physics by CL Arora, S Chand & Company
4. Practical Physics by Kumar P.R.S., Prentice Hall India Learning Private Limited

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**APPLIED ELECTRONICS**			**L**	**T**	**P**
3. Course Code	**PY305**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of electronics and its applications. By using the principles of modern physics and mathematics to obtain quantitative relations which are very important for higher studies. After successfully completion of course, the student will able explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding of modern physics and characterization of semiconductor based electronic devices.
CO2	Students will be able to realize the important concepts of advance electronics related to bipolar junction transistors.
CO3	Students will gain an understanding of advanced concepts of transistors and related to biasing circuits for small and large scale signal conditioning, power amplifications and effect of external factors in transistor operations.
CO4	Students will learn about the high switching semiconducting devices like FETs and MOSFETs for designing power supplies for industrial and commercial applications.
CO5	Students will learn about the Power electronic devices like the UJT, TRIAC, etc. and designing Integrated Circuits for fabrication of high yield monolithic ICs.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SEMICONDUCTOR AND P-N JUNCTION DIODE**

Diffusion of minority carriers in semiconductor, work function in metals and semiconductors Junctions between metal and semiconductors, Semiconductor and p.n. Junction, Depletion layer, Junction Potential Width of depletion layer, Field and Capacitance of depletion layer, Forward A.C. and D.C. resistance of junction, Reverse Breakdown, Zener and Avalanche diodes, Tunnel diodes, Point contact diode, their importance at High frequencies, LED photodiodes, Effect of temperature on Junction diode Thermistors.

Unit-2	**Number of lectures =08**	**Title of the unit: TRANSISTOR – I**

Transistor parameters, base width modulation, transit time and life-time of minority carriers, Base- Emitter resistance Collector conductance, Base spreading resistance, Diffusion capacitance, Reverse feedback ratio, Equivalent circuit for transistors, Basic model, hybrid model and Y parameter equivalent circuit, Input and output impedances.

Unit-3	**Number of lectures = 08**	**Title of the unit: TRANSISTOR – II**

Current and Voltage gain, Biasing formulae for transistors, Base bias, emitter bias and mixed type bias and mixed type biasing for small and large signal operation, Transistor circuit application at law frequencies, their AC and DC equivalent for three different modes of operation, Large signal operation of transistors, Transistor Power amplifiers, Class A and B operation, Maximum power output Effect of temperature, heat sinks, thermal resistance Distortion in amplifiers, cascading of stages, Frequency response, Negative and positive feedback in transistor amplifiers.

Unit-4	**Number of lectures = 08**	**Title of the unit: FIELD EFFECT TRANSISTORS AND POWER SUPPLIES**

Field effect transistors and their characteristics, biasing of FET, use in preamplifiers, MOSFET and their simple uses. Electronically regulated low and high voltage power supplies, Inverters for battery operated equipments. Phototransistors, Silicon Controlled rectifiers.

Unit-5	**Number of lectures = 08**	**Title of the unit: POWER ELECTRONICS AND INTEGRATED CIRCUITS**

Triac Construction, Operation and Characteristics, Unijunction Transistors (UJT), its characteristics, IC-classification, Making monolithic ICs, IC-fabrication of components on monolithic IC, IC packings, IC symbols.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding of modern physics and characterization of semiconductor based electronic devices.	**3**	**2**	**1**	**2**	**1**	**1**	**3**
CO2	Students will be able to realize the important concepts of advance electronics related to bipolar junction transistors.	**3**	**2**	**1**		**2**	**1**	**3**
CO3	Students will gain an understanding of advanced concepts of transistors and related to biasing circuits for small and large scale signal conditioning, power amplifications and effect of external factors in transistor operations.	**3**	**2**	**1**		**2**	**1**	**3**
CO4	Students will learn about the high switching semiconducting devices like FETs and MOSFETs for designing power supplies for industrial and commercial applications.	**3**	**2**	**1**		**1**	**1**	**3**
CO5	Students will learn about the Power electronic devices like the UJT, TRIAC, etc. and designing Integrated Circuits for fabrication of high yield monolithic ICs.	**3**	**2**		**2**	**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://nptel.ac.in/courses/117/107/117107095/
2. https://nptel.ac.in/courses/108/101/108101091/
3. https://nptel.ac.in/courses/117/103/117103063/

13. Books recommended:

1. B. G. Streetman; “Solid State Electronic Devices”, UK Edition (Prentice-Hall of India. New Delhi, 1986).
2. W. D. Stanley; “Electronic Devices, Circuits and Applications” (Prentice-Hall, New Jersey, USA. 1988).
3. J. D. Ryder; “Electronics Fundamentals and Applications” IInd Edition (Prentice-Hall of India. New Delhi, 1986).
4. I. Millman and A. Grabel; “Microelectronics”, International. Edition (McGraw-Hill Book Company, New York, 1988).

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**SPECTROSCOPIC TECHNIQUES**			**L**	**T**	**P**
3. Course Code	**CH308**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: Students able to understand the interaction of electromagnetic radiation with the materials, spectroscopic techniques like Ultraviolet, FT-IR, Nuclear Magnetic Resonance spectroscopy and mass spectrometry.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), Mclafferty rearrangements.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: UV SPECTROSCOPY**

Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules; unsaturated carbonyl compounds, conjugated dienes and polyenes.

Unit-2	**Number of lectures =08**	**Title of the unit: IR SPECTROSCOPY**

Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, characteristic vibrational frequencies of some organic compounds.

Unit-3	**Number of lectures = 08**	**Title of the unit: NMR SPECTROSCOPY**

Introduction, theory of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling,, Interpretation of NMR spectra of some representative compounds.

Unit-4	**Number of lectures = 08**	**Title of the unit: MASS SPECTROSCOPY**

Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols and amines, ketones, aldehydes, esters, acids, anhydrides), molecular ion peak, metastable peak, Mclafferty rearrangements, Nitrogen rule.

Unit-5	**Number of lectures = 08**	**Title of the unit: ATOMIC ABSORPTION SPECTROPHOTOMETRY**

Introduction, Principle, Instrumentation, Sample preparation, Internal standard and standard addition, calibration and applications of AAS.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understanding Wave-like propagation of light, electronic transitions, instrumentation, conjugated systems and transition energies, Woodward – Fieser rules for calculation of wave length.	**3**	**1**	**2**		**2**	**1**	**2**
CO2	Comprehension of absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds.	**3**	**1**	**2**		**2**	**1**	**2**
CO3	To create basics of NMR spectroscopy, instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting and vicinal coupling.	**3**	**1**	**2**		**2**	**1**	**3**
CO4	Able to evaluate the NMR spectra of some representative compounds: Hydrocarbons, Aldehydes, Ketones, Acids and Alcohols, Applications of NMR spectroscopy.	**3**	**1**	**1**		**2**	**1**	**3**
CO5	Analyze the theory, instrumentation, important useful terms in mass spectrometry; molecular ion peak, metastable peak, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ketones, aldehydes), Mclafferty rearrangements.	**3**	**1**	**1**		**2**	**1**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://www.youtube.com/watch?v=2Y8pSoS0d1g
2. http://www.infocobuild.com/education/audio-video-courses/chemistry/ApplicationOfSpectroscopicMethods-IIT-Madras/lecture-25.html
3. https://scrippslabs.com/summary-of-spectroscopic-techniques/
4. https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf

13. Books recommended:

1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.
2. Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V Edition Tata Mc Grawhills
3. Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications.
4. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.
5. Principles and practice of analytical chemistry, F. W. Fifield, D. Kealey, 5th edition, Blackwell publication.
6. Analytical chemistry, Gary D. Christian, 6th edition, Wiley and sons publication.
7. Spectrometric identification of organic compounds, R. M. Silverstein, 6th edition, John Wiley and sons.
8. Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers.

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**MATHEMATICAL METHODS IN PHYSICS**			**L**	**T**	**P**
3. Course Code	**PY307**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES:

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	
CO2	
CO3	
CO4	
CO5	

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit:**
Unit-2	**Number of lectures =08**	**Title of the unit:**
Unit-3	**Number of lectures = 08**	**Title of the unit:**
Unit-4	**Number of lectures = 08**	**Title of the unit:**
Unit-5	**Number of lectures = 08**	**Title of the unit:**

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1								
CO2								
CO3								
CO4								
CO5								

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**ADVANCED SOLID STATE PHYSICS**			**L**	**T**	**P**
3. Course Code	**PY308**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: This course aims to extend the material covered in the basic courses in Solid State Physics, Electronic Materials and Device Physics and provide a broader and deeper understanding of the physics of today's semiconductor devices. This includes discussions on the materials properties and optical properties underlying fundamental devices.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Students will gain an understanding of the vibrations involved in Lattice which help them to understand the concept of phonon and vibrational dynamics.
CO2	Students will gain knowledge of semiconductor and their benefits over conductors and trying to improve upon these qualities.
CO3	Students will gain an understanding of dielectric material, their properties and use of dielectric material in capacitor. It will help in understanding about Capacitors, as it is one of the most basic electrical components in any electronic circuit.
CO4	Students will gain an understanding of different kinds of magnetic material and it uses.
CO5	Students will be able to evaluate the optical properties of the material and will create own understanding approaches to the finding them.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: ELEMENTARY LATTICE DYNAMICS**

Elementary Lattice Dynamics: Lattice vibrations and phonons. Linear monoatomic and diatomic chains, Acoustical and optical phonons, Qualitative description of the phonon spectrum in solids, Dulong and Petit's law, Einstein and Debye theories of specific heat of solids, T^3 law.

Unit-2	**Number of lectures =08**	**Title of the unit: SEMICONDUCTOR PHYSICS**

Classifying materials as semiconductors, Chemical bonds in semiconductors, Mechanism of current flow, Forbidden, valence and conduction bands, Intrinsic and extrinsic semiconductors, Carrier concentration and Fermi level for intrinsic semiconductor, Carrier concentration, Fermi level and conductivity of extrinsic semiconductor.

Unit-3	**Number of lectures = 08**	**Title of the unit: DIELECTRIC PROPERTIES OF MATERIALS**

Polarization, Depolarization field, Electric susceptibility, Polarizability, Sources of polarizability (electronic, ionic, dipolar & orientational), Classical theory of electric polarizability, Frequency dependence of ionic polarizability, Local electric field at an atom, Clausius-Mosotti equation, Langevin-Debye equation, Complex dielectric constant and loss.

Unit-4	**Number of lectures = 08**	**Title of the unit: MAGNETIC PROPERTIES OF MATERIALS**

Magnetic properties of matter: dia, para, ferri and ferromagnetic materials, Classical Langevin theory of dia and paramagnetic materials, Quantum mechanical treatment of paramagnetism, Curie law, Weiss's theory of ferromagnetic domains, Discussion of B-H Curve, hysteresis and energy loss.

Unit-5	**Number of lectures = 08**	**Title of the unit: OPTICAL PROPERTIES OF MATERIALS**

Classical Model-Drude model, ionic conduction, Optical refractive index and relative dielectric constant, Optical absorption in metals, semiconductors and insulators, Colour centres, Excitons, Luminescence, LED, Photo detector, Photomultiplier.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Students will gain an understanding of the vibrations involved in Lattice which help them to understand the concept of phonon and vibrational dynamics.	**3**		**1**		**1**	**2**	
CO2	Students will gain knowledge of semiconductor and their benefits over conductors and trying to improve upon these qualities.	**3**		**2**		**3**	**2**	**2**
CO3	Students will gain an understanding of dielectric material, their properties and use of dielectric material in capacitor. It will help in understanding about Capacitors, as it is one of the most basic electrical components in any electronic circuit.	**3**		**2**		**3**	**2**	**2**
CO4	Students will gain an understanding of different kinds of magnetic material and it uses.	**3**		**1**		**2**	**2**	**2**
CO5	Students will be able to evaluate the optical properties of the material and will create own understanding approaches to the finding them.	**3**		**2**		**3**	**2**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

1. Introduction to Solid State Physics by Charles Kittel (Willey Publication).
2. Elements of Solid-State Physics by Puri and Babbar (S. Chand).
3. Solid State Physics by S. O. Pillai (New Age International).

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMICAL PROCESS INDUSTRY**			**L**	**T**	**P**
3. Course Code	**CH309**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the composition, preparation, properties and uses of ammonia, nitric acid, phosphorus chemical, glass, cement, ceramics and refractories and their related toxic hazards on the health of consumer.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.
CO3	Understand the composition of glass and their types, properties and uses.
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.
CO5	Understand the classification, properties and uses of ceramics and refractoriness and their respective characteristics.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: SYNTHETIC NITROGEN PRODUCTS**

Ammonia, nitric acid, ammonium nitrate and ammonium sulphate their manufacture with reference to; consumption Pattern, Raw materials, Production process, Quality control, Hazards and safety and Effluent management.

Unit-2	**Number of lectures =08**	**Title of the unit: CHLOR-ALKALI INDUSTRIAL PRODUCTS**

Caustic soda Chlorine. Phosphorus chemicals; Phosphorus, phosphoric acid, ammonium phosphate, superphosphate, triple superphosphate. Lime, gypsum, Silicon, calcium carbide.

Unit-3	**Number of lectures = 08**	**Title of the unit: GLASS**

Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.

Unit-4	**Number of lectures = 08**	**Title of the unit: CEMENT**

Introduction, Classification and General Properties of Glass , Characteristics, raw Materials, Chemical Reactions, Methods of Manufacture and Uses.

Unit-5	**Number of lectures = 08**	**Title of the unit: CERAMICS AND REFRACTORIES**

Introduction, Types of ceramics materials, properties and applications. Refractories, classification of refractories, characteristics of refractories materials, properties of refractories. Neutral refractories; Silicon carbide. Acid refractories; High Alumina refractories.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Evaluate different preparation processes for the manufacture of ammonia, nitric acid, ammonium nitrate and ammonium sulphate and their related quality control, hazards, safety and effluent management.	**3**	**2**	**3**	**3**	**2**	**3**	**2**
CO2	Evaluate different manufacturing methods of caustic soda and phosphorus chemicals and their properties and uses.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO3	Understand the composition of glass and their types, properties and uses.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO4	Analyze the composition, types, properties and preparation of cement and its setting time.	**3**	**2**	**3**	**3**	**1**	**3**	**2**
CO5	Understand the classification, properties and uses of ceramics and refractoriness and their respective characteristics.	**3**	**2**	**3**	**3**	**1**	**3**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. https://encyclopedia2.thefreedictionary.com/chemical+process+industry
2. https://www.youtube.com/watch?v=RjZJjneJ5fk
3. https://www.chemicalprocessing.com/
4. https://www.britannica.com/science/phosphorus-chemical-element

13. Books recommended:

1. Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.
2. Groggins P.M., Unit Process in Organic Synthesis, 5th edition, International student edition, Pubs: McGraw-Hill Book Co., New York, 1998.
3. Dryden's outlines of Chemical Technology, edited and revised by Gopala Rao M. and Marshall S, Pubs: East-West Press, New Delhi, 2004.
4. Industrial Chemistry B.K.Sharma, goel publishing house.
5. Chemical process industries N.R Nerris shreve.
6. Chemical process principales: part 1 & II – O.A / Hougen, K.M Watson RA Ragatz (CBS)
7. Shrev's Chemical process Industries: 5th edition – George T. Austin, Mc Graw Hill.

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**CHEMISTRY OF POLYMERS**			**L**	**T**	**P**
3. Course Code	**CH317**			3	1	0
4. Type of Course (use tick mark)				**Core ( )**	**DE (√)**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective of this course is to study the mechanism of polymer preparation, their processing techniques, commercial uses, identification techniques and preparation process of vinyl polymers, polyamides, polyesters, synthetic rubbers, cellulose and copolymer resins.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Student will be able to evaluate the different mechanisms of polymer preparation and their classification.
CO2	Student will be able explain various polymer reactions such as hydrolysis, acidolysis, crosslinking etc.
CO3	Understand the colligative properties of Polymers and evaluate the identification techniques such as NMR and FTIR of Polymers.
CO4	Understand the degradation and its types.
CO5	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubbers.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: INTRODUCTION**

Basic concepts of polymer science, Classification of polymers, Average molecular weight and Molecular weight distribution. Polymerization: Mechanism and kinetics of: Free radical addition polymerization, Ionic addition polymerization, Coordination polymerization, Step growth polymerization.

Unit-2	**Number of lectures =08**	**Title of the unit: POLYMER REACTIONS**

Introduction; types- hydrolysis, acidolysis, addition, substitution, halogenation, hydrogenation, crosslinking, curing, (brief mechanism and usefulness of each reaction to be highlighted with examples).

Unit-3	**Number of lectures = 08**	**Title of the unit: STRUCTURE AND PROPERTIES**

Thermal transitions, Crystallinity, Molecular weight characterization, Nuclear Magnetic Resonance (NMR) and Fourier Transform Infrared (FTIR) techniques.

Unit-4	**Number of lectures = 08**	**Title of the unit: POLYMER DEGRADATION**

Introduction, Types of degradation- thermal degradation, mechanical degradation, degradation by ultrasonic waves, photo degradation, degradation by high-energy radiation, oxidative degradation and hydrolytic degradation and biodegradation.

Unit-5	**Number of lectures = 08**	**Title of the unit: SYNTHESIS, PROPERTIES AND APPLICAIONS**

Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethylmethacrylate, Polyethene, Polybutadiene, Polyvinylidene, Polycarbonates, Polyesters, Polyurethanes, Phenolic polyesters, Polyamides, Polysulphones.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Student will be able to evaluate the different mechanisms of polymer preparation and their classification.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO2	Student will be able explain various polymer reactions such as hydrolysis, acidolysis, crosslinking etc.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO3	Understand the colligative properties of Polymers and evaluate the identification techniques such as NMR and FTIR of Polymers.	**1**	**2**	**2**	**2**	**3**	**1**	**2**
CO4	Understand the degradation and its types.	**1**	**1**	**2**	**2**	**3**	**1**	**2**
CO5	Understand the preparation process of vinyl polymers, polyamide, polyesters and rubbers.	**1**	**1**	**2**	**2**	**3**	**1**	**2**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

5. https://www.youtube.com/watch?v=kMHYNuyKQ2Q&list=PLBAcrca02tZdHmbDFvnOA6ZYTJPnF5sMe
6. https://www.youtube.com/watch?v=Gzin6mP-tUM&list=PLLy_2iUCG87CbDZMn4eP_XT09XTJOVooJ
7. https://www.youtube.com/watch?v=68fF7Tnl0wE
8. https://www.youtube.com/watch?v=YZf5q-ICf8Y

13. Books recommended:

6. Principles of polymer chemistry: A Ravve, 2nd Edition, Kluwer Academic publications
7. Polymer Science and technology: Joll. R. Fried, Prentice – Hall.
8. Principles of polymer systems: F. Rodriguez, Claude Cohen, C.K. Ober, L.A. Archer, Vth Edition, Taylor & Francis
9. Introduction to polymers: R.J. Young and P.A. Lovell, 2nd Edition, Netron Thornes publications
10. Polymer chemistry – an introduction, Malcolm D. Stevens, Oxford University press.

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**FUNDAMENTALS OF FOOD CHEMISTRY**			**L**	**T**	**P**
3. Course Code	**CH310**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The course focuses on providing knowledge of food constituents, food additives and food processing techniques. The study of food laws and standards appraise students about quality and safety assurance and food related hazards.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Understanding of Indian food law and food standards, value of quality assurance and safety assurance.
CO2	Comprehension of chemical structure, properties and argue importance of food components, including carbohydrates, protein, lipids, vitamins and minerals.
CO3	Describe the principles in food processing techniques and differentiate food preservation methods like heat preservation and cold preservation, food packaging
CO4	Able to explain different types of food additives with examples and judge its value in real life.
CO5	Analyze the importance of food safety and food related physical, chemical and biological hazards.

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: GOVERNMENTAL REGULATIONS**

Introduction, Food laws and standards: Indian food safety laws and standards; Quality and safety assurance in food industry; BIS Laboratory Services and Certification by BIS.

Unit-2	**Number of lectures =08**	**Title of the unit: CONSTITUENTS OF FOOD AND THEIR NUTRITIVE ASPECTS**

Carbohydrates, Proteins, Fats and oils, Vitamins and Minerals.

Unit-3	**Number of lectures = 08**	**Title of the unit: FOOD PROCESSING TECHIQUES**

Common unit operations, Food deterioration and their control; Heat preservation and processing, Cold preservation and processing Food dehydration, Food concentration & food packaging.

Unit-4	**Number of lectures = 08**	**Title of the unit: FOOD ADDITIVES**

Preservatives, Antioxidants, Chelating agents, Surface active agents, Stabilizing and Thickening agents, Buffering agents, Colouring agents, Sweetening agents & Flavoring agents.

Unit-5	**Number of lectures = 08**	**Title of the unit: FOOD SAFETY, RISKS AND HAZARDS**

Food related Hazards, Microbiological Considerations in food safety, Effects of processing and storage on microbial safety, Chemical hazards associated with foods, Prevention methods from food born disease.

11. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Understanding of Indian food law and food standards, value of quality assurance and safety assurance.	**3**	**2**	**3**	**2**	**3**	**3**	**3**
CO2	Comprehension of chemical structure, properties and argue importance of food components, including carbohydrates, protein, lipids, vitamins and minerals.	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO3	Describe the principles in food processing techniques and differentiate food preservation methods like heat preservation and cold preservation, food packaging	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CO4	Able to explain different types of food additives with examples and judge its value in real life.	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CO5	Analyze the importance of food safety and food related physical, chemical and biological hazards.	**3**	**2**	**3**	**3**	**3**	**3**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

1. http://www.basicknowledge101.com/pdf/Food%20chemistry.pdf
2. https://courses.foodcrumbles.com/courses/food-chemistry-basics/
3. https://www.cabdirect.org/cabdirect/abstract/19710406009

13. Books recommended:

1. Food Chemistry, Belitz and Gosch, Springer – Verlag Bertin Heiderberg, 2nd Edition, 1999
2. Principles of Human Nutrition, Martin Eastwood, Chapman and Hall, London, I Edition, 1997.
3. Food – The Chemistry of its Components, T.P. Coultate, Royal Soc. Chemistry, 4th Edition, 2002.
4. Food additives, Branan, Alfred Larry, Davidson P. Michae, Food Science and Technology series (35), Morcel Dekker, Inc, 1990.
5. Introduction to food science, Rick Parker, Delmar Learning, U.S.A, I Edition, 2003.
6. Nutrition Science and application, Lori Smolin L.A., Saunders College Publishing, 3rd Edition.
7. Human Nutrition and dietetics, J.S. Barrow, W.P.T James, Churchill Livingstone, 9th Edition, 1993.

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: PHYSICS						
2. Course Name	**PHYSICS OF MATERIALS**			**L**	**T**	**P**
3. Course Code	**PY306**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with physics	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )

7. Total Number of Lectures, Tutorials, Practicals

Lectures = 30	**Tutorials = 10**	**Practical = Nil**

8. COURSE OBJECTIVES: The purpose of this undergraduate course is to impart basic and key knowledge of materials. By using the basic knowledge of materials to obtain quantitative relations which are very important for further research. After successfully completion of course, the student will be able to explore subject into their respective dimensions.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	**ATTRIBUTES**
CO1	To learn about crystal structure and its fractures
CO2	To introduce crystal imperfection and elastic properties of crystals.
CO3	To introduce the structure of metals, alloys, ceramics and glasses and their processing.
CO4	To Introduce the Nanomaterials and nanotechnology
CO5	To learn various characterization techniques of nanoparticles or nanomaterials

10. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: INTRODUCTION**

Introduction: Atomic basis of structure – ionic bonding, Covalent bonding, Metallic bonding, Secondary bonding, Crystalline and non-crystalline states, crystal symmetry, silica and silicates, polymers, fullerenes.

Fracture: Ductile fracture, Brittle fracture, Fracture toughness, Ductile-brittle transition, Protection against fracture, Fatigue fracture.

Unit-2	**Number of lectures =08**	**Title of the unit: CRYSTAL IMPERFECTIONS AND ELASTIC PROPERTIES**

Crystal Imperfections: Point, line, surface and volume imperfections, dislocations and their geometry, Disorder in polymers and non-crystalline materials.

Elastic Properties: Elastic behavior and its atomic model, Rubber like elasticity, anelastic behavior, relaxation processes, viscoelastic behavior, plastic deformation

Unit-3	**Number of lectures = 08**	**Title of the unit: STRUCTURE AND PROCESSING OF MATERIALS**

Structure of metals and alloys, structure of ceramics and glasses, structure of polymers, structure of composites (qualitative). Brief introduction of processing of metals, alloys, ceramic and glasses.

Unit-4	**Number of lectures = 08**	**Title of the unit: INTRODUCTION TO NANOMATERIALS**

Brief introduction of nanomaterials, properties of Nanomaterials. Methods to produce nanomaterials: Sol-Gel synthesis method. Applications of nanomaterials. Carbon Nanomaterials: classification and properties, Nanowires: classification, properties and applications. Nanocomputers.

Unit-5	**Number of lectures = 08**	**Title of the unit: TOOLS AND TECHNIQUES**

Crystallography: Particle size determination, Electron Microscopy: Scanning Electron Microscopy (SEM), Tunneling Electron Microscopy (TEM) (qualitative), sample preparation for an electron microscope, Difference between TEM and SEM, Disadvantages of electron microscope, Atomic force microscope (AFM) (qualitative).

11. CO-PO mapping

COs	**Attributes**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	To learn about crystal structure and its fractures	**3**	**1**	**1**		**2**	**1**	**1**
CO2	To introduce crystal imperfection and elastic properties of crystals.	**3**	**1**	**2**		**2**	**1**	**1**
CO3	To introduce the structure of metals, alloys, ceramics and glasses and their processing.	**3**	**1**	**2**		**2**	**1**	**1**
CO4	To Introduce the Nanomaterials and nanotechnology	**3**	**1**			**2**	**1**	
CO5	To learn various characterization techniques of nanoparticles or nanomaterials	**3**	**1**			**2**	**1**	

3 Strong contribution, 2 Average contribution , 1 Low contribution

12. Brief description of self-learning / E-learning component

13. Books recommended:

1. Introduction to Solid State Physics: C. Kittel (Wiley, VII ed.)
2. Introduction to Solids: L.V. Azaroff (Tata McGraw Hill).
3. Solid State Physics: A.J. Dekker (Prentice-Hall).
4. Essentials of Materials Science: A.G. Guy (McGraw Hill).
5. Materials Science and Engineering: V. Raghvan (Prentice Hall).
6. Elements of Materials Science and Engineering: L.H. Van Vlack (Addison-Wesley).
7. Introduction to Nanotechnology: Charles P. Poole Jr, Frank J. Owens.

SEMESTER – VI (Physics, Chemistry)

1. Name of the Department: CHEMISTRY						
2. Course Name	**UG CHEMISTRY PROJECT**			**L**	**T**	**P**
3. Course Code	**CH318**			3	1	0
4. Type of Course (use tick mark)				**Core (√)**	**DE ( )**	**FC ( )**
5. Pre-requisite (if any)	10+2 with Chemistry	**6. Frequency (use tick marks)**	Even (√)	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 30		**Tutorials = 10**		**Practical = Nil**		

8. COURSE OBJECTIVES: The main objective is to enhance the technical skills and to provide students industrial exposure.

9. COURSE OUTCOMES (CO):

After the successful course completion, learners will develop following attributes:

COURSE OUTCOME (CO)	ATTRIBUTES
CO1	Hands on training
CO2	Integrate class room theory with laboratory scale practice.
CO3	Understanding professional ethics of industry and code of conduct.

10. CO-PO mapping

COs	Attributes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	Hands on training	**3**	**2**	**3**	**2**	**3**	**3**	**3**
CO2	Integrate class room theory with laboratory scale practice.	**3**	**2**	**2**	**3**	**3**	**3**	**3**
CO3	Understanding professional ethics of industry and code of conduct.	**3**	**2**	**2**	**2**	**3**	**3**	**3**

3 Strong contribution, 2 Average contribution , 1 Low contribution