Name of the Faculty : Faculty of Science

Name of the Programme : B.Sc (Non-Medical)

Scheme of Study/Scheme of Examination 2021

									Theory		Theory (Internal)					Practical				Practical (Internal)									
Semester/ Year	Subject Code	Nomenclature	Theory/ Practical	Core/ AECC/ SEC/ DSE/ GE	L	T	P	Credits	Max	Pass	Midterm	Assignment	Professional Activities	Max	Pass	Demonstration/Conduct/Presentation	Viva-voce	Max	Pass	Attendance & Regularity in lab Work	Project/Laboratory Work Report	Midterm oral examination/Assesment	Conduct/Demonstration	Max	Pass	Overall Max Marks	Overall Pass Marks	Whether to be offered under CBCS (Yes/No)	Scheme of Examinations (Theory+Internal+Practical+Oral/ Theory+Internal+Practical/ Theory+Practical
			ASSIGNED MARKS						60	24	20	10	10	40	16	20	20	40	16	10	10	10	30	60	24				
I / I	17030101	English Communiation	Theory	AECC	2	0	0	2	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030102	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030108	Mechanics	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030109	MechanicsLab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030110	DifferentialCalculus	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030111	DifferentialCalculus Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
II/I	17030201	Environmental Science	Theory	AECC	2	0	0	2	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030202	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030203	Chemical Energetics, Equilibria & Functional Group Organic Chemistry-I Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030208	Electricity, Magnetismand EMT	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030209	Electricity, Magnetismand EMT Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030210	Differential Equations	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030211	Differential Equations Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
III/II	17030301	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030302	Solutions, Phase Equilibria, Conductance, Electrochemistry & Functional Group Organic Chemistry-II Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030307	Thermal Physicsand Statistical Mechanics	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030308	Thermal Physicsand Statistical Mechanics Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030309	Real and Complex Analysis	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030310	Introduction to MAT Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030311	Human Values and Ethics	Theory	AEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal
IV/II	17030401	Transition Metal & Coordination Chemistry, Statesofmatter & Chemicalkinetics	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030402	Transition Metal & Coordination Chemistry, Statesofmatter & Chemicalkinetics Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030407	Wavesand Optics	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030408	Wavesand Optics Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030409	Abstract and Linear Algebra	Theory	Core	4	0	0	4	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030410	Abstract and Linear Algebra Lab	Practical	Core	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030417	Computational Physics Skills	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030418	Applied Optics	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030419	Mobile Communications	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030420	Renewable Energy and Energy Harvesting	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal
	17030421	Physics Workshop Skills	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16											100	40	No	Theory+Internal

	17030422	Basic Instrumentation Skills	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
V/III	17030513	Solid State Physics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030514	Solid State Physics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030515	Atomic Molecular and Laser Physics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030516	Atomic Molecular and Laser Physics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030517	Digital and Analog Electronics Circuit and Instrumentation	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030518	Digital and Analog Electronics Circuit and Instrumentation Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030519	Integral Calculus	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030520	Integral Calculus Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030521	Operation Research	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030522	Operation Research Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030523	Probability & Statistics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030524	Probability & Statistics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030525	Analytical Methods in Chemistry	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030526	Analytical Methods in Chemistry Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030529	Quantum Chemistry, Spectroscopy and Photochemistry	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030530	Quantum Chemistry, Spectroscopy and Photochemistry Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030537	Special Functions & Integral Transform	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030538	Fluid Dynamics	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030539	Vector Calculus	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030540	Number Theory	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030541	Solid Geometry	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030542	Computer Fundamentals	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030543	University Basket	Theory	OEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
VI/III	17030613	Elements of Modern Physics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030614	Elements of Modern Physics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030615	Quantum Mechanics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030616	Quantum Mechanics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030617	Nuclear and Particle Physics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030618	Nuclear and Particle Physics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030619	Numerical Methods	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030620	Numerical Methods Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030621	Discrete Mathematics	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030622	Discrete Mathematics Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030623	Elementary Inference	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030624	Elementary Inference Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030625	Polymer Chemistry	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030626	Polymer Chemistry Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030627	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV - IR Spectroscopy	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030628	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV- IR Spectroscopy Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030629	Chemistry of Main Group Elements, Theories of Acids and Bases	Theory	DSE	4	0	0	4	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030630	Chemistry of Main Group Elements, Theories of Acids and Bases Lab	Practical	DSE	0	0	4	2								20	20	40	16	10	10	10	30	60	24	100	40	No	Practical+Internal
	17030631	Project work	Practical	DSE	0	0	8	6								40	40	80	32	20	20	20	60	120	48	200	80	No	Practical+Internal
	17030632	Basic Analytical Chemistry	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030633	Fuel Chemistry	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030634	Chemical Technology and Society	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030635	Pharmaceutical Chemistry	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030636	Chemistry of Cosmetics & Perfumes	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
	17030637	Pesticide Chemistry	Theory	SEC	3	0	0	3	60	24	20	10	10	40	16										100	40	No	Theory+Internal
		***Online courses from MOOCs (Sem – I to Sem – VI)**						**12**																					

***4 week course- 1 credit, 8 week course- 2 credits, 12 weeks course- 3 credits**
One, 12 week course or
One, 4 week course & One, 8 week course or
Three, 4 week courses

Faculty of Science
B.Sc (Non-Medical)
Syllabus and Curriculum 2020
Program Structure under Choice Based Credit System (CBCS)

Semester-I

<table>
<tr><td colspan="7">1. Name of the Department:</td></tr>
<tr><td>2. Course Name</td><td colspan="4">English Communication</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="4">17030101</td><td>4</td><td>0</td><td>0</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td>Core ()</td><td>DSE ()</td><td>GE ()</td><td>AEC (✓)</td><td colspan="2"></td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>10+2 with Science stream</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td colspan="2">Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practicals</td></tr>
<tr><td colspan="2">Lectures = 52</td><td colspan="2">Tutorials = Nil</td><td colspan="4">Practical = Nil</td></tr>
<tr><td colspan="8">8. Course Description:</td></tr>
<tr><td colspan="8">In this Ability Enhancement Compulsory course, the students will be able to know about the basic knowledge of English Comprehension, Speeches with its terminologies.</td></tr>
<tr><td colspan="8">9.Course Objectives (COs):
1. To learn basics of English language
2. To gain knowledge of English terminology and concept
3. To study the concept of grammar and its appropriate implications
4. To enhance writing and communication skills.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">Upon successful completion of this course, the students will be able to:
1. Know about the English Language
2. Describe the terminology and basics concept of English Grammar.
3. Improve writing skills, note making etc.
4. Apply the concept of English language in their written and verbal communications.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="3">Number of lectures=13</td><td colspan="4">Title of the unit: Listening Comprehension</td></tr>
<tr><td colspan="8">Speeches, Interviews, audio-video clippings followed by exercises, Introduction to Communication, Importance of Communication, Barriers to Communication and ways to overcome them</td></tr>
<tr><td>Unit – 2</td><td colspan="3">Number of lectures=13</td><td colspan="4">Title of the unit: Conversation skills</td></tr>
<tr><td colspan="8">Greetings and Introducing oneself, Framing questions and answers, Role play, Buying: asking details etc., Word formation strategies, Vocabulary building: Antonyms, Synonyms, Affixation, Suffixation, One word substitution</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit – 3</td><td colspan="3">Number of lectures=13</td><td colspan="4">Title of the unit: Reading Comprehension</td></tr>
</table>

Simple narration and Stories, Newspaper and articles clippings, Sentence types, Note Making, Paragraph Writing, Comprehension

Unit – 4	**Number of lectures=13**	**Title of the unit: Writing Comprehension**

Report Writing: types, characteristics. Letters: types, format, style, Précis Writing, Paragraph: Order, Topic sentence, consistency, coherence, Report and Proposal, Project Writing: Features, Structure. Pronunciation, Syllable and Stress, Intonation and Modulation

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

1. https://www.youtube.com/watch?v=G_ZeBr6bhyw
2. https://www.youtube.com/watch?v=4l5RciQZxyk
3. https://www.youtube.com/watch?v=ijrMpZWUUcc
4. https://www.youtube.com/watch?v=OgNVUZvB9Ow
5. https://www.youtube.com/watch?v=OfTIrsSliLM
6. https://www.youtube.com/watch?v=LquflXdZRVo

13. Books Recommended

1. Fluency in English-II, Department of English, Delhi University, Oxford University Press.
2. Murphy's English Grammar with CD, Murphy, Cambridge University Press.
3. English Vocabulary in Use (Advanced), Michael McCarthy and Felicity, CUP.
4. Learning Spoken English by Lynn Lundquist-ASIN: B0094XNOPW.
5. Essential English Grammar: A Self-Study Reference and Practice Book for Elementary

1. Name of the Department: Chemistry						
2. Course Name	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons		**L**	**T**	**P**	
3. Course Code	17030102		4	0	0	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals.		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This core paper in Chemistry will help Science students understand and rationalize bonding in compounds, basic shapes and structures of molecules and even predict properties, which may have potential applications as materials, nanostructured materials and devices.

The course highlights the uses and limitations of the Schrodinger wave equation and an explanation of the rules governing the filling up of electrons in various orbitals and the electronic configuration of the atoms and ions. Energetics behind the formation of ionic bonds (Born Landè Equation), the forces of interaction operating in covalent molecules (bond energy) will be explained in detail.

Organic chemistry is probably the most active and important field of chemistry, due to its diverse applications in life and industry. The course highlights the various electronic effects with emphasis on inductive effect, hyper-conjugation, resonance and how they affect the properties of these compounds. Nucleophilic and electrophilic behavior of organic compounds and the intermediates formed during reactions; carbocations; carbanions; and free radicals will be exaplined along with along with studying the effects of functional groups on reactions.

Stereochemistry of organic compounds, which involves the study of the relative spatial arrangement of atoms that form the structure of molecules will be discussed at length. Many important reactions and their mechanisms would also be discussed.

9. Course Objectives:

The objectives of this course are to:

1. Introduce Schrödinger wave equation, quantization of energy and electronic configuration of atoms and ions.
2. Explain three types of chemical bonding- ionic, covalent and metallic- and understand energetics of bond formation.
3. Introduce the properties of organic compounds with special emphasis on inductive effect, hyperconjugation and resonance. electrophilicity and nucleophilicity and impact of functional groups on reactions
4. Understand stereochemistry of compounds
5. Learn important reactions and mechanisms

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Predict complete structure of atom with electronic configurations
2. Explain ionic and covalent bonding in detail
3. Explain various electronic effects and basics of stereochemistry
4. Identify important properties and reactions of aliphatic hydrocarbons (alkanes, alkenes and alkynes)

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Atomic Structure**

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit – 2	**Number of lectures = 14**	**Title of the unit: Chemical Bonding and Molecular structure**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Unit – 3	**Number of lectures = 16**	**Title of the unit: Fundamentals of Organic Chemistry and Stereochemistry**

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit – 4	**Number of lectures = 10**	**Title of the unit: Aliphatic Hydrocarbons**

Aliphatic Hydrocarbons : Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$.

12. Brief Description of self-learning/ E – learning component

1. http://www.wou.edu/chemistry/files/2017/01/CH105-Chapter-8-PDF-file.pdf
2. http://ncert.nic.in/ncerts/l/kech205.pdf
3. https://www.utdallas.edu/~scortes/ochem/OChem1_Lecture/Class_Materials/09_stereo_notes.pdf

13. Books Recommonded

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991 ISBN 0-412-40290-4

2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley, ISBN0471505323.

3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons,978-0471629788

4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006, ISBN 978-0060429959

5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014) ISBN 978-1-118-65305-0 .

6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013,ISBN 0-495-05101-2.

7. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988), ISBN978-8177584332.

8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000, ISBN 9780070992900.

9. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S., ISBN 978-8177585421

10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010, ISBN,978-8131704813

11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010 ISBN, 978-8121935159

1. Name of the Department: Chemistry						
2.Course Name	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab		**L**	**T**		**P**
3. Course Code	17030103		0	0		4
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

The lab work emphasizes learning of basic skills helpful not only to chemistry students but all those who want to pursue any experimental science. It includes volumetric analysis of compounds, crystallization of compounds, determining the purity, melting and boiling point of compounds and simple chromatographic techniques.

9. Course Objectives:

The objectives of this course are to:

1. Learn strength of solution through volumetric analysis
2. Learn separation of Na_2CO_3 and $NaHCO_3$ by volumetric analysis
3. Detect various extra elements in organic compounds
4. Separate mixture by paper chromatography

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Predict the technique of volumetric analysis
2. Determine strengths of Fe(II), Cu(II) solutions
3. Detect heteroatoms (N, S, Cl, Br, I) in organic compounds
4. Separate amino acids and sugars with paper chromatography

11. List of Experiments (Student has to perform ten experiments – at least two from each section)

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
3. Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
4. Identify and separate the sugars present in the given mixture by paper chromatography.

12. . Brief Description of self-learning/ E – learning component

1. https://vlab.amrita.edu/?sub=2&brch=191&sim=344&cnt=1
2. http://bbec.ac.in/wp-content/uploads/2015/08/Practical_first-semester.pdf
3. https://www.macalester.edu/~kuwata/Classes/200102/Chem%2011/Revised%20Amino%20Acids%20(9%201%2001).pdf
4. https://pubs.acs.org/doi/abs/10.1021/ed007p724

13. Books Recommended

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012, ISBN, 978-8131773710.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009, ISBN 9788131723258.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G. ISBN 978-0582462366.
4. Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996, ISBN 978-0582462366
5. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960 ISBN 978-8131727102

1. Name of the Department: Physics						
2. Course Name	Mechanics	**L**	**T**		**P**	
3. Course Code	17030108	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
The course will teach about the fundamental concept of mechanics and their subsequent development in applications in various field like oscillations and waves, elastic properties of materials, rest in motion and relative motion etc.						
9. Course Objectives:						
The aim of this course is to understand the basic concepts for the development of mechanics such as mathematical concept in physics, oscillations and waves, elastics properties of materials, rest in motion and relative motion etc.						
10. Course Outcomes (COs):						
After going through this course the student 1. Will have understanding of Mechanics knowledge 2. Can implement, the elastic properties of the materials in everyday life 3. Acquire skills to understand the mechanism of satellite motion, 4. Help students in critical thinking and problem solving.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 13**	**Title of the unit: Vectors**				
Vectors: Vector algebra, Scalar and vector products, Derivatives of a vector with respectto a parameter, **Ordinary Differential Equations:** 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients. **Oscillations:** Simple harmonic motion, Differential equation of SHM and its solutions,Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations.						
Unit - 2	**Number of lectures = 13**	**Title of the unit: Laws of Motion**				
Laws of Motion: Frames of reference, Newton's Laws of motion, Dynamics of a system of particles, Centre of Mass. **Momentum and Energy:** Conservation of momentum, Work and energy, Conservationof energy,						

Motion of rockets.

Rotational Motion: Angular velocity and angular momentum, Torque, Conservation ofangular momentum,

Gravitation: Newton's Law of Gravitation, Kepler's Laws (statement only), Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS),

Unit - 3	**Number of lectures = 13**	**Title of the unit: Elasticity**

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation betweenelastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder

Unit - 4	**Number of lectures = 13**	**Title of the unit: Special Theory of Relativity**

Special Theory of Relativity: Constancy of speed of light, Postulates of SpecialTheory of Relativity, Length contraction, Time dilation, Relativistic addition of velocities.

12. Books Recommended

1. University Physics, FW Sears, MW Zemansky and HD Young13/e, 1986, Addison-Wesley (ISBN-10- 0201603225; ISBN-13 : 978-0201603224)

2. Mechanics Berkeley Physics course,v,1: Charles Kittel, et, Al, 2007, Tata McGraw-Hill, (ISBN:9780070667280, 0070667284)

3. Physics – Resnick, Halliday& Walker 9/e, 2010, Wiley (ISBN: 978-1-119-30685-6)

4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole, (ISBN-10:0534369642; ISBN-13 : 978-0534369644)

13. Links

1. https://nptel.ac.in/courses/122103011/6

2.http://web.mit.edu/8.01t/www/materials/modules/chapter23.pdf

3. http://www.feynmanlectures.caltech.edu/III_17.html

4. https://nptel.ac.in/courses/105108070/1

5. https://nptel.ac.in/courses/122104014/

1. Name of the Department: Physics						
2. Course Name	Mechanics Lab	**L**	**T**		**P**	
3. Course Code	17030109	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 52**			

8. Course Description:

The experiment has been designed in such a way the student can measure distance uptomicrometer scale, can determine elastic constant of different materials and calculate moment of inertia of regular and irregular bodies.

9. Course Objectives:

The aim of this paper is that the student performs the experiment based on the description and calculates the results. Compare the result with the standard value wherever applicable and know how to calculate different type of errors also he/she understand how the theoretical concepts are verified experimentally.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to verify

1. The theoretical formulas by performing experiment
2. Demonstrate the practical application of properties of materials etc. in actual practice

11. List of Experiments

1. Moment of Inertia of a fly-wheel.
2. M.I. of an irregular body using a torsion pendulum.
3. Surface Tension by Jeager's method.
4. Young modulus by bending of beam.
5. Modulus of rigidity by Maxwell's needle.
6. Elastic constants by Searle's method.
7. Viscosity of water by its flow through a uniform capillary tube.
8. Thermal conductivity of a good conductor by Searle's method.
9. Mechanical equivalent of Heat by Callender's and Barne's method.
10. 'g' by Bar pendulum.

12. Book Recommended

1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House ISBN-10 : 0423738909, ISBN-13 : 978-0423738902

2. A Text book of Practical Physics, Indu Parkash, Ram Krishan and A.K.Jha, 11th Edition,2011, Kitab Mahal, New Delhi, ISBN-10 : 8122504167, ISBN-13 : 978-8122504163

3.B.Sc. Practical Physics, C.L. Arora S.Chand & Company, 2010 ISBN-10 : 8121909090

4.Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd, ISBN: 9788131525203

1. Name of the Department: Mathematics						
2. Course Name	Differential Calculus	**L**	**T**		**P**	
3. Course Code	17030110	4	0		0	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course is designed to develop the topics of differential calculus. Emphasis is placed on limits, continuity, derivatives. Upon completion, students should be able to select and use appropriate models and techniques for finding solutions to derivative-related problems with and without technology.

9. Course Objectives:

Students that successfully complete this course will be able to:

1. Learn to find and use limits of functions,
2. Apply the Mean Value Theorem.
3. Find intervals of concavity and points of inflection of elementary algebraic functions and trigonometric functions.
4. Curvature and Asymptotes.

10. Course Outcomes (COs):

After completing the course, students are expected to be able:

1. To evaluate various limits, continuity and differentiability of functions and to apply the Leibnitz's theorem for finding higher order derivative of product of two functions.
2. To expand functions using Taylor's and Maclaurin's series, Leibnitz theorem and use their applications
3. To acquire the concept of finding partial derivatives and associated rules.
4. To understand the basic concept of asymptotes, envelopes and theirs applications

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Continuity and Differentiation**

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, nth differentiation of functions, Leibnitz's theorem.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Mean Value Theorems**

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of $\sin x$, $\cos x$, e^x, $\log(1+x)$, $(1+x)^m$ Maxima and Minima, Indeterminate forms.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Partial Differentiation**

Partial differentiation, Euler's theorem on homogeneous functions, Differentiability of functions of two variables, Change of variables, Taylors theorem for two variables, Composite functions and Implicit & explicit functions, Total differentials.

Unit – 4	**Number of lectures = 20**	**Title of the unit: Asymptote and Curve Tracing and Curvature**

Asymptotes in Cartesian coordinates, Asymptotes in polar coordinates, Oblique Asymptotes, Concavity, Convexity & Points of Inflexion, Tangents and normal Curvature, Singular points, Tracing of curves in Cartesian, Parametric and polar co-ordinates

Curvature, radius of curvature for Cartesian Curves, Parametric curves, polar curves, Newton's method. Radius of Curvature for pedal curves. Tangential polar equation, Center of curvature. Circle of curvature. Chord of curvature, Evolutes.

Web Links

1. https://www.khanacademy.org/math/differential-calculus
2. https://www.mathsisfun.com/calculus/
3. http://library.umac.mo/ebooks/b31290735.pdf
4. http://webmath2.unito.it/paginepersonali/cordero/English/derivatives.pdf

12. Books Recommended

1. Murray R.Speigel: Theory and Problems of Advanced Calculus, Schaum's Outline series, Schaum Publishing Co., New York.
2. N. Piskunov: Differential and Integral Calculus, Peace Publishers, Moscow.
3. Gorakh Prasad: Differential Calculus, Pothishasla Pvt. Ltd. Allahabad.

1. Name of the Department: Mathematics						
2. Course Name	Differential Calculus Lab	**L**	**T**		**P**	
3. Course Code	17030111	0	0		4	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 35**			

8. Course Description:

This course is designed to emphasize the knowledge of differential calculus using the visible picture of the function. Emphasis is placed on limits, continuity, derivatives, maxima –minima, mean value theorems etc. Upon completion, students should be able to select and use appropriate models and techniques for finding solutions to derivative-related problems with technology.

9. Course Objectives:

Students that successfully complete this course will be able to:

1. To discuss the existence of limits and continuity of a functions with graph,
2. To discuss the existence of derivative of a functions with graph,
3. Application the Mean Value Theorem using graph,
4. Extrema and minima in two variables with graph.

10. Course Outcomes (COs):

After completing the course, students are expected to be able to evaluate various limit & continuity problem, Mean value theorems and applications of Partial Differential equations.

11. The list of practical's to perform in the computer lab.

1. To calculate limit, right hand limit and left hand limit of functions and draw the graph of the function
2. To calculate continuity of functions and draw the graph of the function
3. To identify points of discontinuity with the help of graph
4. To calculate derivatives of a one and two variable functions with graph
5. To discuss the applicability of Mean value theorems through graph
6. To calculate value of 'c' using Mean value theorems
7. To find extreme value of a function of one variables and critical points
8. To find maximum and minimum value of functions
9. To find absolute maxima and absolute minima of functions of two variables
10. To calculate partial derivatives and plotting of functions
11. To calculate Higher order partial derivatives
12. To calculate Total derivative

1. Gurpreet Singh Tuteja, "Practical Mathematics, International BOOK house Pvt Ltd.
2. https://www.mathworks.com/help/symbolic/solve-a-single-differential-equation.html

3. https://in.mathworks.com/help/symbolic/solve-a-system-of-differential-equations.html
4. https://www.mathworks.com/help/matlab/math/choose-an-ode-solver.html
5. http://www.math.tamu.edu/undergraduate/research/REU/comp/matode.pdf

12. Books Recommended

1. Shanti Narayan: Differential and Integral Calculus.
2. Murray R.Speigel: Theory and Problems of Advanced Calculus, Schaum's Outline series, Schaum Publishing Co., New York.
3. N. Piskunov: Differential and Integral Calculus, Peace Publishers, Moscow.
4. Gorakh Prasad: Differential Calculus, Pothishasla Pvt. Ltd. Allahabad.
5. Gorakh Prasad: Integral Calculus, Pothishasla Pvt. Ltd. Allahabad

Semester-II

1. Name of the Department:						
2. Course Name	Environmental Science			**L**	**T**	**P**
3. Course Code	17030201			4	0	0
11. Type of Course (use tick mark)		Core ( )	DSE ()	AEC (✓)	SEC ( )	
5. Pre-requisite (if any)	10+ 2 with Science Stream	**6. Frequency** (use tick marks)	Even ( )	Odd ( )	Either Sem ( )	Every Sem ( )
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 52		**Tutorials = Nil**		**Practical = Nil**		
8. Course Description:						
This course study of environmental problems is inherently interdisciplinary, blending perspectives from the sciences, social sciences, and humanities. .						
9. Course Objectives:						
1. To learn the Organizational level of ecological systems 2. To understand the scope of environmental sciences in the current scenario. 3. To gain the knowledge and impact of various types of pollutions along with their preventive measures. 4. To understand the different environmental issues and there social impact.						
10. Course Outcomes (COs):						
Upon successful completion of this course, the students will be able to: 1. Know the Importance of environmental studies and methods of conservation of natural resources.. 2. Describe the structure and function of an ecosystem and explain the values and Conservation of bio-diversity. 3. Recall social issues and legal provision and describe the necessities for environmental act 4. To describe the impact of various pollutants in society and the parameters to overcome these pollutants.						
11. Unit wise detailed content						
Unit-1	**Number of lectures=13**	**Title of the unit:-** The Multidisciplinary nature of environmental studies.				
The Multidisciplinary nature of environmental studies, Definition, scope and importance. Need for public awareness. Natural Resources, Renewable and non-renewable resources: Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources,						

use of alternate energy sources. Case studies. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Unit – 2	**Number of lectures=13**	**Title of the unit:-** Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Biodiversity and its conservation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit – 3	**Number of lectures=13**	**Title of the unit:** Environmental Pollution

Definition, causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Fireworks, their impacts and hazards. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit – 4	**Number of lectures=13**	**Title of the unit:** Social Issues and the Environment

Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Consumerism and waste products. Environmental Legislation (Acts and Laws) Issues involved in enforcement of environmental legislation. Human Population and the Environment. Population growth, variation among nations with case studies, Population explosion – Family Welfare Programmes and Family Planning Programmes, Human Rights, Value Education, Women and Child Welfare

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

1. https://www.youtube.com/watch?v=9TmZRZ-w1Y4
2. https://www.youtube.com/watch?v=YaRkQ6mYNC4
3. https://www.youtube.com/watch?v=bCVtowxwqR8
4. https://www.youtube.com/watch?v=v-RMhW4Xcyw
5. https://www.youtube.com/watch?v=InD80_yGLR0
6. https://www.youtube.com/watch?v=QzP2mnrVdeY

13. Books Recommended

1. Dhameja, S. K., Environmental Engineering and Management, S. K. Kataria and sons, New Delhi, 1st Edition2015.
2. Anubha Kaushik and Kaushik C.P., Environmental Science & Engineering" New Age international Publishers, New Delhi, 2010.
3. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
4. ErachBharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.
5. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. USA, 2nd Edition2004.
6. Erach Bharucha, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India, 2002.
7. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media, 2003.
8. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001. 7. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
9. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 1994.

1. Name of the Department: Chemistry						
2. Course Name	Chemical Energetics, Equilibria &Functional Group Organic Chemistry-I	**L**	**T**	**P**		
3. Course Code	17030202	4	0	0		
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 52		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

This course aims to explain the physical world around us by describing important principles and definitions of thermochemistry. Through Laws of thermodynamics, energetics of reactions will be explained. Calculation of bond energy, bond dissociation energy, resonance energy, entropies and enthalpies will be demonstrated. In addition, concepts related to chemical equilibrium (Gibb's Free Energy, Le Chatlier's Principle) will be discussed.

Equilibria in term of ions will also be explained. Important concepts include strong, moderate and weak electrolytes; ionization of water; ionization of weak acids and bases; common ion effect; pH scale; buffer solutions; and solubility of sparingly soluble salts.

In Organic Chemistry, preparation and reactions of aromatic hydrocarbons; alkyl and aryl halides; alcohols, phenols and ethers will be discussed. Important reactions and their mechanisms will be explained.

9. Course Objectives:

The objectives of this course are to:

1. Introduce students to energetics of chemical reactions through Laws of Thermodynamics
2. Explain various concepts of chemical and ionic equilibria
3. Understand reactions and preparations of aromatic hydrocarbons; aryl and alkyl halides.
4. Learn preparation and chemical reactions of alcohols, phenols, ethers, aldehydes, and ketones.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Explain energetics of chemical reactions through important principles and definitions of thermo chemistry
2. Explain degree of ionization and the differences between strong, moderate and weak electrolytes and other important concepts of chemical equilibria
3. Understand mechanism of various name reactions
4. Explain synthesis and reactions of aromatic hydrocarbons; aryl and alkyl halides, alcohols, phenols, ethers, aldehydes, and ketones.

11. Unit wise detailed content

Section A: Physical Chemistry (26 Lectures)

Unit-1	**Number of lectures = 8**	**Title of the unit: Chemical Energetics**

Review of thermodynamics and the Laws of thermodynamics

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation and bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature- Kirchoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit – 2	**Number of lectures = 18**	**Title of the unit: Chemical Equilibrium and Ionic Equilibria**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^0, Le Chatlier's Principle.

Relationships between K_p, K_c and K_x for reactions involving ideal gases.

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis- calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts- applications of solubility product principle.

Section B: Organic Chemistry (26 Lectures)

Unit – 3	**Number of lectures = 14**	**Title of the unit: Aromatic Hydrocarbons; Alkyl and aryl halides**

Functional group approach for the following reactions (preparations and reactions) to be studied in context to their structure.

Aromatic Hydrocarbons

Preparation: (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Alkyl and aryl halides

Alkyl halides (upto 5 carbons) Types of Nucleophiles (S_N1, S_N2 and S_Ni) reactions.

Preparation: From alkenes and alcohols

Reactions: Hydrolysis, nitrite and nitro formation, nitrile and isonitrile formation, Williamson's ether synthesis: Eliminations vs. substitution.

Aryl Halides

Preparation: (Chloro, bromo and iodo benzene case): from phenol, Sanmeyer & Gattermann reactions.

Reactions: (Chlorobenzene): Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent. Benzyne mechanism: KNH_2/NH_2 (or $NaNH_2/NH_3$).

Reactivity and relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit 4	**No. of Lectures = 12**	**Title of the unit: Alcohols, Phenols and ethers (Up to 5 Carbons)**

Alcohols:

Preparation: Preparation of 1^o, 2^o and 3^o alcohols using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acids and esters.

Reactions: With Sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppenauer oxidation

Diols: (Upto 6 Carbons), oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case)

Preparation: Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten-Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Preparation:from acid chlorides and nitriles

Reactions: Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol condensation, Canizzaro's reaction, Wittig reaction, Benzoin condensation.

Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

12. Brief Description of self-learning/ E – learning component

1. **https://www.youtube.com/watch?v=l0CSnOfOYmw**
2. **https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Map%3A_Organic_Chemistry_(McMurry)/17%3A_Alcohols_and_Phenols**
3. **https://ncert.nic.in/ncerts/l/lech104.pdf**
4. **https://nptel.ac.in/courses/104/106/104106089/**

13. Books Recommended

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014), ISBN 978-1-118-87576-6.
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013, ISBN 978-0-495-05101-5.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988) ISBN 978-8177584332.
4. Finar, I.L. Organic Chemistry (Vol. I and II), E.L.B.S., ISBN 978-8177585421
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010, ISBN 978-8131704813

1. Name of the Department: Chemistry						
2.Course Name	Chemical Energetics, Equilibria &Functional Group Organic Chemistry-I Lab		**L**	**T**		**P**
3. Course Code	17030203		0	0		4
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals						
Lectures = 0	**Tutorials = 0**		**Practical = 52**			

8. Course Description:

The lab work emphasizes learning of basic skills helpful not only to chemistry students but all those who want to pursue any experimental science. It includes using instruments to determine physical parameters, *e.g.*, heat capacity, enthalpy, solubility and pH; crystallization of compounds, determining the purity, melting and boiling point of compounds and simple chromatographic techniques. Syntheses of selected organic compounds will also be performed and their mechanisms will be discussed.

9. Course Objectives:

The objectives of this course are to:

1. Learn various experimental concepts of thermochemistry such as heat capacity, enthalpy and solubility using different solutions
2. Preparation of buffer solutions and determination of pH of various solutions, for instance, aerated drinks, fruit juices, shampoos and soaps.
3. Purification of organic compounds by crystallization and distillation
4. Preparation of selected organic compounds and discussion about their mechanism.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Determine enthalpy of Neutralization, Ionization of acetic acid, Solution of salts (KNO_3, NH_4Cl) and Hydration of Copper Sulphate
2. Prepare buffer solutions and measure pH of different solutions, for instance, aerated drinks, fruit juices, shampoos and soaps
3. Purify organic compounds by crystallization, distillation and determine their purity with melting and boiling points
4. Perform the synthesis of important compounds and predict their mechanisms

11. List of Experiments (Student has to perform ten experiments – at least two from each section)

Section A: Physical Chemistry

Thermochemistry

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of *H*.

Ionic equilibria

1. pH measurements
2. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
3. Preparation of buffer solutions:
4. Sodium acetate-acetic acid
5. Ammonium chloride-ammonium hydroxide
6. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
4. Bromination of Phenol/Aniline
5. Benzoylation of amines/phenols
6. Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

12. Brief Description of self-learning/ E – learning component

1.file:///C:/Users/Anaya/Downloads/144_Sample-Chapter.pdf
2.https://classnotes.org.in/class11/chemistry/organic-chemistry-some-basic-principles techniques/purification-of-organic-compounds
3. http://egyankosh.ac.in/bitstream/123456789/15894/1/Experiment-10.pdf
4. http://ijcps.org/admin/php/uploads/640_pdf.pdf

13. Books Recommended.

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,ISBN 978-0582462366
2. Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996, ISBN 978-0582462366.
3. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960 ISBN 978-8131727102 .
4. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011) ISBN 978-81-265-3016-8.

1. Name of the Department: Physics						
2. Course Name	Electricity, Magnetism and EMT	**L**	**T**		**P**	
3. Course Code	17030208	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
The course will teach about the vector analysis of electric field and magnetic field , integral and differential form of Maxwell equations and electromagnetic wave propagation.						
9. Course Objectives:						
To impart knowledge about electrostatics, magnetism, and Maxwell's equations and their practical applications.						
10. Course Outcomes (COs):						
After successful completion of this course, students will have 1. basic understanding of electricity and magnetism, and their everyday life applications 2. understanding of propagation of electromagnetic radiation in different medium like vacuum, isotropic dielectric medium etc. 3. skills to design the projects based on basics of electricity and magnetism, 4. assistance to students in critical thinking and problem solving.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 13**	**Title of the unit: Vector Analysis**				
Review of vector algebra (Scalar and Vector product), gradient,divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only)						
Unit - 2	**Number of lectures = 13**	**Title of the unit: Electrostatics**				
Electrostatic Field, electric flux, Gauss's theorem of electrostatics,Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor, Electric potential as line integral of electric field, Energy per unit volume in electrostatic field, Dielectric medium, Polarization, Displacement						

vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric,

Unit - 3	**Number of lectures = 13**	**Title of the unit: Magnetism**

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility, Brief introduction of dia-, para-and ferro-magnetic materials,

Electromagnetic Induction:Faraday's laws of electromagnetic induction, Lenz's law,self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Maxwell`s equations and Electromagnetic wave propagation**

Equation of continuityof current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. AC response of RC, RL and LCR circuit.

12. Book Recommended:

10. Electricity and Magnetism, Edward M, Purcell, 1986, McGraw-Hill Education, ISBN 13: 9780070049086
11. Electricity and Magnetism, J,H, Fewkes& J, Yarwood, Vol, I, 1991, Oxford Univ, Press
12. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House, ISBN-13: 978-9350975534
13. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole, ISBN-13: 978-0534369644
14. D,J, Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings, ISBN-13: 9780138053260

13. links

1. https://nptel.ac.in/courses/115101005/downloads/lectures-doc/Lecture-23.pdf

2. https://nptel.ac.in/courses/113106032/15%20-%20Magnetic%20Properties.pdf

3.https://theopenacademy.com/sites/default/files/oadb/Sciences/Physics/Physics%20II%3B%20Electricity%20and%20Magnetism%20-%20MIT%20-%20Walter%20Lewin%20-%20BYNCSA/Notes/Course%20Notes/The-Displacement-Current-And-Maxwells-Equations.pdf

4. https://ocw.mit.edu/courses/mechanical-engineering/2-71-optics-spring-2009/video-lectures/lecture-14-maxwells-equations-polarization-poyntings-vector/

5. https://www.eit.lth.se/fileadmin/eit/courses/eten05/ht2016/lectures/lecture1.pdf

1. Name of the Department: Physics						
2. Course Name	Electricity, Magnetism and EMT Lab	**L**	**T**		**P**	
3. Course Code	17030209	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

Experiments include the fundamental characteristics of DC power supply, RC coupled amplifier, Melde's experiment, electronic voltmeter, compound pendulum etc.

9. Course Objectives:

To understand the working principles of different types of transistors and diodes like JFET, MOSFET, LED and Photo diodes and implement them into practically working equipment which are helpful in our daily life.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to:

1. Apply the concepts of basic electronic devices to design various electronic circuits.
2. Understand operation of diodes, transistors in order to design basic circuits.
3. Measure the oscillations of a mass under different combination of springs.

11. List of Experiments

1. To draw common base and common emitter characteristics of a transistor and calculate transistor and calculate transistor characteristics parameters.
2. To study the ripple factor in a D.C. power supply.
3. To draw frequency response curve of transistorised R.C. coupled amplifier.
4. To find out the frequency of a tuning fork by Melde's experiment.
5. Study of series and parallel resonance circuits.
6. Electronic Voltmeter measurement of peak, average & R .M.S. values of signal.
7. Study of voltage doubler and trippler circuits.
8. Study of a compound pendulum.
9. Study of oscillations of a mass under different combinations of springs.
10. Study of oscillations under a bifilar suspension.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House, ISBN- 9780357109953
2. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, Cengage Learning India Pvt. Ltd., ISBN-9788131525203
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition,reprinted 1985, Heinemann Educational Publishers, ISBN- 9780135159552

1. Name of the Department: Mathematics						
2. Course Name	Differential Equations	**L**	**T**		**P**	
3. Course Code	17030210	4	0		0	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 50		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

Differential equations and their solutions. Linear Differential equation. Homogeneous Differential Equations. Second order linear differential equations. Total differential equations.

9. Course Objectives:

To introduce the basic concept of Differential equations and their solutions. Strength of these concepts in engineering and real world problems will be highlighted.

10. Course Outcomes (COs):

1. To explain an integrating factor, which may reduce the given differential equation into an exact one and eventually provide its solutions.
2. To familiarize the orthogonal trajectory of the system of curves on a given surface.
3. To determine solutions to second order linear non-homogeneous differential equations with constant coefficients.
4. To investigate the qualitative behavior of solutions of systems of differential equations

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the Unit: Introduction to Differential Equations**

Order and degree of a differential equation, Linear & Non-Linear Differential equation, Homogeneous equations, Geometrical meaning of DE, Exact DE, Integrating factors, First order higher degree equations solvable for x,y,p, Lagrange's equation, Clairaut's equations, Equations reducible to Clairaut's form, Singular solutions.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Orthogonal Trajectories and Homogeneous DE**

Orthogonal trajectories in Cartesian coordinates and polar coordinates, Self orthogonal family of curves, Linear DE with constant coefficients, Homogeneous linear ODE, Equations reducible to homogeneous form

Unit - 3	**Number of lectures = 10**	**Title of the unit: Linear DE and Non-homogeneous DE**

Linear DE of second order with variable coefficients: Reduction to normal form, Method of undetermined coefficients, Transformation of the equation by changing the dependent variable/independent variable, Solution by operators of non-homogeneous linear DE, Reduction of order of a DE

Unit - 4	Number of lectures = 20	Title of the unit: General Methods to solve DE and Solutions of Simultaneous DE and Total DE and Methods
Method of variations of parameters, , Ordinary simultaneous DE, Solution of simultaneous DE involving operators x (d/dx) or t (d/dt) etc, Simultaneous equation of the form dx/P=dy/Q=dz/R, Total DE, Condition for Pdx+Qdy=Rdz=0 to be exact, General method of solving Pdx+Qdy+Rdz=0 by taking one variable constant, Method of auxiliary equations.		
Web Links…		
1. https://www.khanacademy.org/math/differential-equations 2. https://www.mathsisfun.com/calculus/differential-equations.html 3. https://www.math.ust.hk/~machas/differential-equations.pdf 4. http://www.math.toronto.edu/selick/B44.pdf		
12. Books Recommended		
1. D.A. Murray: Introductory Course in Differential Equations. Orient Longaman (India), 1967 2. A.R.Forsyth: A Treatise on Differential Equations, Machmillan and Co. Ltd. London 3. E.A. Codington: Introduction to Differential Equations. 4. S.L.Ross: Differential Equations, John Wiley & Sons 5. B.Rai and D.P. Chaudhary: Ordinary Differential Equations; Narosa, Publishing House Pvt. Ltd		

1. Name of the Department: Mathematics						
2. Course Name	Differential Equations Lab	**L**	**T**		**P**	
3. Course Code	17030211	0	0		4	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 35**			

8. Course Description:

This course is designed to emphasize the knowledge of differential equations. Emphasis is placed on different forms of linear and non-linear differential equations. Upon completion, students should be able to write the programs in Matlab or other software's.

9. Course Objectives:

1. Give an account of basic concepts and definitions for differential equations;
2. Use methods for obtaining exact solutions of linear homogeneous and non-homogeneous differential equations;
3. Describe some simple numerical solution techniques and be familiar with mathematical software for differential equations;
4. Use elementary methods for linear systems of differential equations.

10. Course Outcomes (COs):

After completing the course, students are expected to be able to solve differential equations analytically.

1. Solve a differential equation analytically by using the solve function, with or without initial conditions.
2. To solve a system of differential equations,
3. To solve first order Linear ODE
4. To solve First order linear differential equations
5. To solve first order Bernoulli equations
6. To solve ODE with initial conditions
7. To solve Non-linear differential equations with initial conditions
8. To solve second order ODE with initial conditions
9. To solve a system of Ordinary differential equations
10. To find the explicit solution of first order differential equations
11. To find the explicit solution of second order differential equations

11. Books Recommended

1. Gurpreet Singh Tuteja, "Practical Mathematics, International BOOK house Pvt Ltd.
2. https://www.mathworks.com/help/symbolic/solve-a-single-differential-equation.html
3. https://in.mathworks.com/help/symbolic/solve-a-system-of-differential-equations.html
4. https://www.mathworks.com/help/matlab/math/choose-an-ode-solver.html
5. http://www.math.tamu.edu/undergraduate/research/REU/comp/matode.pdf

Semester-III

1. Name of the Department:Chemistry						
2. Course Name	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Organic Chemistry-II			**L**	**T**	**P**
3. Course Code	17030301			4	0	0
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical.						
Lectures = 52	**Tutorials = 0**			**Practical = 0**		

8. Course Description:

This course will delve deeper into the thermodynamics of solutions- ideal and non-ideal. Raoult's Law which governs the behavior of ideal solutions will be explained. In addition, miscibility of liquids (partial and immiscibility) will be discussed. Principles of steam distillation, Nernst distribution law and its application, and solvent extraction will be highlighted.

This course will also explain equilibrium between phases. Phases, components and degrees of freedom of a system will be explained. In addition, phase diagrams of one-component systems (water and Sulphur) and selected two-component systems involving eutectics, congruent and incongruent melting points will be discussed.

Conductivity, transference number and ionic mobility will be explained as a foundation for electrochemistry. Important concepts in electrochemistry include measuring EMF of a cell; Nernst equation; standard electrode potential and the electrochemical series; concentration cells; pH determination; and potentiometric titrations.

In organic chemistry, preparation and reactions of carboxylic acids and their derivatives (acid chlorides, esters, amides, anhydrides); amines and Diazonium salts; amino acids, peptides and proteins; and carbohydrates will be discussed.

9. Course Objectives:

The objectives of this course are to:

1. Introduce students to thermodynamics of ideal solutions, Raoult's law and principles governing miscibility of liquids
2. Explain phase diagrams of one component system and two component systems, molar conductivity, transference number and ionic mobility
3. Learn how to measure EMF of a cell, and pH using Hydrogen electrode
4. Explain preparation and reactions of Carboxylic acids and their derivatives; amines and diazonium salts; amino acids, peptides and proteins; and carbohydrates.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Understand phase diagrams for selected one component and two component system
2. Determine degree of ionization of weak electrolytes; solubility products of sparingly soluble salts; ionic

product of water; and hydrolysis constant of a salt

3. Determine EMF of a cell and from the EMF data,: ΔG, ΔH and ΔS.
4. Predict mechanism of preparation and reactions of Carboxylic acids and its derivatives alongwith amino acids, proteins, and carbohydrates.

11. Unit wise detailed content

Section A: Physical Chemistry II (26 Lectures)

Unit-1	**Number of lectures = 14**	**Title of the unit: Solutions and Phase Equilibrium**

Thermodynamics of ideal solutions: Ideal solutions and Raoult's Law, deviations from Raoult's law- non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature, effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation, Nernst distribution law and its application, solvent extraction.

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius-Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and Sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $FeCl_3$-H_2O and Na-K only)

Unit – 2	**Number of lectures = 12**	**Title of the unit: Conductance and Electrochemistry**

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Application of conductance measurements, determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base).

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes, Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

pH determination using hydrogen electrode and quinhydrone electrode.

Potentiometric titrations- qualitative treatment (acid-base and oxidation-reduction only).

Section B: Organic Chemistry -II (26 Lectures)

Unit – 3	**Number of lectures = 10**	**Title of the unit: Carboxylic Acids and their derivatives; Amines and Diazonium Salts**

Functional group approach for the following reactions (preparations and reactions) to be studied in context to their structure.

Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic)

Preparation: Acidic and Alkaline hydrolysis of esters

Reactions: Hell-Vollhard-Zelinsky Reaction

Carboxylic acid derivatives (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts

Amines (Aliphatic and Aromatic) (Upto 5 Carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test with HNO_2, Schotten-Baumann Reaction, Electrophilic substitution (case aniline), nitration, bromination, sulphonation.

Diazonium salts

Preparation: from aromatic amines

Reactions: conversion to benzene, phenol, dyes.

Unit 4	**No. of Lectures = 16**	**Title of the unit: Amino acids, peptides and proteins; Carbohydrates**

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of amino acids: ester of -COOH group, actylation of -NH2 group, complexation with Cu^{2+}ions, ninhydrin test

Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins

Determination of primary structure of peptides by degradation. Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme).

Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) and C-activating groups and Merrifield solid-phase synthesis.

Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellulose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

12. Brief Description of self-learning/ E – learning component

1. https://youtu.be/suUaAJVvGXI
2. https://nptel.ac.in/courses/113106032/9%20-%20Phase%20diagrams.pdf
3. https://youtu.be/TNn0fmujzmg
4. http://chemistry2.csudh.edu/rpendarvis/aminrxn.html
5. https://olemiss.edu/courses/bisc102/macromol.html

13. Books Recommended

1. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007), ISBN 9780070647749
2. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004), ISBN 978-8185015590
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009), ISBN 978-0840048288
4. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998), ISBN 978-0201044058
5. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New Delhi (1985), ISBN 978-0023947919.
6. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), ISBN 978-8131704813
7. Finar, I.L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education),

ISBN 978-8177585421

8. Finar, I.L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), ISBN 978-8177585414
9. Nelson, D.L. & Cox, M.M. Lehninger's Principles of Biochemistry 7th Ed., W.H. Freeman, ISBN 978-1464187964
10. Berg, J.M., Tymoczko, J.L. &Stryer, L. Biochemistry, W.H. Freeman, 2002, ISBN 978-1429276351

1. Name of the Department: Chemistry							
2.Course Name	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Organic Chemistry-II Lab		**L**		**T**		**P**
3. Course Code	17030302		0		0		4
4. Type of Course (use tick mark)			**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite(if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()		Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals.							
Lectures = 0		**Tutorials = 0**		**Practical = 52**			

8. Course Description:

The lab work emphasizes learning of basic skills helpful not only to chemistry students but all those who want to pursue any experimental science. It includes studying equilibria by distribution methods; construction of the phase diagram of a binary system and determining its critical temperature and composition; determination of cell constant, conductance and degree of dissociation; perform conductometric titrations; perform potentiometric titrations; qualitative analysis of organic compounds; simple chromatographic techniques; and miscellaneous experiments in organic chemistry, *e.g.*, titration of glycine and determination of its concentration, studying the action of salivary amylase on starch, and differentiating between a reducing and nonreducing sugar.

9. Course Objectives:

The objectives of this course are to:

1. Study the equilibrium of selected reactions by distribution method, Construction of phase diagram of a binary system, and determination of critical temperatures and composition.
2. Learn the cell constant, conductance, degree of dissociation and perform conductometric and potentiometric titrations
3. Learn qualitative analyses of selected organic compounds possessing monofunctional groups and difference between reducing and nonreducing sugar
4. Titration of glycine and determination of its concentration
5. Studying the action of salivary amylase on starch

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Explain the equilibrium of selected reactions by distribution method
2. Construct phase diagrams of binary systems (simple eutectic) and determine critical parameters
3. Determine cell constant, conductance and degree of dissociation of an acid
4. Perform qualitative analyses of selected organic compounds possessing monofunctional groups and predict the action of salivary amylase on starch

11. **List of Experiments (Student has to perform ten experiments – at least two from each section)**

Section A: Physical Chemistry

Distribution

1. Study of the equilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) \longrightarrow I_3^-(aq)$

$Cu^{2+}(aq) + xNH_2(aq) \longrightarrow [Cu(NH_3)_x]^{2+}$

Phase equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and
3. dissociation constant of a weak acid.
4. Perform the following conductometric titrations:
5. Strong acid vs. strong base
6. Weak acid vs. strong base

Potentiometry

1. Perform the following potentiometric titrations:
2. Strong acid vs. strong base
3. Weak acid vs. strong base
4. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a nonreducing sugar

12. Brief Description of self-learning/ E – learning component

1. https://youtu.be/amFOhvc6p
2. https://m.tau.ac.il/~chemlaba/Files/conductometry-titrations.pdf.
3. http://users.metu.edu.tr/chem223/potentiometry.pdf
4. https://nptel.ac.in/courses/102103047/PDF/mod4.pdf

13. Books Recommended

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996 ISBN 978-0582462366
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960, ISBN 978-8131727102
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011) ISBN 978-81-265-3016-8.
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Pres, ISBN 978-8173714757.

1. Name of the Department: Physics						
2. Course Name	Thermal Physics and Statistical Mechanics	**L**	**T**		**P**	
3. Course Code	17030307	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
The course will deepen your understanding of basics of thermodynamic principles, thermodynamic potentials, and the kinetic theory of gases.						
9. Course Objectives:						
The objectives of this course are 1. To study the different laws of thermodynamics and their practical applications. 2. To define the thermodynamic potentials and derive the Maxwell's equations. 3. To study the transport phenomena in the gases. 4. To study the three different statistics and differentiate between them						
10. Course Outcomes (COs):						
After completion of this course, students will have understanding of 1. The laws of thermodynamics and will be able to apply them in day to day life 2. Maxwell's relations and will be able to apply it to calculate specific heats, Joule coefficient etc. 3. Distribution of velocities and its experimental verification 4. Classical and Quantum mechanics and their comparison						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 13**	**Title of the unit: Thermodynamic Description of system**				
Zeroth Law of thermodynamics andtemperature, First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: Work Done during Isothermal and processes, Entropy-temperature diagrams, Third law of thermodynamics,						

Unattainability of absolute Adiabatic Processes, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Carnot Engine and its Efficiency, Refrigerator and its Efficiency.Entropy changes in reversible & irreversible zero.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Thermodynamic Potentials**

Extensive and Intensive Thermodynamic Variables. Thermodynamic Potentials U, H, F and G : Their Definitions, Properties and Applications. Approach to Absolute Zero.Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Kinetic Theory of Gases**

Derivation of Maxwell's law of distribution of velocities andits experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Mean, RMS and Most Probable Speeds. Degrees of Freedom.Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Statistical Mechanics**

Basics of probability, mean, variance, distributions.Phase space, Macrostate and Microstate, Entropy andThermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

12. Books Recommended:

1. Thermal Physics, S, Garg, R, Bansal and C, Ghosh, 1993, Tata McGraw-Hill, ISBN: 9781259003356

2. A Treatise on Heat, Meghnad Saha, and B,N, Srivastava, 1969, Indian Press, ISBN: 978-0856550683

3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications, ISBN: 978-0486603612

4. Heat and Thermodynamics, M,W,Zemasky and R, Dittman, 1981, McGraw Hill, ISBN: 978-0070170599

5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F,W,Sears & G,L,Salinger, 1988,ISBN: 978-8185015712

6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole, ISBN: 978-0534369644

7. Thermal Physics, A, Kumar and S,P, Taneja, 2014, R, chand Publications, ASIN : B08F7MCVH1

13. links

1. https://nptel.ac.in/courses/103103036/9

2. https://courses.physics.ucsd.edu/2010/Spring/physics210a/LECTURES/210_COURSE.pdf

3. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/lecture-notes/5_60_lecture1.pdf

4. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/lecture-notes/5_60_lecture10.pdf

5. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/lecture-notes/5_60_lecture8_9.pdf

1. Name of the Department: Physics						
2. Course Name	Thermal Physics and Statistical Mechanics Lab	**L**	**T**		**P**	
3. Course Code	17030308	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

The experiment has been designed in such a way the student can learn about thermo-electric effect, conduction of heat through metals and use of potentio-meter fore calibration etc.

9. Course Objectives:

1. To understand the working principles of thermocouples and various effects associated with thermocouple.
2. Students will learn about the various processes of transmission of heat and basic principle of thermodynamics
3. Students will be able to calculate the optical parameters
4. Students will learn about optically active substances

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

1. Apply the concepts of basic thermodynamics principle to design the different type's thermocouples for daily life applications such as a refrigerator, cooling etc.
2. Correlate the theoretical concepts with the experimental ones
3. Acquire and analyze the experimental data
4. 4. To calculate one parameter using different experimental techniques

11. List of Experiments

1. To study the variation of thermo emf across two junction of a thermo couple with temperature.
2. To determine the coefficient of thermal conductivity of copper by Searl's apparatus.
3. To determine mechanical equivalent of heat by Callender and Barne's constant flow method.

4. Determination of wave length of sodium light and the number of lines per centimeter using a diffraction grating.
5. Calibration of a thermocouple by potential meter
6. To determine the wavelength of a monochromatic light using Newton's Rings.
7. Resolving power of telescope.
8. Comparison of Illuminating Powers by a Photometer.
9. Measurement of (a) Specific rotation (b)concentration of sugar solution using polarimeter.
10. Ordinary and extra ordinary refractive indices for calcite or quartz.

12.Book Recommended

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsop, 1971, Asia Publishing House, ISBN: 978-0423738902
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi, ISBN: 978-8122500844
3. Engineering Practical Physics, S. Panigrahi & B.Mallick, 2015, Cengage Learning India Pvt. Ltd., ISBN: 978-8131525203

1. Name of the Department: Mathematics						
2. Course Name	Real and Complex Analysis	**L**	**T**		**P**	
3. Course Code	17030309	4	0		0	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 10**		**Practicals: 0**		

8. Course Description:

Real analysis is a large field of mathematics based on the properties of the real numbers and the ideas of sets, functions, and limits.

This course is aimed to provide an introduction to the theories for functions of a complex variable. Topic covers: Complex numbers and their algebraic, concepts of analyticity, Cauchy-Riemann relations and harmonic functions, complex integration and complex power series, calculus of residues in the evaluation of integrals etc

9. Course Objectives:

The objective of this course is to introduce the fundamental ideas Fourier series, properties and Drichlet's conditions etc., the functions of complex variables and developing a clear understanding of the fundamental concepts of Complex Analysis such as analytic functions, Conformal mapping, mobius transformations and a range of skills which will allow students to work effectively with the concepts.

10. Course Outcomes (COs):

After completing this course, students will be able to:

1. Basics of Real Number, series and sequences
2. Becoming familiar with the concepts Complex numbers and their properties and operations with Complex number.
3. Evaluating Analyticity, differentiability and continuity of complex function, complex integration and power series.
4. C-R conditions, Mobius transformation and Conformal mapping etc.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Real Number System**

Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, completeness property of R, Archimedean property of R, intervals, Boundedness of the set of Real numbers, Least upper bound and Greatest lower bound of a set, Neighborhoods, interior points and isolated points, Limit points, open sets, closed sets, Interior of a set, Closure of a set in Real numbers and their properties, Bolzano-Weierstrass theorem.

Unit - 2	**Number of lectures = 12**	**Title of the unit: Sequence and Series**

Sequences: Real sequences and their convergence, Subsequences, Theorem on limits of sequences, Divergent sequence, Bounded sequence, Monotonic sequence, Monotone convergence theorem, Cauchy's sequence, Cauchy general principle of convergence. Infinite series: Convergence and divergence of infinite series, Comparison tests of positive term infinite series, Cauchy's general principle of convergence of series, Convergence and divergence of geometric series, Auxiliary series or p-series, D-Alembert's ratio test, Rabbe's Test, Logarithmic Test, De Morgan and Bertrand's Test, Cauchy n^{th} Root Test, Gauss Test, Cauchy Integral test, Cauchy's condensation test, Alternating series: Leibnitz's Test, absolute and conditional convergence, Sequences and series of functions, Pointwise and uniform convergence. Mn-test, M-test.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Continuity, Differentiability, Analytical Functions and their properties**

Differentiability and Continuity of a complex function, Analytic function, necessary and sufficient conditions for a function to be analytic, Cartesian and polar form of the Cauchy-Riemann equations Harmonic functions.

Unit - 4	**Number of lectures = 8**	**Title of the unit: Complex Integration and Power Series**

Integration of complex functions, Cauchy Integral theorem and formula, Power series, radius and circle of convergence, Taylor's Maclarian's and Laurent's series, Zeroes and singularities of complex functions, Residues.

Unit-5	**Number of lectures = 7**	**Title of the unit: Conformal Mapping and Mobius Transformation**

Mapping by elementary functions: Translation, Rotation, Magnification and Inversion, Conformal mapping, Mobius transformations, Fixed points, cross ratio, Inverse Points and Critical Mappings. Evaluation of real integrals using residues (around unit and semi circle only).

12. Web Links:

1. https://www.youtube.com/watch?v=qkxLNSwop7c
2. https://www.youtube.com/watch?v=qTDDFMAt7j4

13. Books Recommended

1. T.M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985
2. R.R. Goldberg: Real Analysis Oxford & IBH publishing Co., New Delhi, 1970
3. D. Somasundaram and B. Choudhary: A First Course in Mathematical Analysis, Narosa Publishing House,New Delhi, 1997

4. Shanty Narayan: ACourse of mathematical Analysis, S.Chand& Co., new Delhi
5. Shanti Narayan: Theory of Functions of a Complex variable, S. Chand & Co, New Delhi.

1. Name of the Department: Mathematics						
2. Course Name	Introduction to MATLAB	**L**	**T**		**P**	
3. Course Code	17030310	0	0		4	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 10**		**Practicals: 52**		

8. Course Description:

This course gives an introduction to MATLAB. It is designed to give students fluency in mathematical software. The course consists of interactive lectures with students doing sample programming problems in real time.

9. Course Objectives:

MATLAB is powerful coding languages in science and engineering computing. This course is an application-oriented introduction to the two languages. The student will be exposed to simple math computations, modeling and simulation problems, data analysis and processing, as well as visualization techniques.

10. Course Outcomes (COs):

1. Understand the fundaments of procedural and functional programming;
2. Dominate MATLAB data types and structure.
3. Beabletosetupsimpleengineeringproblemssuchthattheycanbesolvedandvisualizedusingbasic codes in both languages.
4. Be ready to use advanced coding in MATLAB in their subsequent studies.

11. Unit wise detailed content

1. Starting with MATLAB: arithmetic operations with scalars, display for-mats, elementary built-infunctions, scalar variables.

2. Creating, manipulating and operating arrays.

3. Creating and running script files. Global variables. Input and output.

4. Two-dimensional plots.

5. Functions and function files. Local and global variables. In line functions.

6. Programmingin Matlab: relational and logical operators, conditional statements, loops and nested loops.

7. Polynomials and interpolation. Linear algebra

8. Applications in numerical analysis: solving a one-variable equation, optimization, integration and ordinary differential equations.

12. Web Links:

https://www.wolfram.com/language/elementary-introduction/

https://in.mathworks.com/learn/tutorials/matlab-onramp.html
https://www.tutorialspoint.com/matlab/index.htm

13. Books Recommended

1. EssentialMATLABforEngineersandScientists,6thEdition,BrianHahn;DanielT.Valentine,Academic Press, Web ISBN-13: 978-0-12-805271-6, available through KAUSTlibrary.
2. Amos Gilat: MATLAB-An Introduction and its Applications, Wiley India Edition.
3. E. Balagurusamy: Programming in ANSI C, McGraw Hill Education, 8th Ed.

1. Name of the Department :						
2. Course Name	Professional ethics and human values	**L**		**T**	**P**	
3. Course Code	17030311	3		0	0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures =		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

This course provides students with the knowledge of ethics in professional and social life. Some of the examples from history and day to day life will make the students more responsible towards their profession, society and family.

9. Course Objectives:

To understand Ethics and Universal Declaration on Bioethics and its need.
To give due regard to nature and other forms of life by protecting the environment and become socially responsible citizens
To inculcate moral and human values for the sustainable growth of the society.

To become Professionally strong by taking responsibility for what they do in there professional and social life.

10. Course Outcomes (COs):

1. The students will understand the values of ethics and moral values deeply.
2. The students will understand the value of environment and respect for nature.
3. The students will realize the values of responsible citizens to work for the society.
4. The students will be able to take strong decisions and perform their duties responsibly as a professional.

11. Unit wise detailed content

Unit-1	**Number of lectures =**	**Title of the unit: Introduction to Ethics and Bioethics**
Introduction, Definition, Understanding Ethics, Medical Ethics and Bioethics, History and Development of Ethics, Universal declaration on Bioethics, Need and Importance of professional ethics.		
Unit –2	**Number of lectures =**	**Title of the unit: Different types of Ethics**
Environmental Ethics, Respect for nature, Respect for cultural diversity and pluralism. Bio-Safety and Ethical use of animals in the laboratory, Disaster Bioethics,Ethics in Media and Technology, Research Ethics, Ethical Issues in Cyber space.		
Unit –3	**Number of lectures =**	**Title of the unit: Value of Human Life**
Human Rights and Values: Autonomy, Consent, Equality, Confidentiality, Vulnerability and Personal Integrity, Religious and Cultural Values, Importance of a Family, Guidance to youngsters, Gender Equality sharing of benefits.		
Unit - 4		**Title of the unit: Professional Ethics**

Professional Ethics and Public Policy, Goals, Dignity of Labour, Responsibilities towards Safety and Risk, Voluntary vs involuntary Risk, Designing and Research ethics, Privacy, Authorship, Intellectual Property Rights.

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

https://www.youtube.com/watch?v=cFOZplkRqsk

https://www.youtube.com/watch?v=Fqt7m8LH5GY

https://www.youtube.com/watch?v=2VYF_t51FyE

https://www.youtube.com/watch?v=9JJykyE2MHw

13. Books Recommended

1. Professional Ethics and Morals by Prof. A.R. Aryasri, Dharanikota Suyodhana – Maruthi Publications.
2. Professional Ethics and Human Values by A. Alavudeen, R.KalilRahman and M. Jayakumaran – University Science Press.
3. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013

Semester-IV

1. Name of the Department: Chemistry						
2. Course Name	Transition Metal & Coordination Chemistry, States of matter & Chemical kinetics	**L**	**T**	**P**		
3. Course Code	17030401	4	0	0		
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course will give an excellent opportunity to study and use the knowledge of Transition Elements,coordination chemistry, Gaseous State, Liquid State, Solid State and Chemical Kinetics.

9. Course Objectives:

The objectives of this course are to:

1. Study the properties of transisition elements.
2. Understand the key features of coordination compounds
3. Discuss the various properties of solids, liquids and gases.
4. Study the reaction rates, theories of reaction rates and different order reactions.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Identify the behavior of transition elements
2. Recognize the types of isomers and nomenclature and applications of coordination compounds.
3. Become familiar with the various applications of molecules in different states.
4. Describe how the rate of a chemical reaction changes as a function of time.

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Transition Elements (3d series)**

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Unit – 2	**Number of lectures = 11**	**Title of the unit: Coordination Chemistry**

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature. Crystal Field Theory, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude

of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

Unit – 3	Number of lectures = 15	Title of the unit: Gaseous Sate and Liquid State

Gaseous State: Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behavior, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical constants and their calculation from van der Waals equation. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions.

Liquid State: Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

Unit – 4	Number of lectures = 15	Title of the unit: Solid State and Chemical Kinetics

Solid State: Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Chemical Kinetics: The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

12. Brief Description of self-learning/ E – learning component

1. https://www.google.com/url?q=https://drive.google.com/open?id%3D1r6jYZJtNeTTav5aIetani3hpEIKz0a-&sa=D&ust=1555314141248000&usg=AFQjCNHmFFiBqYai0X612pGuK5KQgA8iyg
2. 2.https://www.google.com/url?q=https://drive.google.com/open?id%3D1z9E0o8y0prgSNfUS2dNHUL2qYOGmDqOh&sa=D&ust=1555314141234000&usg=AFQjCNEx62Pf-Ce1gLbpmSZClBkKLwBixQ
3. https://www.slideshare.net/shahzad_ali27/chemical-kinetics-32001888
4. https://fns.uniba.sk/fileadmin/prif/chem/kag/Bakalar/vch_noga/GEN_INORG_CHEM15.pdf
5. http://uou.ac.in/sites/default/files/slm/BSCCH-103.pdf

13. Books Recommended

1 Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007), ISBN 9780070647749

2 Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004), ISBN 978-8185015590

3 Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009), ISBN 978-0840048288

4 Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998), ISBN 978-0201044058

5 Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New Delhi (1985), ISBN 978-0023947919.

6 Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley ISBN 978-0471505327

7 Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press, ISBN 978-0198552314

8 Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd ISBN 9788130915852

9 Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008, 978-8131507599

1. Name of the Department : Chemistry						
2. Course Name	Transition Metal & Coordination Chemistry, States of matter & Chemical kinetics Lab			**L**	**T**	**P**
3. Course Code	17030402			0	0	4
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

This course provides practical training in inorganic qualitative analysis, surface tension and viscosity measurements and kinetics of chemical reactions which enable students to solve the technical problems during the separation of mixtures.

9. Course Objectives:

The objectives of this course are to:

1. Identify different cations and anions in an inorganic mixture.
2. Perform experiment on surface tension and viscosity
3. Study the kinetics of chemical reactions.
4. Learn various estimations using gravimetry and complexometric titration

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Separate the components in an inorganic mixture
2. Identify quality of any chemical and any formulation.
3. Apply Arrhenius equation to study different chemical reactions.
4. Perform gravimetry and complexometric titrations for estimation of ions

11. List of Experiments (Student has to perform ten experiments – at least two from each section)

Inorganic Chemistry:

I. Semi-micro qualitative analysis (using H_2S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, K^+

Anions: CO_3^{2-}, S^{2-}, SO_2, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

II. Estimations

1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel (II) or aluminium as oximate in a given solution gravimetrically.
2. Estimation of (i) Mg2+ or (ii) Zn2+ by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.

Physical Chemistry:

I. Surface tension measurement (use of organic solvents excluded)

a. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

b. Study of the variation of surface tension of a detergent solution with concentration.

II. Viscosity measurement (use of organic solvents excluded).

a. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's

viscometer.

b. Study of the variation of viscosity of an aqueous solution with concentration of solute.

III. Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
   a. Acid hydrolysis of methyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Compare the strengths of HCl and H2SO4 by studying kinetics of hydrolysis

12. Brief Description of self-learning/ E – learning component

1. https://amrita.olabs.edu.in/?sub=73&brch=7&sim=31&cnt=1
2. http://chemlab.truman.edu/files/2015/07/edta.pdf

13. Books recommended

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012 ISBN 978-8131773710
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009, ISBN 978-8131723258
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011), ISBN 978-81-265-3016-8.

1. Name of the Department: Physics						
2. Course Name	Waves and Optics	**L**	**T**		**P**	
3. Course Code	17030407	4	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about different types of simple harmonic motion and their superposition, flow of fluids, free forced and resonant oscillation and the phenomenon of interference, diffraction and polarization.

9. Course Objectives:

To impart knowledge about harmonic oscillations, and their superposition, various fluids phenomenon, propagation of sound, and different optical phenomenon.

10. Course Outcomes (COs):

After completion of this course, students will have understanding of

1. Harmonic Oscillator, Superposition of Two Perpendicular Harmonic Oscillations, Wave motion and Sound
2. Phenomenon and application of Fluids
3. Wave Optics, Interference and Michelson's Interferometer
4. Understanding of Diffraction and Polarization.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Harmonic oscillations**

Simple Harmonic Motions: - Simple Harmonic Oscillations. Differential Equation of SHM and its Solution. Amplitude, Frequency, Time Period and Phase. Velocity and Acceleration. Kinetic, Potential and Total Energy and their Time Average Values.

Superposition of Two Perpendicular Harmonic Oscillations:- Superposition of Two Mutually Perpendicular Simple Harmonic Motions with Frequency Ratios 1:1 and 1:2 using Graphical and Analytical Methods. Lissajous Figures and their uses.

Waves Motion- General: Transverse waves on a string, Travelling and standing waveson a string, Normal Modes of a string, Group velocity, Phase velocity, Relation between phase velocity and group velocity, Plane waves, Spherical waves, Wave intensity,

Sound: Simple harmonic motion, forced vibrations and resonance , Fourier's Theorem (Application to saw tooth wave and square wave), Intensity and loudness of sound -Decibels, Intensity levels - musical notes & musical scale, Acoustics of buildings: Reverberation and time of reverberation, Absorption coefficient, Sabine's formula - measurement of reverberation time, Acoustic aspects of halls and auditoria.

Unit – 2	**Number of lectures = 13**	**Title of the unit: Fluids**

Fluids: Surface Tension: Synclastic and anticlastic surface , Excess of pressure, Application to spherical and cylindrical drops and bubbles, variation of surface tension with temperature, Jaegar's method, Viscosity: Rate flow of liquid in a capillary tube - Poiseuille's formula, Determination of coefficient of viscosity of a liquid, Variations of viscosity of a liquid with temperature lubrication, Physics of low pressure - production and measurement of low pressure , Rotary pump, Diffusion pump, Molecular pump, Knudsen absolute gauge, penning and pirani gauge, Detection of leakage.

Unit – 3	**Number of lectures = 13**	**Title of the unit: Wave Optics**

Wave Optics: Electromagnetic nature of light, Definition and Properties of wave front,Huygens Principle

Interference: Interference: Division of amplitude and division of wavefront, Young'sDouble Slit experiment, Lloyd's Mirror and Fresnel's Biprism, Phase change on reflection: Stokes' treatment, Interference in Thin Films: parallel and wedge-shaped films, Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes), Newton's Rings: measurement of wavelength and refractive index,

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determinationof wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit – 4	**Number of lectures = 13**	**Title of the unit: Diffraction and Polarization**

Diffraction: Fresnel Diffraction, Fraunhofer diffraction: Single slit & Diffraction grating, Resolving and Dispersive Power of grating.

Polarization: Transverse nature of light waves, Plane polarized light – production andanalysis, Circular and elliptical polarization, Production of circularly and elliptical polarized light, Double Refraction, Nicol Prism, Retarders (Quarter wave plate and Half wave plate), and Specific Rotation.

12. Books Recommended

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill, ISBN Num. 0070323305 9780070323308
2. Fundamentals of Optics, H.R., Gulati and D.R., Khanna, R. Chand Publication, 1991, ISBN No. 8180450821
3. University Physics, F.W., Sears, M.W., Zemansky and H.D., Young, Addison-Wesley, 1986, ISBN Number 0201603225

13. Online links :

1. https://www.youtube.com/watch?v=nOb_iQjTy-Q&list=PLUl4u3cNGP61R5sPDPKVfcFlu95wSs2Kx
2. https://nptel.ac.in/courses/122105023/
3. https://swayam.gov.in/course/1408-mechanics-heat-oscillations-and-waves
4. https://freevideolectures.com/course/2271/physics-i-oscillations-and-waves
5. https://nptel.ac.in/courses/122103011/52

1. Name of the Department: Physics						
2. Course Name	Waves and Optics Lab	**L**	**T**		**P**	
3. Course Code	17030408	0	0		4	
4. Type of Course (use tick mark)		**Core (√)**	**DSE ()**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

In this paper the experiments based on a theoretical concept of light has been introduced such as determination of wavelength by Biprism, Newton's ring and gratings.

9. Course Objectives:

To understand the working principles of various instruments such as spectrometer, telescope, laser and their use in determination of physical quantities like wavelength, refractive index and resolving power.

10. Course Outcomes (COs):

After performing these experiment, students will be able to implement and demonstrate the use of

1. Optical instruments like Fresnel's biprism
2. Indetermination of various physical quantities related to light and materials
3. Study of double slit interference and thin wire by diffraction method (using He-Ne Laser)
4. Study of Telescope and measurement's Specific rotation and concentration using Polarimeter

11. List of Experiments

1. Wave length of Sodium light by Fresnel's biprism.
2. Velocity of ultrasonic waves by grating formation in CC14.
3. Diameter of Lycopodium powder particles by Carona rings.
4. To study double slit interference by He-Ne laser.
5. Diameter of a thin wire by diffraction method (using He-Ne Laser).
6. Young's modulus by Newton's Rings method.
7. Resolving power of a prism.
8. Thickness of a thin plate using air wedge.
9. Resolving Power of plane transmission grating.

10. To determine the wavelength of a monochromatic light using Newton's Rings.

11. Resolving power of telescope.

12. Measurement of (a) Specific rotation (b)concentration of sugar solution using polarimeter.

13. Ordinary and extra ordinary refractive indices for calcite or quartz.

12. Book Recommended:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill, ISBN No. 0070323305 9780070323308
2. Fundamentals of Optics, H.R., Gulati and D.R., Khanna, R. Chand Publication, 1991, ISBN No. 8180450821.
3. University Physics, F.W., Sears, M.W., Zemansky and H.D., Young, Addison-Wesley, 1986, ISBN No. 0201603225
4. Wave and Optics, Dr. D.C. Tayal, Himalaya Publishing House Pvt. Ltd. 2019, ISBN No. 978-93-5299-710-7.

1. Name of the Department: Mathematics						
2. Course Name	Abstract and Linear Algebra	**L**	**T**		**P**	
3. Course Code	17030409	4	0		0	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials =0**		**Practical = 0**		
8. Course Description:						
This course covers properties of groups, homomorphism and isomorphism of groups, and introduction to rings, fields and covers the concept of Vector spaces, Basis and Dimension of vector spaces, Quotient spaces etc. It also covers Linear Transformations and algebra of linear transformations. This course also covers the concepts of Inner product spaces.						
9. Course Objectives:						
This course aims to provide a first approach to the subject of abstract and linear algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings, fields and some related structures. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill. Linear Algebra course is to present the basic concepts of Vector Spaces and Linear Transformations. The course also presents basic concepts of Inner product Spaces.						
10. Course Outcomes (COs):						
Upon completion of the course, students will be able: 1. To demonstrate knowledge and understanding of groups, subgroups, and order of an element in finite groups. 2. To understand the concept of rings, subrings, integral domains, fields, Euclidean ring and unique factorization domain. 3. To analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces. 4. To use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 10**	**Title of the unit: Groups, Permutations and Alternating groups**				
Definition of a group with example and simple properties of groups, Subgroups, cyclic groups , Cosets, Left and right cosets, Largrage's theorem and its consequences, Normal subgroups, Quotient groups, Permutations groups. Even and odd permutations. Alternating groups, Cayley's theorem, Center of a group and derived group of a group.						
Unit – 2	**Number of lectures = 10**	**Title of the unit: Rings, Integral Domain & Fields**				

Introduction to rings, subrings, integral domains and fields, Characteristics of a ring, ideals (principle, prime and Maximal) and Quotient rings, Field of quotients of an integral domain. Euclidean rings, Polynomial rings.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Vector Spaces, Finite Dimensional vector spaces**

Definition and examples of vector spaces, Subspaces. Sum and direct sum of subspaces, Linear span, Linear dependence and independence and their basic properties, Finite dimensional Vector spaces, Existence theorem for basis, Invariance of the number of elements of a basis set, Quotient spaces. Dimensions of quotient spaces.

Unit – 4	**Number of lectures = 10**	**Title of the unit: : Linear Transformations and Inner Products**

Linear transformations, Null space, Range space of a linear transformation, Rank & Nullity of linear transformation, Matrix of a linear transformation and Change of basis, Algebra of linear transformations, Singular and Non –Singular linear transformation, Eigen values and Eigen vector of linear transformations, Inner product spaces, Cauchy Schwarz inequality, Orthogonal vectors, orthogonal complements, Orthogonal sets, Gram-Schmidt Orthogonalization process.

12. Web Links :

1. https://www.youtube.com/watch?v=vfyUU_prh9s
2. https://www.youtube.com/watch?v=a9LcIKyuHQo

13. Books Recommended

1. N Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. Joseph A. Gallian, Contemporary Abstract Algebra, 4th, Narosa Publishing House, 1999.
3. B. Bhattacharya, S.K. Jain and S.R. Nagpal : Basic Abstract Algebra (2nd edition)
4. A Text Book of Modern Abstract Algebra, Shanti Narayan
5. S.Luther and I.B.S. Passi : Algebra, Vol. II, Narosa Publishing House.
6. John B. Fraleigh, A First course in Abstract Algebra, 7th, Pearson, 2002.
7. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
8. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007
9. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
10. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007

1. Name of the Department: Mathematics						
2. Course Name	Abstract and Linear Algebra Lab	**L**	**T**		**P**	
3. Course Code	17030410	0	0		4	
4. Type of Course (use tick mark)		**Core (✓)**	**DSE ()**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials =0**	**Practical = 52**			
8. Course Description:						
This course covers properties of groups, homomorphism and isomorphism of groups, and introduction to rings, fields and covers the concept of Vector spaces, Basis and Dimension of vector spaces, Quotient spaces etc. It also covers Linear Transformations and algebra of linear transformations. This course also covers the concepts of Inner product spaces.						
9. Course Objectives:						
This course aims to provide a first approach to the subject of abstract and linear algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings, fields and some related structures. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill. Linear Algebra course is to present the basic concepts of Vector Spaces and Linear Transformations. The course also presents basic concepts of Inner product Spaces.						
10. Course Outcomes (COs):						
Upon completion of the course, students will be able to: 1. Demonstrate knowledge and understanding of the concept of cosets of a subgroup of a group, normal subgroups, symmetric groups, cyclic groups and their properties, direct product of groups and quotient groups. 2. Demonstrate knowledge and understanding of rings, subrings, integral domains, fields, Euclidean ring and unique factorization domain. 3. Students in this course will demonstrate ability to work within vector spaces with its properties. 4. Students in this course will demonstrate ability to manipulate linear transformations.						
11. Unit wise detailed content						

Using both MATLAB and Mathematics:

1. To find the determinants of matrices
2. To find the an inverse of matrices
3. To find the rank of the matrices
4. To find the solution of system of linear and non-linear equations
5. To find the eigenvalues and eigenvectors matrices and linear transformations
6. To find the nullity of linear transformations
7. To find the roots of algebraic, Transcendental, Logarithmic equations
8. To find the solution of linear and non-linear differential equations
9. To find the solution of linear and non-linear partial differential equations
10. To solve the definite and indefinite integrals
11. To find the binary numbers
12. To draw the graph of polynomials in one and more than one variables

12. Web Links :

1. https://in.mathworks.com/learn/tutorials/matlab-onramp.html
2. https://www.tutorialspoint.com/matlab/index.htm

13. Books Recommended

1. Amos Gilat: MATLAB-An Introduction and its Applications, Wiley India Edition.
2. E. Balagurusamy: Programming in ANSI C, McGraw Hill Education, 8th Ed.

1. Name of the Department: Physics						
2. Course Name	Computational Physics Skills	**L**	**T**		**P**	
3. Course Code	17030417	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics,						
9. Course Objectives:						
To impart knowledge about various computer programming method to solve problems in physics.						
10. Course Outcomes (COs):						
After completion of this course, students will have understanding of 1. The use of computational methods to solve physical problems 2. Use of computer language as a tool in solving physics problems (applications) 3. Course will consist of hands on training on the Problem solving on Computers,						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction**				
Introduction: Importance of computers in Physics, paradigm for solving physics problems for solution**,** Usage of linux as an Editor, **Algorithms and Flowcharts:** Introduction: Problem formulation, algorithm development, algorithm implementation, and algorithm verification. Structure and documentation Flowchart: Concept of flowchart, symbols, guidelines, types, Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.						
Unit - 2	**Number of lectures = 10**	**Title of the unit: Scientific Programming**				
Scientific Programming: Some fundamental Linux Commands (Internal and External commands), FORTRAN: "Formula Translation". Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and						

program, **Operators**: Arithmetic, Relational, Logical and Assignment Operators, **Expressions**: Arithmetic, Relational, Logical, Character and Assignment Expressions, **Statements**: I/O Statements (non-formatted/formatted), Executable and Non-Executable Statements.

Program creation, compilation and linking. Layout of FORTRAN Program, Format of writing Program and concept of coding, Initialization and Replacement Logic, Implementation issues: compilation errors, segmentation violations, Not-a-Number (NaN), Input/Output (IOSTAT) errors, Runtime errors. Transportable code, standard extensions.

Examples from physics problems.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Control Statements**

Control Statements: Types of Logic (Sequential, Selection, Repetition), **Branching Statements** (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), **Looping Statements** (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), **Jumping Statements** (Unconditional GOTO, Computed GOTO, Assigned GOTO), **Subscripted Variables** (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), **Functions and Subroutines** (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file,

Examples from physics problems along with the following hands on can be done:

1. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN,
2. Short program like To print out all natural even/ odd numbers between given limits, To find maximum, minimum and range of a given set of numbers, Calculating Euler number using exp(x) series evaluate d at x=1.

Unit - 4	**Number of lectures =** 10	**Title of the unit: Scientific word processing**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages, **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors,

Visualization: Introduction to graphical analysis and its limitations, Introduction to Gnuplot, importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Following exercises can be taken for practices:

1. To write sample reports using LaTeX with equations and figures included.

12. Books Recommended

1. Introduction to Numerical Analysis, S,S, Sastry, 5th Edn,, 2012, PHI Learning Pvt, Ltd. ISBN-10 : 9788120345928.
2. Computer Programming in Fortran 77", V, Rajaraman (Publisher:PHI). ISBN-10: 9788120311725.
3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994). ISBN-10: 0201529831.
4. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co. ISBN:007037984X 9780070379848.
5. Computational Physics: An Introduction, R, C, Verma, et al, New Age International Publishers, New Delhi (1999). ISBN-10: 8122416594.
6. A first course in Numerical Methods, U,M, Ascher and C, Greif, 2012, PHI Learning. ISBN-10 : 0898719976.
7. Elementary Numerical Analysis, K,E, Atkinson, 3rd Edn ,, 2007, Wiley India Edition, ISBN-10 : 9758724428.

13. Online Links

1. https://ocw.mit.edu/courses/earth-atmospheric-and-planetary-sciences/12-010-computational-methods-of-scientific-programming-fall-2011/lecture-notes/
2. http://www.physics.ntua.gr/~konstant/ComputationalPhysics/Book/ComputationalPhysicsKNA.html
3. https://www3.nd.edu/~powers/ame.20214/

1. Name of the Department: Physics						
2. Course Name	Applied Optics	**L**	**T**		**P**	
3. Course Code	17030418	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
The course will teach about different types of light source and detectors, fourier transform spectroscopy, holography and the phenomenon of interference, diffraction and polarization.						
9. Course Objectives:						
To impart knowledge about different types of light source and detectors, fourier transform spectroscopy, holography and the phenomenon of interference, diffraction and polarization.						
10. Course Outcomes (COs):						
Students will have understanding of 1. Study of different types of light sources and detectors 2. how to use Fourier transform spectroscopy for analyzing various physical phenomenon related to light 3. Study of different type Holography and it's application in microscopy 4. Study about Optical fibres and their properties, Single mode and multimode fibres and Fibre optic sensors						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 8**	**Title of the unit: Sources and Detectors**				
Sources and Detectors Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser and Semiconductor lasers **Semiconductor Sources and Detectors:** Light Emitting Diode (LED), Solid State Laser, Photovoltaic Cell						
Unit - 2	**Number of lectures**	**Title of the unit: Fourier Optics**				

	=13	

Fourier Optics

Concept of Spatial frequency filtering, Fourier transforming, Harmonic analysis of a signal, Amplitude and phase modulations, Transfer function of free space, Optical Fourier transform, Diffraction & Interference and optical image processing.

Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) with application in atmospheric remote sensing, Nuclear Magnetic Resonance (NMR) Spectroscopy

Unit - 3	**Number of lectures = 9**	**Title of the unit: Holography**

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, Interferometry, and character recognition in-line and off-axis holography; Transmission and reflection holograms, Amplitude and phase holograms

Unit - 4	**Number of lectures = 10**	**Title of the unit: Photonics: Fibre Optics**

Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Dispersion, Attenuation in optical fibre and attenuation limit. Single mode and multimode fibres, Erbium-doped fiber amplifiers and lasers, Fibre optic sensors: Fibre Bragg Grating

12. Books Recommended

1. Fundamental of optics, F, A, Jenkins & H, E, White, 1981, Tata McGraw hill, ISBN 978--470-12212-9
2. LASERS: Fundamentals & applications, K, Thyagrajan & A.K., Ghatak, 2010, Tata McGraw Hill, ISBN No. 978-9385935862.
3. Fibre optics through experiments, M,R., Shenoy, A. Ghatak, S.K., Khijwania, Bishnu P. Pal, 2017, Viva book Pvt. Ltd. ISBN No. 978-8130918112
4. Nonlinear Optics, Robert W, Boyd, (Chapter-I), 2008, Elsevier, ISBN No. 9780123694706.
5. Optics, Karl Dieter Moller, Learning by computing with examples using Maple, 2007, Springer, ISBN No. 0387261680.
6. Optoelectronic Devices and Systems, S.C., Gupta, PHI Learning Pvt, Ltd, 2005, ISBN: 9788120350656
7. Optical Physics, A, Lipson, S. G., Lipson, H. Lipson, 4thEdn., Cambridge Univ, 1996, Press ISBN No. 978-0511763120

13. Online Links

1. https://en.wikipedia.org/wiki/Holography
2. https://www.youtube.com/watch?v=j4qbhVQQdBQ
3. https://www.youtube.com/watch?v=saVE7pMhaxk

1. Name of the Department: Physics						
2. Course Name	Mobile Communications	**L**	**T**		**P**	
3. Course Code	17030419	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 0**	**Practical = 0**			
8. Course Description:						
This course discusses basics of cellular mobile system, radio system design, GSM and wireless systems.						
9. Course Objectives:						
The main objectives of the course are to: 1. Introduce the basics of cellular mobile system 2. Introduce the basics of frequency management and channel assignment 3. Study the modulation and access techniques 4. Study the digital and wireless systems						
10. Course Outcomes (COs):						
1. Students will get knowledge about the Cellular Radio Systems Design 2. Students will get an idea about the antenna structures and the frequency management 3. Students will know about the methods of modulation and access techniques 4. Students will be able to understand the cellular technology used in daily life like GSM, basics of 4G etc.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 12**	**Title of the unit: Basics of Cellular Mobile System**				
Wireless communication systems, Applications of wireless communication systems, Types of wireless communication systems, trends in mobile communication systems. Basic cellular systems, Performance criteria, Uniqueness of mobile radio environment, Operation of cellular systems, analog & digital cellular systems.						
Unit - 2	**Number of lectures = 12**	**Title of the unit: Elements of Cellular Radio System Design**				

Elements of Cellular Radio System Design, Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Hando (mechanism, Cell splitting.

Concept of frequency reuse channels, Co-channel interference reduction factor, Desired C/I from a normal case in an omnidirectional antenna system, Handoff mechanism, Cell splitting.

Unit - 3	**Number of lectures = 10**	**Title of the unit: GSM system overview**

GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM, GPRS and EDGE.

Unit - 4	**Number of lectures = 6**	**Title of the unit: Wireless Networks**

Overview of Wi-Fi, WiMAX and Bluetooth technology (Basic features and physical specifications)

12. Books Recommended

1. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press, UK, 2005, ISBN: 978-0521843478
2. William, C. Y. Lee, "Mobile Cellular Telecommunications", 2nd Edition, McGraw Hill, 1990, ISBN: 978-0071436861
3. "Mobile Communication Hand Books", 2nd Edition, IEEE Press, ISBN: 978-0780310698
4. Theodore S Rappaport, "Wireless Communication Principles and Practice", 2nd Edition, Pearson Education, 2002, ISBN: 9780133755367
5. Kaveh Pahlavan and Prashant Krishnamurthy", Principles of Wireless Networks", PHI, 2001, ISBN: 978-0130930033
6. Lawrence Harte, "3G Wireless Demystified", McGraw Hill Publications, 2001, ISBN: 978-0071363013

13. Online Links

1. https://nptel.ac.in/courses/106105080/pdf/M5L9.pdf
2. http://www.wtec.org/loyola/wireless/chapter02.pdf
3. https://nptel.ac.in/courses/117105077/pdf-m-7/m7l38.pdf

1. Name of the Department: Physics						
2. Course Name	Renewable energy and energy harvesting	**L**	**T**		**P**	
3. Course Code	17030420	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 40	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will focus on the physical principles underlying energy processes. The application of these principles for harvesting energy from various sources will also be discussed.

9. Course Objectives:

To teach students the fundamental laws and physical processes that governs the sources, extraction, storage, and uses of energy.

10. Course Outcomes (COs):

Students will have enhanced their abilities to:

1. Understand how physical principles influence energy use.
2. Understand how to solve the problem of energy demand using various alternatives.
3. Understand the mechanism of energy harvesting,
4. Develop critical thinking and problem solving.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Fossil fuels and Alternate Sources of energy**

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources, renewable energy-sources and features, hybrid energy systems,

Unit – 2	**Number of lectures = 10**	**Title of the unit: Solar energy and Solar Photovoltaic Systems**

Solar energy: Solar radiation spectrum, Radiation measurement, Applications (Heating, Cooling, Drying, Distillation, Power generation)

Solar Photovoltaic systems: Operating principle Photovoltaic cell, concepts Cell, module, array, Series and parallel connections Applications (Battery charging, Pumping, Lighting and

Peltier cooling)

Unit – 3	Number of lectures = 10	Title of the unit: Ocean Energy, Wind Energy, Microhydel and Biomass

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics,

Wind Energy: Wind patterns and wind data, Site selection, Types of wind mills,

Biomass: Learning objectives, Operating principle, Combustion and fermentation, Applications (Bio gas, Wood stoves, Bio diesel and Combustion engine)

Unit – 4	Number of lectures = 10	Title of the unit: Piezoelectric Energy harvesting

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

12. Books Recommended

1. Non-conventional energy sources - G, D Rai - Khanna Publishers, New Delhi, ISBN: 978-81-7409-073-7
2. Solar energy - M P Agarwal - S Chand and Co, Ltd, ISBN: 9788121939713
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd, ISBN 978-1-56720-105-5
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University, ISBN- 9780199261789
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009, ISBN: 978-93-87374-12-6,
6. J, Balfour, M,Shaw and S, Jarosek, Photovoltaics, Lawrence J Goodrich (USA), ISBN: 0750660732

13. Online Links

1. http://en,wikipedia,org/wiki/Renewable_energy
2. https://nptel.ac.in/courses/108108078/

1. Name of the Department: Physics						
2. Course Name	Physical Workshop Skills	**L**	**T**		**P**	
3. Course Code	17030421	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 40	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the practical uses of mechanical, electrical and magnetic equipment which has been beneficial for our everyday life.

9. Course Objectives:

To impart knowledge about various mechanical, electrical and magnetic equipment such as lathe, shaper, drilling, milling and surface machines, Cutting tools, Multimeter, Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB etc.

10. Course Outcomes (COs):

After performing these experiment students will be able to

1. Explain and use various equipment's used for measurement in physics experiments.
2. Hand on the mechanical equipment for manufacturing, cutting, shaping and drilling etc.
3. Use electrical and electronic devices in laboratory.
4. Explain the use of prime movers.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction**

Introduction: Measuring units, conversion to SI and CGS, meter scale, Vernier caliper, Screw gauge and their utility, Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, Sextant and its uses, Characteristics of IR sensor.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Mechanical Skill**

Concept of workshop practice, Overview of manufacturing methods: casting, foundry, machining, forming and welding, Types of welding joints and welding defects, Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood, Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines, Cutting tools, lubricating oils. Cutting of a metal sheet using blade,

Smoothening of cutting edge of sheet using file.		
Unit - 3	**Number of lectures = 10**	**Title of the unit: Electrical and Electronic Skill**
Use of Multimeter, soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB, Operation of oscilloscope, Making regulated power supply, Timer circuit.		
Unit - 4	**Number of lectures = 10**	**Title of the unit: Introduction to prime movers**
Gear system, wheel, Fixing of gears with motor axel, Lever, Lifting of heavy weight using lever, braking systems, working principle of power generation systems, Demonstration of pulley experiment.		

12. Books Recommended

1. A text book in Electrical Technology - B L Theraja – S, Chand and Company. ISBN- 978-8121924405
2. Performance and design of AC machines – M,G, Say, ELBS Edn. ISBN- 978-8123910277
3. Mechanical workshop practice, K,C, John, 2010, PHI Learning Pvt, Ltd. ISBN- 978-8120341661
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn, Editor Newnes. ISBN- 978-1138784727
5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland. ISBN: 978-1845365929

1. Name of the Department: Physics						
2. Course Name	Basic Instrumentation Skills	**L**	**T**		**P**	
3. Course Code	17030422	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (√)**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 40	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the practical uses of mechanical, electrical and magnetic equipment which has been beneficial for our everyday life.

9. Course Objectives:

To impart knowledge about various mechanical, electrical and magnetic equipment such, multimeter, AC millivoltmeter, cathode ray oscilloscope, signal generator and analysis of related instruments etc.

10. Course Outcomes (COs):

After completion of this course, students will be able to

1. Understand the basics of measurement
2. Understand the working of electronic voltmeter
3. Learn the components, working and applications of CRO.
4. Understand the signal generators and analyze the instruments and its practical applications.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Basic of Measurement**

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter**:** Principles of measurement of dc voltage and direct current, ac voltage, alternating current and resistance. Specifications of a multimeter and their significance.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Electronic Voltmeter**

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter**:** Type of AC millivoltmeters:

Unit – 3	Number of lectures = 10	Title of the unit: Cathode Ray Oscilloscope
Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization, Front panel controls, Specifications of a CRO and their significance.		
Unit - 4	**Number of lectures = 10**	**Title of the unit: Signal Generators and Analysis Instruments**
Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis, Digital Multimeter**:** Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter,		

12. Books Recommended

1. A text book in Electrical Technology - B L Theraja - S Chand and Co., ISBN : 978-8121924405
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill, ISBN : 978-0071072700
3. Logic circuit design, Shimon P. Vingron, 2012, Springer, ISBN : 978-3642432569
4. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning, ISBN : 978-8131518076
5. Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill,ISBN : 978-9339219505
6. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer, ISBN : 978-3540004295

13. Online Links

1. http://denethor.wlu.ca/pc320/scope/oscilloscope.pdf
2. http://deltauniv.edu.eg/new/engineering/wp-content/uploads/Oscilloscope.pdf

Semester-V

<table>
<tr><td colspan="8">1. Name of the Department: Physics</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Solid State Physics</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2">17030513</td><td>4</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core ()</td><td>DSE (√)</td><td>AEC ()</td><td>SEC ()</td><td>GE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical</td></tr>
<tr><td colspan="3">Lectures = 52</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description:</td></tr>
<tr><td colspan="8">This course will deepen your understanding of the different types of crystal structures and that will help you to analyze the electrical, mechanical, optical, and magnetic properties of the solids.</td></tr>
<tr><td colspan="8">9. Course Objectives:</td></tr>
<tr><td colspan="8">1. To study the basics of crystallography and lattice dynamics.
2. To understand the diamagnetic, paramagnetic and ferromagnetic properties of the materials
3. To understand the dielectric properties of materials.
4. To study basics of band theory and get familiar with superconducting phenomenon.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">After successful completion of the course, students will
1. have a basic knowledge of crystal systems and will be able to calculate thermal and electrical properties in the free-electron model.
2. understand the magnetic properties of matter and its applications
3. understand the dielectric properties of materials with its applications.
4. know the band theory of solids and theory of superconductivity.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="3">Number of lectures = 13</td><td colspan="4">Title of the unit: Crystal Structure</td></tr>
<tr><td colspan="8">Crystal Structure: Solids: Amorphous and Crystalline Materials, Lattice TranslationVectors, Lattice with a Basis – Central and Non-Central Elements, Unit Cell, Primitive & non-primitive cells Miller Indices, Reciprocal Lattice, Types of Lattices, Brillouin Zones, Diffraction of X-rays by Crystals, Bragg’s Law.

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomicand Diatomic Chains, Acoustical and Optical Phonons, Dulong and Petit’s Law, Einstein and Debye theories of specific heat of solids, T^3 law</td></tr>
</table>

Unit - 2	Number of lectures = 13	Title of the unit: Magnetic Properties of Matter
Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials,Classical Langevin Theory of dia – and Paramagnetic Domains, Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss.		
Unit - 3	**Number of lectures = 13**	**Title of the unit: Dielectric Properties of Materials**
Dielectric Properties of Materials: Polarization, Local Electric Field at an Atom,Depolarization Field, Electric Susceptibility, Polarizability, ClausiusMosotti Equation, Classical Theory of ElectricPolarizability, Normaland Anomalous Dispersion.		
Unit - 4	**Number of lectures = 13**	**Title of the unit: Elementary band theory and superconductivity**
Elementary band theory: Kronig Penny model, Band Gaps, Conductors,Semiconductors and insulators, P and N type Semiconductors, Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient, **Superconductivity:** Experimental Results, Critical Temperature, Critical magnetic field,Meissner effect, Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect.		

12. Books Recommended

9. Introduction to Solid State Physics, Charles Kittel, 8th Ed,, 2004, Wiley India Pvt, Ltd,ISBN : 978-8126535187
10. Elements of Solid State Physics, J,P, Srivastava, 2nd Ed,, 2006, Prentice-Hall of India, ISBN : 978-8120350663
11. Introduction to Solids, Leonid V, Azaroff, 2004, Tata Mc-Graw Hill, ISBN : 978-0882753454
12. Solid State Physics, Neil W, Ashcroft and N, David Mermin, 1976, Cengage Learning, ISBN : 978-9387067721
13. Solid State Physics, Rita John, 2014, McGraw Hill, ISBN : 978-9332901797
14. Elementary Solid State Physics, 1/e M, Ali Omar, 1999, Pearson India, ISBN : 978-0201607338
15. Solid State Physics, M,A, Wahab, 2011, Narosa Publications, ISBN : 978-8184874938

13.Online links

1. https://www.youtube.com/watch?v=qh29mj6uXoM
2. https://www.youtube.com/watch?v=2pCdQ2gkwjQ
3. https://www.youtube.com/watch?v=nBW4max0fuU
4. https://nptel.ac.in/courses/115101012/
5. https://nptel.ac.in/courses/122101001/20

1. Name of the Department: Physics						
2. Course Name	Solid State Physics Lab	**L**	**T**		**P**	
3. Course Code	17030514	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 52**			

8. Course Description:

Experiments include the fundamental of materials used in making solar cell, semiconductor diodes, laser diode etc.

Course Objectives:

To understand the working of solar cell, semiconductor diode laser diode etc. and application of their characteristics in making solid state devices.

10. Course Outcomes (COs):

After performing the experiment, the student will be able to convert solar energy into electrical energy using solar cell, laser diode and design circuits rectifier, amplifier etc.

11. List of Experiments

1. Verification of inverse square law by photo-cell.
2. To study the characteristics of a solar cell.
3. To draw forward and reversed bias characteristics of a semiconductor diode.
4. Zener Diode voltage regulation characteristics.
5. E.C.E. of hydrogen using Ammeter.
6. Low resistance by Carey Foster's Bridge with calibration.
7. Frequency of A.C. mains and capacity by electrical vibrator.
8. Frequency of A.C. mains by sonometer using an electromagnet.
9. Measurement of angle dip by earth Inductor.
10. To study Hall effect.

12. Book Recommended:

11. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House, ISBN : 978-0423738902.
12. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers, ISBN : 978-0435686666.
13. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Ed., 2011, KitabMahal, New Delhi, ISBN : 978-8122504163.
14. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India, ISBN : 978-8120350663.

1. Name of the Department: Physics						
2. Course Name	Atomic, Molecular and Laser Physics	**L**	**T**		**P**	
3. Course Code	17030515	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

Atom and molecule are the fundamental unit for all matters in universe. Matter, whatever the states, is made of atoms. The properties of all matters are governed by the electronic structure of atom and molecule. They have individual properties like electronic, magnetic and optical properties, which are quite different from the collective properties of matter made of atoms and molecules. This course will enlighten the knowledge of atoms and molecules and build up the pre-requisite knowledge for all science and engineering field.

9. Course Objectives:

1. Comparing between atomic emission spectroscopy and atomic absorption spectroscopy; Optical spectroscopy, Atomic spectrum.
2. Molecular spectroscopy.
3. Theory of magnetic energy, Anomalous Zeeman's effect and Landue splitting.factor.
4. Working principle of different types of laser and its applications.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to

1. Describe theories explaining the structure of atoms and the origin of the observed spectra.
2. Explain the observed dependence of atomic spectral lines on externally applied electric and magnetic fields
3. Understand the basics of Laser.
4. Explain different Laser used and make a comparison between them.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Atomic spectroscopy**

Basic concept of atom model and need of vector atom model, Vector atom model, Quantum numbers associated with vector atom model, Penetrating & non- penetrating orbits, Alkali spectra (Description), Spectral lines in different series of alkali spectra, Spin orbit interaction and doublet term separation, LS coupling and jj coupling description, Expression for interaction energy in LS

coupling, Expression for interaction energy in jj coupling.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Molecular Spectroscopy**

Normal Zeeman effect, Anomalous Zeeman Effect, Zeeman pattern of D_1 and D_2 lines of Na atom, Paschen Back effect of a single valance electron system, Weak field Stark effect of H-atom, Discrete set of electronic energies of molecules, Quantization of vibrational energies, Quantization of rotational energies, Raman effect (Quantitative Description), Stokes and Anti-stokes lines.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Basics of lasers**

Main features of Laser (Directionality and Intensity), Main features of Laser (Monochromaticity and Coherence), Einstein coefficients and possibility of amplification, Momentum transfer & life time of a level absorption, Kinetics of optical, Laser pumping.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Working of lasers**

RUBY Laser (Principle, construction & working), He-Ne Laser (Principle, construction & working), CO_2 Laser (Principle, construction & working), Semiconductor Laser (Principle, construction & working), Application of Laser in the field of medicine and industry.

12. Books Recommended

1. Jain, V,K, Introduction to Atomic and Molecular Spectroscopy, New Delhi: Narosa, ISBN : 978-8173197758
2. White, H E, Introduction to Atomic Spectra, ISBN: 978-9352604777
3. Herzberg, G, Molecular Spectra and Molecular Structure, ISBN : 978-0486601151
4. Banwell, Fundamentals of Molecular Spectroscopy, ISBN : 978-9352601738
5. Thyagrajan and Ajay Ghatak, Lasers, Theory and Applications, 2nd ed, ISBN : 978-1461426943
6. Laud, B,B, Laser and Nonlinear Optics, 2nd ed, ISBN : 978-8122430561

13. Online links

1. https://nptel.ac.in/courses/104104085/
2. https://nptel.ac.in/courses/115105100/56

1. Name of the Department: Physics						
2. Course Name	Atomic, Molecular and Laser Physics Lab	**L**	**T**		**P**	
3. Course Code	17030516	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

Experiments based on atomic and molecular physics and related topics such as determination of e/m ratio by Thomson method, basic characteristics of G.M counter etc.

9. Course Objectives:

To learn by performing experiment based on G.M. Counter, cathode ray oscilloscope, spectrometer etc..

10. Course Outcomes (COs):

After performing these experiment students will be able to demonstrate the experiment and their practical applications.

11. List of Experiments

1. e/m by Thomson method.
2. To draw the Plateau of G.M. Counter
3. To determine the Mass attenuation coefficient by G.M. Counter.
4. Transistor as voltage Amplifier in C-B configuration.
5. Transistor as voltage Amplifier in C-E configuration.
6. Study of B-H Curve by C.R.O.
7. Study of Hartley Oscillator (Calibration of Gang Condenser).
8. Measurement of Energy Gap of Four Probe Method.
9. Characteristics of PNP transistor.
10. Rydberg constant by Hydrogen gas spectrum.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House, ISBN : 978-0423738902.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers, ISBN : 978-0435686666.
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Ed., 2011, KitabMahal, New Delhi, ISBN : 978-8122504163.
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India, ISBN : 978-8120350663.

1. Name of the Department: Physics						
2. Course Name	Digital and analog electronic circuit and instrumentation	**L**	**T**		**P**	
3. Course Code	17030517	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will teach about the fundamental concept of digital electronics, semiconductor devices, operational amplifiers and their subsequent development in applications in various field like integrated circuit design, constant power supply design etc.

9. Course Objectives:

The aim of this course is to understand the basic concepts for the development of different types of

1. digital electronic circuits
2. semiconductor devices
3. operational amplifiers
4. instrumentations e.g. CRO, rectifiers and zener diode

10. Course Outcomes (COs):

After going through this course the student will be able to

1. implement the basic concepts of digital electronics and understand the working of logic circuits.
2. understand the working principle of semiconductor devices, LED, photodiode and solar cell.
3. learn about operational amplifiers and its applications.
4. understand the basics of instrumentations e.g. CRO, rectifiers and Zener diodes.

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Digital Circuits**

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates, De Morgan's Theorems. Boolean Laws.

Simplification of Logic Circuit using Boolean Algebra. Fundamental Products: Minterms and Maxterms. Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition. Binary Subtraction using 2's Complement Method).Half Adders and Full Adders and Subtractors,

Unit - 2	**Number of lectures = 14**	**Title of the unit: Semiconductor Devices and Amplifiers**

Semiconductor Diodes: p and n type semiconductors. Barrier Formation in pn Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell. Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point.

Unit - 3	**Number of lectures = 14**	**Title of the unit: Operational Amplifiers**

Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop& Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Sinusoidal Oscillators: Barkhausen's Criterion for Self-sustained Oscillations.Determination of Frequency of RC Oscillator

Unit - 4	**Number of lectures = 10**	**Title of the unit: Instrumentations**

Introduction to CRO: Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. Power Supply: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation.

12. Books Recommended

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill, ISBN : 978-0074622452
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill, ISBN : 978-9339219505
3. Microelectronic Circuits, M.H. Rashid, 2nd Edn.,2011, Cengage Learning, ISBN : 978-0534951740
4. Modern Electronic Instrumentation & Measurement Tech., Helfrick & Cooper, 1990, PHI Learning, ISBN : 978-9332556065
5. Digital Principles & Applications, A.P. Malvino, D.P. Leach &Saha, 7th Ed., 2011, Tata McGraw Hill, ISBN : 978-9339203405
6. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd., ISBN : 978-8120352681
7. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd., ISBN : 978-9332549913

13. Online links
1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec08.pdf
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/lecture-notes/MIT6_012F09_lec07.pdf
3. https://www.youtube.com/watch?v=3nk1RK0uArY

1. Name of the Department: Physics						
2. Course Name	Digital and analog electronic circuit and instrumentation Lab	**L**	**T**		**P**	
3. Course Code	17030518	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

Experiments include the fundamental of different types of digital circuits and their design, V-I characteristics of transistors and diodes, and basics of operational amplifiers.

9. Course Objectives:

To understand the working principles of different types of logic gates, operational amplifiers transistors and diodes like pnp, npn, LED and Photo diodes and implement them into practically working equipment which is helpful in our daily life.

10. Course Outcomes (COs):

After successful completion of the course, students will be able to:

1. Apply the concepts of basic electronic devices and digital electronics to design various electronic circuits.
2. Understand operation of diodes, transistors in order to design basic circuits.
3. To investigate the use of different types of operational amplifier

11. List of Experiments

1. Adder-Subtractor using Full Adder I.C.
2. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. To minimize a given logic circuit: Half adder, Full adder and 4-bit Binary Adder..
5. To study IV characteristics of PN diode, Zener and Light emitting diode
6. To study the characteristics of a Transistor in CE configuration.
7. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.

8. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
9. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
10. To study a precision Differential Amplifier of given I/O specification using Op-amp.
11. To investigate the use of an op-amp as a Differentiator

12. Book Recommended:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill, ISBN - : 978-0074624982
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall, ISBN : 978-8120300828
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall, ISBN : 978-9332549913
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill, ISBN : 978-0070634244

1. Name of the Department: Mathematics						
2. Course Name	Discrete Mathematics	**L**	**T**		**P**	
3. Course Code	17030519	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 50		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

The purpose of this course is to understand and use (abstract) discrete structures that are backbones of computer science. In particular, this class is meant to introduce logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in computer science.

9. Course Objectives:

1. Express a logic sentence in terms of predicates, quantifiers, and logical connectives
2. Apply the operations of sets and use Venn diagrams to solve applied problems; solve problem using the principle of inclusion-exclusion.
3. Apply rules of inference, tests for validity, and methods of proof including direct and

10. Course Outcomes (COs):

Upon completion of the course, students will be able:

1. To write an argument using logical notation and determine if the argument is or is not valid.
2. To demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.
3. To understand the basic principles of sets and operations in set.
4. To demonstrate an understanding of relations and functions and be able to determine their properties.

11. Unit wise detailed content

Unit-1	**Number of lectures =15**	**Title of the unit: Principle of inclusion and exclusion**
Set, Principle of inclusion and exclusion, Equivalence relation and partition ,Denumerable sets, Partial order relation, Mathematical Induction, Pigeon hole principle and its application		
Unit – 2	**Number of lectures = 10**	**Title of the unit: Different type of Proposition**
Proposition, Logical operation, logical equivalence. Conditional proposition, Tautologies and Contradiction, Quantifier, Predicates and validity		
Unit – 3	**Number of lectures = 15**	**Title of the unit: Basic theory of graph**
.Permutation and Combination, Probability, Basic theory of graph, and rings		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Different type of relation**

Discrete numeric function, Generating function, recurrence relation with constant coefficients, Homogeneous Solution, Particular Relation, Total relation
12. Brief Description of self-learning / E-learning component https://www.linkedin.com/company/edureka https://goo.gl/forms/ZmLB2XwoCIKppDh92
13. Books Recommended
1.J.P Tremblay and R, Manohar: Discrete Mathematics Structure with application to Computer science, McGraw-Hill book 2. Babu Ram: discrete Mathematics, Vinayak Publishers and Distributor Delhi 3. C.L Liu: elements of Discrete Mathematics, McGraw-Hill Book Delhi

1. Name of the Department: Mathematics						
2. Course Name	Discrete Mathematics Lab	**L**	**T**		**P**	
3. Course Code	17030520	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd **(✓)**	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical =35**			

8. Course Description:

The purpose of this course is to understand and use (abstract) discrete structures that are backbones of computer science. In particular, this class is meant to introduce logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in computer science.

9. Course Objectives:

1. Express a logic sentence in terms of predicates, quantifiers, and logical connectives
2. Apply the operations of sets and use Venn diagrams to solve applied problems; solve problem using the principle of inclusion-exclusion.
3. Apply rules of inference, tests for validity, and methods of proof including direct and

10. Course Outcomes (COs):

1. Write an argument using logical notation and determine if the argument is or is not valid
2. Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described
3. Understand the basic principles of sets and operations in set
4. Demonstrate an understanding of relations and functions and be able to determine their properties.

11. Discrete Mathematics Lab Syllabus:

Practical Based on Syllabus: Programming in "C" or Applying software packages for problems based on Theory paper Discrete Mathematics.

Use of Mathematical Software packages such as MINITAB, SPSS, Statgraf, MATLAB, PYTHON, MATHEMATICA, SCILAB, MAPLE etc.

Practical Exercises for Mathematical techniques based on topics in paper Discrete Mathematics.

Note:

1. At least eight experiments are to be performed in the semester.

2. At least four experiments are based on Software and remaining experiments may be based on conventional methods.
3. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the department as per the scope of the syllabus.

11. Brief Description of self-learning / E-learning component:

https://www.linkedin.com/company/edureka

https://goo.gl/forms/ZmLB2XwoCIKppDh92

12. Books Recommended

1. J.P Tremblay and R, Manohar: Discrete Mathematics Structure with application to Computer science, McGraw-Hill book
2. Babu Ram: discrete Mathematics, Vinayak Publishers and Distributor Delhi
3. C.L Liu: elements of Discrete Mathematics, McGraw-Hill Book Delhi

1. Name of the Department: Mathematics						
2. Course Name	Operations Research	**L**	**T**		**P**	
3. Course Code	17030521	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

Operations Research is a science of modeling and optimization. It allows you to model real-world problems by using mathematics, statistics, and computers. It provides you tools and theories to solve these real-world problems by finding the optimal solutions to the model's subject to constraints of time, labor, resource, material, and business rules. With Operations Research, people make intelligent decisions to develop and manage their processes.

9. Course Objectives:

This module aims to introduce students to use quantitate methods and techniques for effective decisions making; model formulation and applications that are used in solving decision making problems.

10. Course Outcomes (COs):

On successful completion of this course, students will be able to:

1. Formulate and solve mathematical model (linear programming problem) for a physical situation like production, distribution of goods and economics.
2. Apply the concept of simplex method and its extensions to dual simplex algorithm.
3. Solve the problem of transporting the products from origins to destinations with least transportation cost.
4. To understand the basic concept of Convex set.

11. Unit wise detailed content

Unit-1	**Number of lectures =15**	**Title of the unit: Linear Programming**

Operations research and its scope, Necessity of operations research in industry. Linear programming problems Formulation and Graphical Solution.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Simplex & Duality Theory**

Simplex method, Theory of simplex method, Big-M and Two-Phase methods, Dual simplex method, Duality theory.

Unit – 3	**Number of lectures = 15**	**Title of the unit: Assignment Problem and Transportation Problem**

Initial basic feasible solutions of balanced and unbalanced assignment problems, Optimal solutions, multiple solutions & unbalanced assignment problems.

Initial basic feasible solutions of balanced and unbalanced transportation problems, multiple solution & Optimal solutions.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Convex Sets & Sequencing**
Convex sets, Convex linear combination, convex hull, hyper plane, theorems on convex sets, Sequencing problems.		

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

https://www.youtube.com/watch?v=VNr4wGJTeSE

https://www.youtube.com/watch?v=bPyzoklsfCM

https://www.youtube.com/watch?v=a2QgdDk4Xjw

13. Books Recommended

1. Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004).
2. Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).
3. S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd, New Delhi.
4. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
5. Taha H.A., Operations Research-An Introduction, PHI (2007)

1.Name of the Department: Mathematics						
2.Course Name	Operations Research Lab	**L**	**T**		**P**	
3.Course Code	17030522	0	0		4	
4.Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5.Pre-requisite (if any)		**14. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
6.Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 35**		

7.Course Description:

Operation Research Lab helps the students to understand the beauty of Math application.

Operations Research is a science of modeling and optimization. It allows you to model real-world problems by using mathematics, statistics, and computers. It provides you tools and theories to solve these real-world problems by finding the optimal solutions to the model's subject to constraints of time, labor, resource, material, and business rules. With Operations Research, people make intelligent decisions to develop and manage their processes.

8.Course Objectives:

This module aims to introduce students to use quantitative methods and techniques for effective decisions making; model formulation and applications that are used in solving decision making problems.

9.Course Outcomes (COs):

On successful completion of this course, students will be able to:

Solve the problem on the software like (Maxima, LINGO, MAPLE, Mathematica. MATLAB, PYTHON)

10. OR LAB: At least 08experiments from the following:

1. To determine feasible area by LLP
2. To determine feasible area through graphical solution
3. To solve the LPP by Simplex Method
4. To solve the LPP by Dual Simplex Method
5. To solve the LPP by Two Phase Method
6. To solve the LPP by Big M Method
7. Determine the feasible solution of balanced and unbalanced assignment problem
8. Solve the feasible solution by Transportation Problem.
9. Determine the sequencing problem of m jobs and n machine
10. To solve the feasible area by using the property of Convex set.

11. E-learning resources

https://www.youtube.com/watch?v=kavYLZatz44

https://www.youtube.com/watch?v=IuEOMyGuuIg

https://www.youtube.com/watch?v=LzKcFYlw_5A

12.Books Recommended

1. Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004).

2. Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).

3.S.S. Rao, Optimization Theory and Applications, Wiley Eastern Ltd, New Delhi.

4. G. Hadley, Linear Programming, Narosa Publishing House, 1995.

5.Taha H.A., Operations Research-An Introduction, PHI (2007)

1. Name of the Department: Mathematics						
2. Course Name	Probability & Statistics	**L**	**T**		**P**	
3. Course Code	17030523	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course provides a solid undergraduate foundation in both probability theory and mathematical statistics. Topics include: Basics in probability theory, random variables, expectation and variance, special probability distributions.

9. Course Objectives:

1. To develop the skills of the students in the area of Probability and Statistics
2. To expose the students to the basics of probability distributions and application of family of random variables in real life situations
3. Students should understand basic concepts in probability theory and mathematical statistics learn commonly used probability distributions.

10. Course Outcomes (COs):

After successfully completing of this course, students will be able:

1. To enable to the basic concept of theory of probability.
2. To acquire knowledge of Sheppard's correction and Skewness and Kurtosis.
3. To know about Expectation and generating function.
4. To understand the concept of Binomial, Poisson and Normal distributions.

11. Unit wise detailed content

Unit-1	**Number of lectures = 15**	**Title of the unit: Probability and Random Variables**

Theory of Probability, Law of total and compound probability, Conditional Probability, Baye's theorem, Random variable, Discrete random variable, Continuous random variable, Distribution function.

Unit - 2	**Number of lectures = 10**	**Title of the unit: Measure of central tendency**

Measures of central tendency, Measures of dispersion, Moments, Sheppard's correction (without proof), Skewness and Kurtosis.

Unit - 3	**Number of lectures = 10**	**Title of the unit: Expectation and generating Function**

Mathematical expectation, Addition and Multiplication theorem of expectation, Moment generating functions, Cumulants and Cumulant generating functions.

Unit - 4	**Number of lectures = 15**	**Title of the unit: Discrete and Continuous Probability Distributions**

Discrete and Continuous probability distributions: Binomial, Poisson and Normal distributions with important properties. Fitting of Binomial, Poisson and Normal distributions.

12. E – learning Resources

https://www.youtube.com/watch?v=L5JUUNQ5ahg

https://www.youtube.com/watch?v=nVUGzNxXY3c

https://www.youtube.com/watch?v=prcXGK5FW3o

https://www.youtube.com/watch?v=O-YhNpy7z3I

13. Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi
3. Gupta, S.C. and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2008.
4. M. Alexander, Gray bill Franklin, Boes C. Duane,Introduction to the theory of Statistics, McGraw Hill & Co., 3rd edition.
5. Richard Arnold Johnson, Irwin Miller, John E. Freund, Miller And Freund's Probability and Statistics For Engineers, 8 illustrated, Prentice Hall, 2011
6. William Feller, An introduction to probability theory and its applications, Vol. I , 3rdedition, John Wiley & Sons.

1.Name of the Department: Mathematics						
2.Course Name	Probability & Statistics Lab	**L**	**T**		**P**	
3.Course Code	17030524	4	0		0	
4.Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical						
Lectures =		**Tutorials = 0**		**Practical =35**		

8.Course Description:

This course provides a solid undergraduate foundation in both probability theory and mathematical statistics. Topics include: Basics in probability theory, random variables, expectation and variance, special probability distributions.

9. Course Objectives:

1. To develop the skills of the students in the area of Probability and Statistics.
2. To expose the students to the basics of probability distributions and application of family of random variables in real life situations.
3. Students should understand basic concepts in probability theory and mathematical statistics learn commonly used probability distributions.

10.Course Outcomes (COs):

After successfully completing of this course, students will be able:

1. To apply the knowledge gained in Probability theory in Medical Sciences.
2. To familiarize the students with the Statistical tools in MS-Excel / SPSS.

Preparation of frequency table
Tabulation of data.
Graphical representation of data by:
Histogram, Frequency polygon, Frequency Curve, O gives
Diagrammatic representation of data by: Simple Bar Diagram, Sub-divided Bar Diagram
Multiple Bar diagrams, Squares, Circles and Pie-diagrams.
Determination of Mean: Arithmetic Mean and Combined mean, Geometric Mean, Harmonic Mean
Median, Mode
Quartiles, Deciles and Percentiles.
Measures of Dispersion: Range, Standard deviation and combined standard deviation
Mean deviation, Quartile deviation, Coefficient of variation.
Computation of first four moments,

Measures of Skewness and Kurtosis.

12. E-Learning Resources

https://www.youtube.com/watch?v=_avkg8ILpXs
https://www.youtube.com/watch?v=cEGVeJPO5Js
https://www.youtube.com/watch?v=_vxbYw9R84w

13. Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.
2. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH *Publishing*, New Delhi
3. Gupta, S.C. and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2008.
4. M. Alexander, Gray bill Franklin, Boes C. Duane,Introduction to the theory of Statistics, McGraw Hill & Co., 3rd edition.
5. Richard Arnold Johnson, Irwin Miller, John E. Freund, Miller And Freund's Probability and Statistics For Engineers, 8 illustrated, Prentice Hall, 2011
6. William Feller, An introduction to probability theory and its applications, Vol. I , 3rdedition, John Wiley & Sons.

1. Name of the Department : Chemistry						
2. Course Name	Analytical Methods in Chemistry		**L**		**T**	**P**
3. Course Code	17030525		4		0	0
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 52	**Tutorials = Nil**	**Practical = Nil**

8. Course Description:

This course provides an excellent opportunity to learn about Sampling, evaluation of analytical data, analyzing and identifying samples using different spectroscopic techniques like Infra-red, UV, Visible, flame absorption spectrometry. This course also emphasizes on applications of thermogravimetry, electrochemistry and separation methods like chromatography**.**

9. Course Objectives:

The objectives of this course are to:

1. Learn the basic principles of different instrumentation.
2. Introduce Origin of spectra, fundamental laws of spectroscopy and selection rules and theory of thermogravimetry (TG) and its application.
3. Understand the mechanism and efficiency of separation techniques like solvent extraction, chromatography.
4. Introduce electro analytical methods to study different types of titrations.
5. Learn the basic principle of flame photometry, techniques of atomization and principles of chromatography.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to

1. Identify choice of source, monochromator and detector for single and double beam instrument in spectrometry.
2. Use Flame photometers for the quantitative estimation of trace level of metal ions from water samples
3. Calculate Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents.
4. Understand the basic principle of chromatography

11. Unit wise detailed content

Unit-1	**Number of lectures = 08**	**Title of the unit: Qualitative and quantitative aspects of analysis**

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Unit – 2	**Number of lectures = 20**	**Title of the unit: Optical methods of analysis**

UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.

Basic principles of quantitative analysis: Estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromator, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Thermal methods of analysis and Electroanalytical methods**

Theory of thermogravimetry (TG), basic principle of instrumentation.Techniques for quantitative estimation of Ca and Mg from their mixture. Classification of electro analytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Unit – 4	**Number of lectures = 14**	**Title of the unit: Separation Techniques**

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.

Chromatography: Classification, principle and efficiency of the technique, Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC,

GLC, GPC, TLC and HPLC.Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess

12. Brief Description of self-learning/ E – learning component

1. http://www.oswego.edu/~kadima/CHE425/chapter1_all_one%20slide%20per%20handout.pdf
2. http://web.iitd.ac.in/~sdeep/Electronic.pdf
3. https://nptel.ac.in/courses/103108100/module5/module5.pdf
4. https://nptel.ac.in/courses/103108100/module4/module4.pdf

13. Books Recommended

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook ofQuantitative Chemical Analysis, John Wiley & Sons, 1989 ISBN 978-0582446939
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods ofAnalysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California,USA, 1988, ISBN 978-0534081423
3. Christian, G.D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York,2004 ISBN 978-0471214724
4. Harris, D. C. Exploring Chemical Analysis, Ed. New York, W.H. Freeman,2001, ISBN 978-0716705710
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age,International Publisher, 2009, ISBN 978-1906574000
6. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis,Cengage Learning India Ed. ISBN 978-0495012016
7. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods,Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979, ISBN 978-0853120803
8. 8. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974, ISBN 978-0442221584

1. Name of the Department: Chemistry						
2. Course Name	Analytical Methods in Chemistry Lab		**L**	**T**		**P**
3. Course Code	17030526		0	0		4
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals.						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

Practical work has had a central and distinct role in chemistry education (from school to university) for more than a century. The aim of chemistry is to increase our understanding of the composition, properties and change of matter. Claims and explanations in chemistry should be supported by observational data.

The module designed here for students is to understand the basic principles and learn the experimental techniques of classical titrimetric and gravimetric methods of analysis. The student will also be introduced to common instrumental techniques including chromatography, spectrophotometry, ion exchange resins and electro-analytical methods.

9. Course Objectives:

The objectives of this course are to:

1. Understand the basic principles and learn the experimental techniques of classical titrimetric methods of analysis
2. Understand the theory behind the instrumental techniques of chromatography, spectrophotometry, ion exchange and electro-analytical methods
3. Perform experiments with samples of water to determine BOD, COD, and dissolved oxygen.
4. Study and apply the principle of complexometry for detecting metals in samples at the ppm level.
5. Use flame photometry method for detecting alkali metals in sample as they give characteristic colors in flame.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Refer to the chemical theory behind the use of modern instrumental techniques for quantitative chemical analysis.
2. Identify and estimate traces of metals using the theory of complexation with EDTA
3. Determine Na, Ca and Li in fruit juices and cola drinks by applying flame photometric technique.
4. Use chromatography to separate mixtures of metal ions, dyes, sugars, amino acids and various other samples and calculate their Rf values.

11.List of Experiments (Student has to perform ten experiments – at least two from each section)

I. Chromatography

1. Paper chromatographic separation of Fe3+, Al3+, and Cr3+.
2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
3. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
4. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

II. Solvent Extractions:

1. To separate a mixture of Ni2+ & Fe2+ by complexation with DMG and extracting the Ni2+-DMG complex in chloroform, and determine its concentration by spectrophotometry.
2. Solvent extraction of zirconium with amberlite LA-1, separation from a mixture of irons and gallium.
3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

III. Ion exchange:

I. Determination of exchange capacity of cation exchange resins and anion exchange resins.

II. Separation of metal ions from their binary mixture.

III. Separation of amino acids from organic acids by ion exchange chromatography.

IV. **Spectrophotometr**y

1. Determination of pKa values of indicator using spectrophotometry.
2. Structural characterization of compounds by infrared spectroscopy.
3. Determination of dissolved oxygen, (COD) and (BOD).in water.
4. Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job's method.

12. Brief Description of self-learning/ E – learning component

1. http://www.egyankosh.ac.in/bitstream/123456789/15886/1/Experiment-5.pdf
2. http://www.cee.ntu.edu.sg/aboutus/CEELabs/Env/Documents/LabManu/CV2701%202A-6.pdf
3. https://pubs.acs.org/doi/abs/10.1021/ed007p724

13. Books Recommended

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. Vogel's Textbook of Quantitative Chemical Analysis, John Wiley & Sons, 1989, ISBN 978-0582446939
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988 ISBN 978-0534981440
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004, ISBN 978-0471214724
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001, ISBN 978-0716705710
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009, ISBN 978-1906574000
6. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed., ISBN 978-0495012016
7. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979, ISBN 978-0853120803
8. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974, ISBN 978-0442221584

1. Name of the Department: Chemistry						
2. Course Name	Molecules of Life	**L**	**T**		**P**	
3. Course Code	17030527	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 52		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

The complexity of even the simplest life forms, the single cell, cannot be overstated. From a chemical perspective, cellular components can be segregated into macromolecules (DNA, RNA, proteins etc.) and relatively simpler molecules (amino acids, monosaccharaides and lipids). This course highlights the classification, synthesis, structure and properties of these molecules of life. This course also includes the chemistry of these biomolecules and their roles in metabolism.

9. Course Objectives :

The objectives of this course are:

1. To study the classification and general properties of carbohydrates, proteins, amino acids, enzymes and lipids.
2. To determine the primary structure and synthesis of peptides.
3. To understand the mode of action of enzymes.
4. To understand how DNA carries genetic information.
5. To understand the interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to

1. Identify the different biomolecules and elucidate their structure.
2. Explain Specificity of enzyme action, Enzyme inhibitors and their importance.
3. Calculate saponification value and iodine number and gain knowledge about Nucleic acids and DNA.
4. Describe the Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs cycle, and other biomolecules.

11. Unit wise detailed content

Unit-1	**Number of lectures = 20**	**Title of the unit: Carbohydrates and Proteins**

Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosaccharaides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch

and cellulose) excluding their structure elucidation.

Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoinand with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (tbutyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

Unit – 2	Number of lectures = 12	Title of the unit: Enzymes and correlation with drug action
Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH2 group, double bond and aromatic ring,		
Unit – 3	**Number of lectures = 10**	**Title of the unit: Nucleic Acids and lipids**
Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation. Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Concept of Energy in Biosystems**
Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change.Conversion of food into energy. Outline of catabolic pathways of Carbohydrate-Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.		

12. Brief Description of self-learning/ E – learning component

1. https://www.chem.purdue.edu/courses/chm333/
2. https://ocw.mit.edu/high-school/biology/exam-prep/molecular-genetics/rna-dna-structure-function/

13. Books Recommended

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), ISBN 978-8131704813
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 98, ISBN 978-8177585421
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt.Ltd. (Pearson Education), ISBN 978-8177585414.
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed.,W. H. Freeman, ISBN 978-1464187964.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002, ISBN 978-0716746843

1. Name of the Department: Chemistry						
2. Course Name	Molecules of Life Lab	**L**	**T**		**P**	
3. Course Code	17030528	0	0		4	
4. Type of Course (use tick mark)	**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**	
5. Pre-requisite	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

Practical work has had a central and distinct role in chemistry education (from school to university) for more than a century. The aim of chemistry is to increase our understanding of the composition, properties and change of matter. Claims and explanations in chemistry should be supported by observational data.
This course provides practical training to the students to use various methods to estimate, separate, detect or analyze samples containing biomolecules. Different techniques like chromatography, extraction method, acid base titrations, organic synthesis are introduced.

9. Course Objectives:

The objectives of this course are to:

1. Independently carry out organic synthesis
2. Enable students to prepare their own solutions for experiment having complete knowledge about normality, molality, molarity, mole fraction as measures of concentration.
3. Plan and carry out acid-base titrations; justify choice of indicator and interpret titration curve
4. To differentiate the reducing and non-reducing sugar.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Prepare Biochemical reagent for various solutions with respect to different Normality, Molarity, % Solutions (W/V), (V/V) & Numericals.
2. Perform titrations with suitable indicators to detect the sharp end point and quantitatively estimate the desired samples.
3. Use chromatographic methods to separate mixture of amino acids.
4. Determine iodine value and saponification value of fat/oil.

11. List of Experiments

1. Separation of amino acids by paper chromatography
2. To determine the concentration of glycine solution by formylation method.
3. Study of titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. To determine the saponification value of an oil/fat.
7. To determine the iodine value of an oil/fat
8. Differentiate between a reducing/ nonreducing sugar.
9. Extraction of DNA from onion/cauliflower
10. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC.

12. Brief Description of self-learning/ E – learning component

1. https://eprayoglekha.org/demo/pdf/Experiment3.pdf
2. http://egyankosh.ac.in/bitstream/123456789/15897/1/Experiment-12.pdf
3. http://www.collectionscanada.gc.ca/eppp-archive/100/205/301/ic/cdc/science/english/bio/projects/genetics.html

13. Books Recommended

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS.
2. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press. ISBN 978-8173714757

1. Name of the Department: Chemistry						
2. Course Name	Quantum Chemistry, Spectroscopy & Photochemistry		**L**	**T**		**P**
3. Course Code	17030529		4	0		0
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course is divided into three different sections,

The first unit deals with the introduction to the quantum mechanical model of the atom: Thinking about electrons as probabilistic matter waves using the de Broglie wavelength, the Schrödinger equation, and the Heisenberg's Uncertainty Principle.

The second part focuses on the five key spectroscopic methods used by chemists and biochemists to analyse the molecular and electronic structure of atoms and molecules. These are Vibrational, Rotational, Electronic, Raman and Nuclear Magnetic Resonance (NMR) spectroscopies for understanding the molecular structure and nature of chemical bonding. This course provides a thorough knowledge of the methods of Quantum mechanics and the different types of spectroscopic techniques.

In nature, photochemistry is of immense importance as it is the basis of photosynthesis, vision, and the formation of vitamin D with sunlight. Photochemical reactions proceed differently than temperature-driven reactions. This course also highlights the basic laws of photochemistry, energy levels, quantum yield and examples of photochemical reactions.

9. Course Objectives:

The objectives of this course are to:

1. Introduce students to Schrödinger wave equation, quantization of energy and electronic configuration of atoms and ions.
2. Discuss chemical bonding using valence bond and molecular orbital approaches and apply them to various hydrogen like atoms.
3. Learn the basic principles of molecular spectroscopy such as Rotational, Vibrational, Raman, Electronic and NMR spectroscopy.
4. Study the principles and laws of photochemistry and apply them in field of chemistry, biology, biochemistry, biomedicine etc.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to

1. Understand and basic principles of quantum mechanics
2. Define chemical bonding and able to understand its various theories
3. Gain knowledge of vibrational, Raman, Electronic, NMR and ESR spectroscopic techniques.
4. Apply the laws of photochemistry, Lambert-Beer's law, define terms like photosensitization, quenching, chemiluminescence etc.

11. Unit wise detailed content

Unit-1	**Number of lectures = 16**	**Title of the unit: Quantum Chemistry**

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy

and Heisenberg Uncertainty principle; wave functions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wave functions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, and quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus.

Unit-2	**Number of lectures = 10**	**Title of the unit: Chemical Bonding.**

Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H^{2+}. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H2 (only wave functions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH). Localised and non-localised molecular orbitals treatment of triatomic (BeH2, H2O) molecules. Qualitative MO theory and its application to AH2 type molecules.

Unit 3	**Number of lectures = 20**	**Title of the unit: Molecular Spectroscopy**

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

Unit – 4	**Number of lectures =6**	**Title of the unit: Photochemistry**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitized reactions, quenching. Role of photochemical reactions in biochemical processes, photo stationary states, chemiluminescence.

12. Brief Description of self-learning/ E – learning component

1. https://www.shodor.org/chemviz/overview/quantum.html

2. https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2007/lecture-notes/
3. https://nptel.ac.in/courses/122101001/13
4. https://youtu.be/_IEWeanbfnQ

13. Books Recommended

1. Banwell, C. N. &McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006), ISBN 978-9352601738
2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001), ISBN 978-0074620540
3. House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004), ISBN 978-0123567710
4. Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005),ISBN 978-0124575516
5. Kakkar, R. Atomic & Molecular Spectroscopy: Concepts & Applications, Cambridge University Press (2015), ISBN 978-1107063884

1. Name of the Department: Chemistry						
2. Course Name	Quantum Chemistry, Spectroscopy & Photochemistry Lab		**L**	**T**		**P**
3. Course Code	17030530		0	0		4
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite .	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

A spectrophotometer is a photometer that can measure the intensity of light as a function of its wavelength. Single beam and double beam are the two major classes of spectrophotometers This course provides practical training to handle UV spectrophotometer and study absorbance spectra of various samples in the visible range. Solutions of transition metal ions can be colored (i.e., absorb visible light) because d electrons within the metal atoms can be excited from one electronic state to another. The colour of metal ion solutions is strongly affected by the presence of other species, such as certain anions or ligands. For instance, the colour of a dilute solution of copper sulfate is a very light blue; adding ammonia intensifies the colour and changes the wavelength of maximum absorption (λ_{max}).

Organic compounds, especially those with a high degree of conjugation, also absorb light in the UV or visible regions of the electromagnetic spectrum. (Organic solvents may have significant UV absorption; not all solvents are suitable for use in UV spectroscopy. Ethanol absorbs very weakly at most wavelengths.) Solvent polarity and pH can affect the absorption spectrum of an organic compounds.

9. Course Objectives:

The objectives of this course are to:

1. To measure the absorbance of the sample at different wavelengths.
2. To find out the unknown concentration of the sample.
3. Verification of Beer-Lambert's Law
4. Determine concentration of various solutions using colorimetry

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Record the spectra of different organic compounds.
2. Determine the concentration of KMnO4 and K2Cr2O7 in a mixture.
3. Study the effect of pH on spectra of compounds.
4. To determine the kinetics or rate constant of a chemical reaction

11. List of Experiments

II. UV/Visible spectroscopy

1. Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule-1, kJ mol-1, cm-1, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic

acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

III. Colorimetry

1. Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration
2. Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.
3. Study the kinetics of iodination of propanone in acidic medium.
4. Determine the amount of iron present in a sample using 1,10-phenathroline.
5. Determine the dissociation constant of an indicator (phenolphthalein).
6. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
7. Analyse the given vibration-rotation spectrum of HCl(g)

12. Brief Description of self-learning/ E – learning component

1. https://en.wikipedia.org/wiki/Ultraviolet%E2%80%93visible_spectroscopy
2. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/uv-vis/uvspec.htm
3. http://life.nthu.edu.tw/~labcjw/BioPhyChem/Spectroscopy/beerslaw.htm
4. https://cd1.edb.hkedcity.net/cd/science/chemistry/s67chem/pdf/sDL_2_Iodination.pdf

13. Books Recommended

5. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009,ISBN 978-8131723258.
6. Khosla, B. D.; Garg, V. C. & Gulati, A., Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011) ISBN 978-1906574000
7. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003), ISBN 9780070570078.
8. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003),ISBN 978-0716717355.

1.Name of the Department: Mathematics						
2.Course Name	Special Functions & Integral Transform	**L**	**T**		**P**	
3.Course Code	17030537	3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ()	Every Sem ()

7.Total Number of Lectures, Tutorials, Practical		
Lectures = 26	**Tutorials = 0**	**Practical = 0**

8.Course Description:

This course is designed to describe the different types of tools/operators to solve the various difficult problems of Mathematics. Emphasis is placed on differential equations with variable

coefficient with and the difficult integrations and solution of differential equations. Upon completion, students should be able to select and use appropriate tool for finding solutions integration and differential equations.

5. **Course Objectives:**

Students that successfully complete this course will be able to:

1. Series solution of variable coefficient differential equation
2. Solve a DE with Laplace transform and Laplace transform of functions
3. Fourier transform to solve differential equations
4. Legendre's equation and Bessel's Equation with their properties

6. **Course Outcomes (COs):**

After completing the course, students are expected to be able:

1. To understand about theory of Laplace transform and their application to solve differential equations.
2. To discuss the Fourier transform and its properties and to solve partial differential equations using Fourier transform.
3. To find series solution of differential equations with variable coefficient.
4. To understand the concept of series solution and discuss the solution of Legendre's equation and Bessel's equation.

7. **Unit wise detailed content**

Unit-1	**Number of lectures = 8**	**Title of the unit: Laplace Transform**

Laplace transforms: Existence theorem for Laplace transforms, Linearity of the Laplace transforms, Shifting theorems, Convolution theorem, Laplace transforms of derivatives and integrals, Differentiation and integration of Laplace transforms. Solution of ODEs using Laplace
transforms.

Unit – 2	**Number of lectures = 6**	**Title of the unit: Fourier Transform**

Fourier transforms-Linearity property, Shifting, Modulation, Convolution Theorem, Fourier transform of derivatives, Relations between Fourier transform and Laplace transform, Parseval's
Identity for Fourier transform, Solution of DEs using Fourier Transforms.

Unit – 3	**Number of lectures = 6**	**Title of the unit: Series Solution**

Series solution of second order differential equations: Power series method, solution of Differential equation with singular point, regular and irregular singular point solution. Method
of differentiation.

Unit – 4	**Number of lectures = 6**	**Title of the unit: Legendre and Bessel Polynomial**

Legendre and DEs and their solutions, Legendre functions and their properties, Recurrence relations and generating functions, Orthogonality of Legendre polynomials, Rodrigues' formula for Legendre polynomials. Bessel equation and its solution, Bessel functions and their properties, Relations and generating functions, Orthogonality of Bessel functions.

1. http://www.math.ualberta.ca/~xinweiyu/334.1.10f/DE_series_sol.pdf
2. http://web.mst.edu/~lmhall/SPFNS/spfns.pdf
3. https://www.math.psu.edu/tseng/class/Math251/Notes-LT1.pdfhttps://math.okstate.edu/people/binegar/2233-S99/2233-l24.pdf

12. Books Recommended

1. Erwin Kreyszing : Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999.
2. A.R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd.
3. I.N. Sneddon : Special Functions on mathematics, Physics & Chemistry.
4. W.W. Bell : Special Functions for Scientists & Engineers.
5. I.N. Sneddon: the use of integral transform, McGraw Hill, 1972.
6. Murray R. Spiegel: Laplace transform, Schaum's Series.

1. Name of the Department: Mathematics						
2.Course Name	Fluid Dynamics	**L**	**T**		**P**	
3.Course Code	17030538	3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical						
Lectures = 26		**Tutorials = 0**			**Practicals: 0**	

8.Course Description:

This course is aimed to provide an introduction to the theories for fluid dynamics. Topic covers: Kinematics (Equation of continuity),Equation of motion , General theory of irrotational motion, Motion of sphere (Motion in three dimensions), Sources, sinks and doublets (Motion in two-dimension), Motion of cylinders.

9.Course Objectives:

The objective of this course is to expose student to understand the importance of fluid dynamics in Science & Engineering.

10. Course Outcomes (COs):

After completing this course, students will be able:

1. To classify and exploit fluids based on the physical properties of a fluid
2. To compute correctly the kinematical properties of a fluid element
3. To apply correctly the conservation principles of mass, linear momentum, and energy to fluid flow systems with emphasis on aerodynamics.
4. To apply the general theory of irrotational motion and motion of sphere and cylinders.

11.Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Kinematics (Equation of continuity)**

Kinematics- Eulerian and Lagrangian methods, Stream lines, path lines and streak lines, Velocity potential , Irrotational and rotational motions , Vortex lines, Equation of continuity, Boundary surfaces.

Unit - 2	**Number of lectures = 6**	**Title of the unit: Equations of motion**

Acceleration at a point of a fluid , Components of acceleration in cylindrical and spherical polar coordinates, Pressure at a point of a moving fluid, Euler's and Lagrange's equations of motion, Bernoulli's equation, Impulsive motion.

Unit - 3	**Number of lectures = 6**	**Title of the unit: General theory of irrotational motion**

Acyclic and cyclic irrotation motions, Kinetic energy of irrotational flow, Kelvin's minimum energy theorem, Axially symmetric flows, Liquid streaming past a fixed sphere, Motion of a sphere through a liquid at rest at infinity, Equation of motion of a sphere.

Unit – 4	**Number of lectures = 8**	**Title of the unit: Irrotational Motion in two-dimension , Sources, Sinks and Doublet in 3D**

Irrotational Motion in two-dimension, Complex velocity potential, Milne-Thomson circle theorem, 2-D sources, sinks, doublets and their images, Blasius theorem, 2-D irrotational motion produced by motion of circular and coaxial cylinders in an infinite mass of liquid.Three-dimensional sources, sinks, doublets and their images, Stoke's stream function, Property of Stoke's function.

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

Learners are offered e-learning courseware (also called Web-based training (WBT)), which can be complemented by supplemental resources and assessments.
Courseware is usually housed on a Web server, and learners can access it from an online learning platform or on CD-ROM.
https://nptel.ac.in/noc/individual_course.php?id=noc17-me04
https://nptel.ac.in/courses/112104118/

13. Books Recommended

1. F. Chorlton. Text Book Of Fluid Dynamics, C.B.S. Publishers, Delhi, 1985
2. W.H. Besaint and A.S. Ramasey, A Treatise on Hydromechanics, Part II, CBS Publishers, Delhi, 1988.
3. R.K. Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.
4. G.K. Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi,1994.

1. Name of the Department: Mathematics						
2. Course Name	Vector Calculus	**L**	**T**		**P**	
3. Course Code	17030539	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 26	**Tutorials = 0**	**Practical = 0**

8. Course Description:

Course in multivariable Calculus. Topics include scalar and vector product, gradient divergence and curl; line and surface integrals; and the theorems of Green, Stokes, and Gauss.

9. Course Objectives:

Students will be able to understand:

1. Scalar and vector quantities, Types of vector, Directional vector, Evaluate vector integration of Surface & Volume, Theorems of Gauss, Green and Stokes and problem based on these theorems.
2. To make students familiar withCurl, Divergence, Gradient and its properties.Laplacian operator, spherical and curvilinear coordinates etc.

10. Course Outcomes (COs):

After completing the course, students are expected to be able:

1. To compute dot product, cross product, length of vectors.
2. To compute partial derivatives, derivatives of vector-valued functions, gradient functions.
3. To understand the basic concept of Gradiant, Divergent, curl and their application.
4. To evaluate integrals of functions or vector-related quantities over curves, surfaces, and domains in two- and three-dimensional space.

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Scalar and Vector Product**

Scalar and vector product of three vectors and four vectors, Reciprocal vectors, Vector differentiation, Scalar valued point function and vector valued point function, Derivative along curve, Directional derivatives.

Unit – 2	**Number of lectures = 8**	**Title of the unit: Gradient, Divergence and Curl**

Gradient of scalar point function, Divergence and curl of a vector point function, Characters of Div f and curl f of a vector point function, Vector identities , Gradient, Divergence and curl of sums and product and their related vector identities.

Unit – 3	**Number of lectures = 6**	**Title of the unit: Gradient, Divergence and Curl in orthogonal curvilinear coordinates**

Gradient, Divergence, Curl and Laplacian operator in terms of orthogonal curvilinear coordinates, Cylindrical coordinates and Spherical coordinates.

Unit – 4	**Number of lectures = 6**	**Title of the unit: Vector Integration and Applications**

Vector integration; line integration, Surface integration, Volume integration.

Statements and applications of Green's theorem, Gauss divergence theorem and Stokes theorem

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

https://nptel.ac.in/courses/117101056/17

https://nptel.ac.in/courses/111105122/

https://people.math.gatech.edu/~harrell/calc/calcreslist.html

13. Books Recommended

1. Murrary R. spiegal: Theory end Problems of Advanced Calculus, Schaum Publishing Comp., New York.
2. Shanti Narayana: A Text Book of Vector Calculus. S. Chand & Co., New Delhi
3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
4. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and Sons (Asia) P. Ltd. 2002.
5. P.C. Matthew's, Vector Calculus, Springer Verlag London Limited, 1998.

1.Name of the Department: Mathematics						
2.Course Name	Number Theory	**L**	**T**		**P**	
3.Course Code	17030540	3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical						
8.Lectures = 26		**Tutorials = 0**		**Practical = 0**		

9.Course Description:

Number theory is a vast and fascinating field of mathematics, sometimes called "higher arithmetic," consisting of the study of the properties of whole numbers. It helps to solve the prime number theorem, Goldbach conjecture, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem etc. Number theory make the people intelligent and develop the decisions power to manage their problems.

10.Course Objectives:

This module aims to introduce students to use quantitate methods and techniques for effective decisions making; modelling formulation and applications that are used in solving decision making problems.

11.Course Outcomes (COs):

On successful completion of this course, students will be able:

1. To formulate and increase the solving power of prime number theorem, Goldbach conjecture.
2. To know Chinese remainder theorem, Fermat's little theorem, Wilson's theorem which is related to real life.
3. To understand Number theoretic functions and divisors, Möbius inversion formula and Euler's theorem.
4. To understand Legendre symbol and its properties.

12. Unit wise detailed content

Unit-1	**Number of lectures = 5**

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture.

Unit – 2	**Number of lectures = 5**

Linear congruences, complete set of residues, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem.

Unit – 3	**Number of lectures = 8**

Number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet product, the Möbius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

Unit – 4	**Number of lectures = 8**

Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties.

13. Brief Description of self-learning / E-learning component

https://www.youtube.com/watch?v=NnAy1AXg4yQ

https://www.youtube.com/watch?v=N0aLkfJaX1E

https://www.youtube.com/watch?v=SCvtxjpVQms

14.Books Recommended

1. David M. Burton, Elementary Number Theory (6th Edition), Tata McGraw-Hill Edition, Indian reprint, 2007.
2. Neville Robinns, Beginning Number Theory (2nd Edition), Narosa Publishing House Pvt. Limited, Delhi, 2007.
3. Neal Koblitz, A Course in Number Theory and Cryptography, Springer-Verlag.

1. Name of the Department: Mathematics						
2.Course Name	Solid Geometry	**L**	**T**		**P**	
3.Course Code	17030541	3	0		0	
4.Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5.Pre-requisite (if any)		**14. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem()
6.Total Number of Lectures, Tutorials, Practical						
7.Lectures = 26		**Tutorials = 0**		**Practicals: 0**		

8. Course Description:

Solid Geometry is a large field of mathematics. This course is aimed to provide an introduction to the theories for general equation of second degree and conic, sphere, cones, cylinders, central conicoids and paraboloids.

9. Course Objectives:

The objective of this course is to introduce the fundamental ideasgeneral equation of second degree and conic, sphere, cones, cylinders, central conicoids and paraboloids and a range of skills which will allow students to work effectively with the concepts.

10. Course Outcomes (COs):

After completing this course, students will be able to:

1. Demonstrate knowledge and understanding of general equation of second degree and conic.
2. Demonstrate knowledge and understanding of sphere, cones and cylinders.
3. Demonstrate knowledge and understanding of central conicoids.
4. Demonstrate knowledge and understanding of paraboloids.

11.Unit wise detailed content

Unit-1	**Number of lectures = 5**	**Title of the unit: general equation of second degree and conic**

General equation of second degree, Tracing of conics, Tangent at any point to the conic, chord of contact, pole of line to the conic, director circle of conic, system of conic, Confocal conics, polar equation of a conic, tangent and normal to the conic.

Unit – 2	**Number of lectures = 8**	**Title of the unit: Sphere, Cones , Cylinders**

Plane section of a sphere, sphere through a given circle, Intersection of two spheres, radical plane of two spheres, Co-oxal system of spheres. Cones: Right circular cone, enveloping cone and reciprocal cone. Cylinder: Right Circular cylinder and enveloping cylinder.

Unit-3	**Number of lectures = 8**	**Title of the unit: Central Conicoids**

Central Conicoids: Equation of tangent plane. Director sphere, Normal to the conicoids, polar plane ofa point, Enveloping cone of a conicoid, enveloping cylinder of a conicoid, Polar plane of a point, Enveloping cone of a conicoid, Enveloping cylinder of a conicoid.

Unit-4	**Number of lectures = 5**	**Title of the unit: Paraboloids**

Paraboloids: Circular section, Plane sections of conicoids, Generating lines, Confocal conicoids, Reduction of second degree equations.

12.Web links:

1. https://www.youtube.com/watch?v=AWXGMeN0Ets
2. https://www.youtube.com/watch?v=s1kaJMtZt60

13. Books Recommended

1. R. J.T. Bill, Elementary Treatise on Coordinary Geometry of Three Dimentions, Macmillan India Ltd. 1994.
2. P.k. Jain and Khalil ahmad: a textbook of Analytical Geometry of Three Dimentions,, Wiley Eastern Ltd. 1999.
3. G.B. Thomas and R.L. Finney :calculas, 9^{th} Ed.., Pearson Education, Delhi, 2005.
4. H. Anton, I. Bivens and S.Davis: Calculas. John Wiley and Sons(Asia) Pvt. Ltd., 2002.
5. S. L. Loney: The Elements of Coordinate Geometry, McMillan and Company, London.

1. Name of the Department: Mathematics						
2. Course Name	Computer Fundamentals	**L**	**T**		**P**	
3. Course Code	17030542	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 26	**Tutorials = 0**	**Practical = 0**

8. Course Description:

If you are a high-end computer user at home or college considering a career in information technology, or interested in furthering your knowledge about personal computers, the Comitia® IT Fundamentals™ course is the first step in your preparation. In this course, you will identify PC components, work with files and folders, and conduct basic software installations. This course will provide you with the fundamental skills and concepts required to maintain, support, and work efficiently with personal computers. In addition, you will acquire the essential skills and information you need to set up, configure, maintain, troubleshoot, and perform preventative maintenance of the hardware and software components of a basic personal computer workstation and basic wireless devices. You will also implement basic security measures and implement basic computer and user support practices.

9. Course Objectives:

The course is designed to aim at imparting a basic level appreciation programme for the common man. After completing the course the incumbent is able to the use the computer for basic purposes of preparing his personnel/business letters, viewing information on Internet (the web), sending mails, using internet banking services etc. This allows a common man or housewife to be also a part of computer users list by making them digitally literate. This would also aid the PC penetration program. This helps the small business communities, housewives to maintain their small account using the computers and enjoy in the world of Information Technology.

10. Course Outcomes (COs):

Upon successful completion of this course, students will be able to perform

1. Set up a basic workstation, including installing basic hardware and software and establishing basic network connectivity; identify and correct compatibility issues, identify and prevent basic security risks; and practice basic support techniques on computing devices.
2. Identify hardware commonly found, attached and installed to computing devices.
3. Set up a basic workstation and configure network access work with files, folders and applications.
4. Configure and use wireless devices and secure computing devices, support computers and users.

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: An overview of Computer System and its components**

Computer: Definition, Characteristics of Computers, Basic Applications of Computer(Sports, Research, Education, Business, Medicines & Health Care, Weather Forecasting, Military), Generations of computers, Number System.

Components of Computer System: Central Processing Unit (CPU), input/output Devices, computer Memory: primary and secondary memory, magnetic and optical storage devices, Concepts of Hardware and Software.

Unit – 2	**Number of lectures = 6**	**Title of the unit: Input/Output and hard copy Devices**

Input/output Devices: Punched cards, card-readers, key-punching machines, keyboards, mouse, joysticks, trackballs, digitizer, voice-recognition, optical-recognition, scanners, terminals, point-of-sale terminals, machine-vision systems.

Hard-copy devices: Print quality, Impact printers - DMPs, Daisy-wheel printers, Line-printers, Drum printers, Chain printers; Non-impact printers - Inkjet, Laser, Thermal, LED; Plotters. Soft-copy devices: monitors, video-standards (VGA and SVGA).

Unit – 3	**Number of lectures =6**	**Title of the unit: System software and Computer Network**

Basic Introduction to system software:- Machine language, Assembly language, Low level languages, High level language, Compiler , Interpreter, Linker, Loader, Relationship between Compiler, Interpreter, linker, Loader.

Basic Introduction to Computer Networks:- Computer Network concepts, Topologies- Bus, Star, Ring, Tree, Hybrid, Types of Network- LAN, MAN, WAN.

Unit – 4	**Number of lectures = 8**	**Title of the unit: Operating System, Internet and Social Concerns**

Software and Operating System Concepts: Introduction, Software Types, Language translators, System Utility Software, Application Software; Operating System – Characteristics, its functions, and its classification; User Interfaces – CUI and GUIs. DOS and Windows operating systems.

Internet Basics: Concept of Internet, Application of Internet, WWW, Web-sites and URLs, Search Engine, Using Electronic mails, Instant Messaging, Web Browsing software, Surfing the Internet.

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

13. Books Recommended

1. Nasib Singh Gill: Handbook of Computer Fundamentals, Khanna Books Publishing Co.(P) Ltd., New Delhi, 2016.
2. P.K Sinha: Computer Fundamentals, BPB Publications.
3. Nasib Singh Gill: Computing Fundamentals and Programming in C, Khanna Books Publishing Co.(P) Ltd., New Delhi.
4. V. Rajaraman: Fundamentals of Computers, PHI
5. Norton Peter: Introduction to Computer, McGraw-Hill.
6. Leon, Alexis & Leon, Mathews: Introduction to Computers, Leon Tech World.
7. C.S. French: Data Processing and Information Technology, BPB Publications. Computer Networks (4th Edition), byAndrew S. Tanenbaum.

Semester-VI

Out of the below given Discipline Specific Elective Courses (DSECs), students have to opt and complete there courses (one course each from Physics, Chemistry and Mathematics). They have further choice to opt and complete a project work of six months (in-house or at an industrial/scientific organization) in replacement of any one course (either from Physics/ Chemistry/ Mathematics) as per his/her choice.

<table>
<tr><td colspan="8">1. Name of the Department: Physics</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Elements of Modern Physics</td><td colspan="2">L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2">17030613</td><td colspan="2">4</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td>DSE (√)</td><td>AEC ()</td><td>SEC ()</td><td>GE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical</td></tr>
<tr><td colspan="3">Lectures = 52</td><td colspan="3">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="9">8. Course Description:</td></tr>
<tr><td colspan="9">The course will include the Planck quantum concepts of particle and wave natures, atomic models, uncertainty principle, operators, radio activity and nuclear reactions.</td></tr>
<tr><td colspan="9">9. Course Objectives:</td></tr>
<tr><td colspan="9">The aim of this course is to understand the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, source of nuclear energy and related devices.</td></tr>
<tr><td colspan="9">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="9">After completing this course Students will be able to
1. Explain the quantum mechanical view of wave particle duality and uncertainty principles.
2. Explain wave functions and probability in measurements and Solutions of Schrodinger wave equation for a particle with various potentials.
3. Explain basic physics of nucleus.
4. Explain radioactivity and nuclear processes for energy production.</td></tr>
<tr><td colspan="9">11. Unit wise detailed content</td></tr>
<tr><td colspan="2">Unit-1</td><td colspan="2">Number of lectures = 13</td><td colspan="5">Title of the unit: Introduction to Quantum Mechanics</td></tr>
<tr><td colspan="9">Planck’s quantum, Planck’s constant and light as a collection of photons; Photo-electric effect and Compton scattering, De Broglie wavelength and matter waves; Davisson-Germer experiment, Position measurement- gamma ray microscope thought experiment, Wave particle-duality, and Heisenberg</td></tr>
</table>

uncertainty principle impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Unit - 2	**Number of lectures = 13**	**Title of the unit: Quantum Mechanics**

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

Unit - 3	**Number of lectures = 13**	**Title of the unit: Nucleus**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Radioactivity**

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α-decay; β-decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission, Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons, Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.

12. Books Recommended

5. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill. ISBN- 978-0070151550
6. Modern Physics, John R, Taylor, Chris D, Zafiratos, Michael A,Dubson,2009, PHI Learning. ISBN-978-0138057152
7. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A, Moore, 2003, McGraw Hill. ISBN-978-0072397130
8. Quantum Physics, Berkeley Physics Course Vol,4, E,H, Wichman, 2008, Tata McGraw-Hill Co. ISBN-978-0070702189
9. Modern Physics, R,A, Serway, C,J, Moses, and C,A,Moyer, 2005, Cengage Learning. ISBN-13: 978-0534493394
10. Modern Physics, G, Kaur and G,R, Pickrell, 2014, McGraw Hill. ISBN-978-0534493394

13.Online Links

1. https://nptel.ac.in/courses/115102017/2

2.https://www.youtube.com/watch?v=iMhDYarsfII&rel=1&color1=0xcbba9f&color2=0xcbba9f&border=0&fs=1

3. https://nptel.ac.in/courses/115101010/downloads/lec1.pdf

1. Name of the Department: Physics						
2. Course Name	Elements of Modern Physics Lab	**L**	**T**		**P**	
3. Course Code	17030614	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

Experiments include the Basic concepts of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

9. Course Objectives:

To understand the working principles of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

10. Course Outcomes (COs):

After performing these experiments, students will be able to

1. Demonstrate the concepts of Modern Physics.
2. Develop their hand on sophisticated experimental set ups in lab.
3. Understand the basic methods followed in research.
4. Demonstrate the effect that is how radiation can be converted into electric energy.

11. List of Experiments

1. To determine value of Planck's constant using LEDs of at least 4 different colours
2. To determine value of Boltzmann constant using V-I characteristic of PN diode.
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the ionization potential of mercury.
5. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
6. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
7. To study Hall effect.
8. To determine I-V characteristics of PNP transistors.

9. High resistance by substitution method.
12. Book Recommended:
12. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. ISBN-978-0423738902 13. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 14. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.

1. Name of the Department: Physics						
2. Course Name	Quantum Mechanics	**L**	**T**		**P**	
3. Course Code	17030615	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The course will includes the Planck quantum concepts of particle and wave natures, atomic models, uncertainty principle, operators, Schrodinger wave equation and its applications.

9. Course Objectives:

After completing this course Students will be able to

1. Understand the quantum mechanics using time dependent and time independent Schrodinger equation.
2. Explain the Physics of bound states and hydrogen like atoms.
3. Explain the behavior of Atomic states in electrical and magnetic field.
4. Explain the effects on Atomic states in many electron systems.

10. Course Outcomes (COs):

After completing this course Students will be able to explain the quantum mechanical view of particle and wave nature, uncertainty in measurements, certainty and probability in measurements, time dependent and time independent Schrodinger wave equations and its solution for hydrogen atom and many electron atoms

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Time dependent Schrodinger equation**

Time dependent Schrodinger equation: Introduction to quantum mechanics, Time dependent Schrodinger equation anddynamical evolution of a quantum state; Properties of Wave Function, Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions, Normalization, Linearity and Superposition Principles, Eigenvalues and Eigen functions, Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum, Wave Function of a Free Particle,

Time independent Schrodinger equation-Hamiltonian, stationary states and energyeigenvalues;

expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states.

Unit - 2	**Number of lectures = 13**	**Title of the unit: General discussion of bound states in an arbitrary potential**

General discussion of bound states in an arbitrary potential- continuity of wavefunction, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions,

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation inspherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Orbital angular momentum quantum numbers l and m; s, p, d,..shells (idea only).

Unit - 3	**Number of lectures = 13**	**Title of the unit: Atoms in Electric and Magnetic Fields**

Atoms in Electric and Magnetic Fields: - Electron Angular Momentum, SpaceQuantization, Electron Spin and Spin Angular Momentum, Larmor's Theorem, Spin Magnetic Moment, Stern-Gerlach Experiment.

Atoms in External Magnetic Fields:- Normal and Anomalous Zeeman Effect.

Unit - 4	**Number of lectures = 13**	**Title of the unit: Many electron atoms**

Many electron atoms:- Pauli's Exclusion Principle, Symmetric and AntisymmetricWave Functions, Periodic table, Fine structure, Spin orbit coupling, Spectral Notations for Atomic States, Total Angular Momentum, Vector Model, Spin-orbit coupling in atoms, L-S and J-J couplings.

12. Books Recommended

1. A Text book of Quantum Mechanics, P,M, Mathews & K, Venkatesan, 2nd Ed,, 2010, McGraw Hill. ISBN- 9780070146174
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn,, 2002, Wiley. ISBN-978-8126508181
3. Quantum Mechanics, Leonard I, Schiff, 3rdEdn, 2010, Tata McGraw Hill. ISBN-9780070702431
4. Quantum Mechanics, G, Aruldhas, 2ndEdn, 2002, PHI Learning of India. ISBN-9788120340695
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning. ISBN- 978-0763744519

13. Online Links

1. https://www.youtube.com/watch?v=1az10iSmCzA
2. https://www.youtube.com/watch?v=2ejyr-E7q2M
3. https://nptel.ac.in/courses/115101003/downloads/module2/lecture7.pdf

1. Name of the Department: Physics						
2. Course Name	Quantum mechanics Lab	**L**	**T**		**P**	
3. Course Code	17030616	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**	**Practical = 52**			

8. Course Description:

Experiments include the basic concepts of measurement of Planck's constant using LEDs, measurement of ionization potential of mercury, work function, hall coefficient etc.

9. Course Objectives:

To understand the working principles of measurement of Planck's constant using LEDs, tunnelling current in backward diode or tunnel diode, work function, hall coefficient etc.

10. Course Outcomes (COs):

After performing these experiments, students will be able to

1. Demonstrate the concepts of Quantum Mechanics.
2. Develop their hand on sophisticated experimental set ups in lab.
3. Understand the basic methods followed in research.
4. Demonstrate the behavior of Atomic states in electrical and magnetic field.

11. List of Experiments

1. To determine value of Planck's constant using LEDs of at least 4 different colours
2. To determine I-V characteristics of PNP transistors.
3. To study Hall Effect.
4. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
5. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
6. To study the quantum tunneling effect with solid state device, e.g. tunneling current in backward diode or tunnel diode.
7. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
8. To determine value of Boltzmann constant using V-I characteristic of PN diode.
9. To determine work function of material of filament of directly heated vacuum diode.

12. Books Recommended:

1. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978-6133459274A
2. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill. ISBN-9780070702431
3. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning. ISBN- 978-0763744519

15. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. ISBN-978-0423738902
16. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

4. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi. ISBN-□□□□□□□□□□□□□□□.

1. Name of the Department: Physics						
2. Course Name	Nuclear and particle physics	**L**	**T**		**P**	
3. Course Code	17030617	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical

Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The syllabus is divided into four units i.e. general properties of nuclei and nuclear models, radioactive decay and nuclear reactions, interaction of nuclear radiation with matter, and particle accelerator.

9. Course Objectives:

In this course students will learn about the phenomenon involve in the interaction of nuclear radiation with matters, working principles and characteristics of different types of nuclear detectors, radioactive decay processes and basics of high energy physics

10. Course Outcomes (COs):

After the successful completion of the course, students would be able to

1. Explain the basic concepts of isospin, nuclear forces, Coulomb excitation, nuclear kinematics etc
2. Explain the basic physics of radioactivity and nuclear reaction.
3. Understand and explain the radiation detection system using the physics of interaction ofradiation with matter.
4. Describe the basic features involved in high energy physics.

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: General Properties of Nuclei and Nuclear Models**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties,quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

Nuclear Models: Liquid drop model approach, semi empirical mass formula andsignificance of various terms, condition of nuclear stability, Two nucleon separation energies, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

Unit – 2	**Number of lectures = 13**	**Title of the unit: Radioactivity decay and Nuclear reaction**

Radioactivity decay:(a) Alpha decay: basics ofα-decay processes, theory ofα-emission, Gamow factor,

Geiger Nuttall law, α-decay spectroscopy, (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis, (c) Gamma decay: Gamma rays emission &kinematics, internal conversion.

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions,Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

Unit – 3	**Number of lectures = 13**	**Title of the unit: Interaction of Nuclear Radiation with matter**

Interaction of Nuclear Radiation with matter: Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation, Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter,

Detector for Nuclear Radiations: Gas detectors, estimation of electric field, mobilityof particle, for ionization chamber and GM Counter, Basic principle of Scintillation, Detectors and construction of photo-multiplier tube (PMT), Semiconductor Detectors (Si &Ge) for charge particle and photon detection (concept of charge carrier and mobility).

Unit – 4	**Number of lectures = 13**	**Title of the unit: Particle Accelerators**

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator(Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons,

Particle physics: Particle interactions; basic features, types of particles and its families,Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons,

12. Books Recommended

1. Introductory nuclear Physics by Kenneth S, Krane (Wiley India Pvt, Ltd,, 2008), ISBN-978-8126517855
2. Concepts of nuclear physics by Bernard L, Cohen, (Tata Mcgraw Hill, 1998), ISBN- 9780070992498
3. Introduction to the physics of nuclei & particles, R,A, Dunlap, (Thomson Asia, 2004). ISBN- 978-0534392949
4. Introduction to Elementary Particles, D, Griffith, John Wiley & Sons. ISBN- 978-0-471-60386-3
5. Quarks and Leptons, F, Halzen and A,D, Martin, Wiley India, New Delhi. ISBN- 978-8126516568
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K, Heyde (IOP- Institute of Physics Publishing, 2004), ISBN-978-0750309806.
7. Radiation detection and measurement, G,F, Knoll (John Wiley & Sons, 2000). ISBN: 978-0-470-13148-0
8. Theoretical Nuclear Physics, J,M, Blatt &V,F,Weisskopf (Dover Pub,Inc,, 1991).ISBN- 78-1-4612-9961-5

13. Online links

1.https://nptel.ac.in/courses/115102017/2

2.https://www.youtube.com/watch?v=iMhDYarsfII&rel=1&color1=0xcbba9f&color2=0xcbba9f&border=0&fs=1

3. https://home.cern/science/accelerators

4.http://oregonstate.edu/instruct/ch374/ch418518/Chapter%2017%20Interaction%20of%20Radiation%20with%20Matter-rev.pdf

1. Name of the Department: Physics						
2. Course Name	Nuclear and particle physics Lab	**L**	**T**		**P**	
3. Course Code	17030618	0	0		4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (√)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials =0**	**Practical = 52**			

8. Course Description:

Experiments based on atomic and molecular physics and related topics such as determination of e/m ratio by Thamson method, basic characteristics of G.M counter etc

9. Course Objectives:

To learn by performing experiment based on G.M. Counter, cathode ray oscilloscope, spectrometer etc..

10. Course Outcomes (COs):

After performing these experiments, students will be able to

1. Demonstrate experiments involving Nuclear phenomenon.
2. Develop their hand on sophisticated experimental set ups in lab.
3. Understand the basic methods followed in research.
4. Work with radiation detection systems.

11. List of Experiments

1. e/m by Thomson method.
2. Study of B-H Curve by C.R.O.
3. Study of Hartley Oscillator (Calibration of Gang Condenser).
4. Measurement of Energy Gap of Four Probe Method.
5. To draw the Plateau of G.M. Counter.
6. To determine the Mass Attention Coefficient by G.M. Counter.

12. Book Recommended:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. ISBN-978-0423738902
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
4. 4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India. ISBN- 978- 8120328471

1. Name of the Department: Mathematics						
2. Course Name	Numerical Method	**L**	**T**		**P**	
3. Course Code	17030619	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course analyzed the basic techniques (direct and iterative methods) for the efficient numerical solution of problems in science and engineering. Topics s covered are: Number representation and errors, Polynomials, Locating roots of equations, Solution of nonlinear equations, Interpolation and approximation, Numerical differentiation, Numerical integration, Systems of linear equations, Solution of differential equations

9. Course Objectives:

Many applications in engineering, physics, geology and other specifications containing complicated problems that will require one of the numerical methods to be solved. In this course students will learn the classification of many complicated problems and the suitable numerical methods for obtaining an approximated solution to these problems with desired accuracy.

10. Course Outcomes (COs):

On completion of this course, the students will be able:

1. To demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. To derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. To analyse and evaluate the accuracy of differentiation and integrations using numerical methods.
4. To evaluate the system of linear equations and ordinary differential equations using numerical methods.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Errors & Solution of transcendental and algebraic equations**

Representations of numbers: Round off error, truncation error, significant error, error in numerical computations. Bisection, secant, Regula Falsi, fixed-point, Newton-Raphson, Graffe's methods.

Unit-2	**Number of lectures = 10**	**Title of the unit: Interpolation & Approximation**

Difference schemes, interpolation formulas using differences. Lagrange and Newton interpolation. Hermite interpolation. Divided differences, Different types of approximation, least square polynomial approximation.

Unit-3	Number of lectures = 15	Title of the unit: Numerical differentiation & Numerical integration
Numerical differentiation, Methods based on interpolations, Methods based on finite differences, Numerical integration: Trapezoidal, Simpson's, and Weddle's rules. Gauss Quadrature Formulas		
Unit- 4	**Number of lectures = 15**	**Title of the unit: Solution of linear equations and Numerical Solution of IVP(ODE)**
Direct methods - Gauss elimination, Gauss-Jordan elimination, LU decomposition. Iterative methods - Jacobi, Gauss-Siedel; The algebraic eigenvalue problem: Jacobi's method, Power method. Ordinary differential equations (ODEs): Euler's method, Single-step methods, Runge Kutta's method, multi-step methods		
12. https://unacademy.com/user/Dr-Gajendr... https://goo.gl/PZxFAC		
13. Books Recommended		

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brookes Cole 2004.
2. M.K. Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age international Publishers, New Delhi, India, 2003.
3. Chapra, S. and R. Canale, Numerical Methods for Engineers. New York: McGraw Hill 1998.

1.Name of the Department: Mathematics						
2.Course Name	Numerical Method lab	**L**	**T**		**P**	
3.Course Code	17030620	0	0		4	
4.Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5.Pre-requisite (if any)		**6Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem()
7.Total Number of Lectures, Tutorials, Practical						
8.Lectures = 0		**Tutorials = 0**		**Practical = 35**		

9.Course Description:

This course analyzed the basic techniques (direct and iterative methods) for the efficient numerical solution of problems in science and engineering. Topics s covered are: Number representation and errors, Polynomials, Locating roots of equations, Solution of nonlinear equations, Interpolation and approximation, Numerical differentiation, Numerical integration, Systems of linear equations, Solution of differential equations

10.Course Objectives:

Many applications in engineering, physics, geology and other specifications containing complicated problemsthat will require one of the numerical methods to be solved. In this course students will learn the classification of many complicated problems and the suitable numerical methods for obtaining an approximated solution to these problems with desired accuracy.

11. Course Outcomes (COs):

On completion of this course, the students will learn

1. Practical and theoretical knowledge of a range of iterative techniques for solving linear and nonlinear systems of equations
2. Practical and theoretical knowledge of polynomial interpolation,
3. Practical and theoretical knowledge of schemes for numerical integration
4. Practical and theoretical knowledge of schemes for solving differential equations

12. The list of practical's to perform in the computer lab.

1. Solution of Non-linear equation in single variable using the method of successive bisection.
2. Solution of Non-Linear equation in single variable using the Newton Raphson, Secant, Bi – Section and Modified Euler's, method.
3. Solution of a system of simultaneous algebraic equations using the Gaussian elimination procedure.
4. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method.
5. Solution of a system of simultaneous algebraic equations using the Gauss-Seidel iterative method employing the technique of successive relaxation.
6. Numerical solution of an ordinary differential equation using the Euler's method.
7. Numerical solution of an ordinary differential equation using the Runge - Kutta 4th order method.
8. Numerical solution of an ordinary differential equation using the Predictor – corrector method.
9. Numerical solution of a system of two ordinary differential equation using Numerical integration.

10. Numerical solution of an elliptic boundary value problem using the method of Finite Differences.

Note:

1. At least eight experiments are to be performed in the semester.
2. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the department as per the scope of the syllabus.

12.https://unacademy.com/user/Dr-Gajendr...
https://goo.gl/PZxFAC

13.Books Recommended

1.Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brookes Cole 2004.

2.M.K. Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age international Publishers, New Delhi, India, 2003.

3.Chapra, S. and R. Canale, Numerical Methods for Engineers. New York: McGraw Hill 1998.

1. Name of the Department						
2. Course Name	Integral Calculus	**L**	**T**		**P**	
3. Course Code	17030621	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variable. It is an introduction to the theory and applications of integral calculus of functions of one variable. It includes most of the basic topics of integration on functions of a single real variable: the fundamental theorem of calculus, applications of integrations, and techniques of integration, sequences, and infinite series. The emphasis in this course is on problem solving, not on the presentation of theoretical considerations

9. Course Objectives:

1. Calculus is a primary gateway to an engineering and engineering technology
2. Properly carry out integration through the use of the fundamental formulae and/or the various techniques of integration for both single and multiple integral.
3. Correctly apply the concept of integration in solving problems involving evaluation of arc lengths, areas, volumes, work, and force.

10. Course Outcomes (COs):

1. Understand the meaning of differentiation and integration.
2. Apply the various methods of calculating derivative of a function.
3. Apply techniques of indefinite and definite integration.
4. Understand Surface Multiple Integral as Volume and Application.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Integration Concept/ Formula**

Anti-Differentiation. The Definite Integral, Simple Power Formula, Simple trigonometric Functions, Logarithmic and exponential Functions, Inverse trigonometric Functions, Hyperbolic Functions, General Power Formula, Constant of Integration, Definite Integral

Unit - 2	**Number of lectures = 10**	**Title of the unit: Integration Techniques**

Integration by Parts, Trigonometric Integrals, Trigonometric Substitution, Rational Functions,

Rationalizing Substitution, Definite Integrals, Wallis' Formula, Partial fractions		
Unit - 3	**Number of lectures = 15**	**Title of the unit: Applications**
Improper Integrals, Plane Area, Arc Length, Areas Between Curves, Centroids, Moments of Inertia, Volumes, Work, Hydrostatics Pressure and Force.		
Unit - 4	**Number of lectures = 15**	**Title of the unit: Surface Multiple Integral as Volume and Application**
Surface Tracing: Planes, Spheres, Cylinders, Quadratic Surfaces, Double Integrals, Triple Integral Integral as limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.		
12. https://www.youtube.com/channel/UCJtq... https://gateacademy.co.in/postalcours...		
13. Books Recommended		

1. Yuri A. Brychkov (Ю. А. Брычков), Handbook of Special Functions: Derivatives, Integrals, Series and Other Formulas. Russian edition, Fiziko-MatematicheskayaLiteratura, 2006. English edition, Chapman & Hall/CRC Press, 2008
2. Richard Courant: Differential And Integral Calculus, Vol. 2
3. Martin Braun : Differential Equations and Their Applications 4th Ed.

1.Name of the Department						
2.Course Name	Integral Calculus lab	**L**	**T**		**P**	
3.Course Code	17030622	0	0		4	
4.Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even **(✓)**	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical						
8.Lectures = 00		**Tutorials = 0**	**Practical = 35**			

9.Course Description:

Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variable. It is an introduction to the theory and applications of integral calculus of functions of one variable. It includes most of the basic topics of integration on functions of a single real variable: the fundamental theorem of calculus, applications of integrations, and techniques of integration, sequences, and infinite series. The emphasis in this course is on problem solving, not on the presentation of theoretical considerations

10. Course Objectives:

1. Understand the meaning of differentiation and integration.
2. Apply the various methods of calculating derivative of a function.
3. Apply techniques of indefinite and definite integration.

11.Course Outcomes (COs):

1. Calculus is a primary gateway to an engineering and engineering technology
2. Properly carry out integration through the use of the fundamental formulae and/or the various techniques of integration for both single and multiple integral.
3. Correctly apply the concept of integration in solving problems involving evaluation of arc lengths, areas, volumes, work, and force

12. List of Practical's to perform in computer lab.

1. Evaluate integrals using the method of integration by substitution.
2. Evaluate integrals by using a change of variable substitution.
3. Evaluate integrals of a product of functions using the method of integration by parts.
4. Evaluate integrals of powers of trigonometric functions using integration by substitution.
5. Evaluate integrals by trigonometric substitution.
6. Evaluate integrals using partial fractions.
7. Identify indeterminate forms and use L'Hospital's Rule to evaluate limits resulting in these forms.
8. Use limits to determine the convergence or divergence of improper integrals.
9. Evaluate volumes by Double Integration.
10. Evaluate volumes by Triple Integration.

Note:

1. At least eight experiments are to be performed in the semester.

2. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the department as per the scope of the syllabus.

14. Books Recommended

1. Yuri A. Brychkov (Ю. А. Брычков), Handbook of Special Functions: Derivatives, Integrals, Series and Other Formulas. Russian edition, Fiziko-MatematicheskayaLiteratura, 2006. English edition, Chapman & Hall/CRC Press, 2008
2. Richard Courant: Differential And Integral Calculus, Vol. 2
3. Martin Braun : Differential Equations and Their Applications 4th Ed.

Elink:

https://www.youtube.com/channel/UCJtq...

https://gateacademy.co.in/postalcours...

1. Name of the Department: Mathematics						
2. Course Name	Elementary Inference	**L**	**T**		**P**	
3. Course Code	17030623	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 50	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course introduces students to the basic theory behind the development and assessment of statistical analysis techniques in the areas of point and interval estimation, as well as hypothesis testing.

Topic includes:Point estimation and interval methods, including method of moments and maximum likelihood, unbiasedness, consistency, efficiency and sufficiency, hypothesis testing methods and related confidence interval.

9. Course Objectives:

The objective of the course are to:

1. Familiar the students about method of maximum likelihood and the properties of good estimators.
2. Familiar the students with the concept of statistical inference, point and interval estimation, hypothesis testing under a large variety of discrete and continuous probability models.
3. Familiar the students about ANOVA

10. Course Outcomes (COs):

Upon successful completion of this course the students are able to:

1. How to apply discrete and continuous probability distributions to various business problems.
2. Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.
3. Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit.
4. Perform ANOVA and F-test

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Estimator and their properties**
Parameter and statistic, sampling distribution and standard error of estimate. Point and interval estimation, Unbiasedness, Efficiency, Consistency and Sufficiency.		
Unit - 2	**Number of lectures = 10**	**Title of the unit: Basic of Hypothesis and Method of Estimation**

Method of maximum likelihood estimation. Null and alternative hypotheses, Simple and composite hypotheses, Critical region, Level of significance, One tailed and two tailed tests, Types of errors, Neyman- Pearson Lemma.

Unit - 3	**Number of lectures = 15**	**Title of the unit: Large Sample Test**

Testing and interval estimation of a single mean, single proportion, difference between two means and two proportions.

Unit - 4	**Number of lectures = 15**	**Title of the unit: Small Sample Test and ANOVA Test**

Definition of Chi-square statistic, Chi-square tests for goodness of fit and independence of attributes. Definition of Student's't' and Snedcor's F-statistics. Testing for the mean and variance of univariate normal distributions, Testing of equality of two means and two variances of two univariate normal distributions. Related confidence intervals. Analysis of variance (ANOVA) for one-way and two-way classified data.

12. https://www.youtube.com/watch?v=VK-rnA3-41c
http://www.MathTutorDVD.com
https://lastmomenttuitions.com/how-to...

13. Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
2. Gupta, S.C. and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2008.
3. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
4. A.M. Goon, M.K. Gupta, and B. Das Gupta, Fundamentals of Statistics, Vol-II.
5. R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics.

1.Name of the Department: Mathematics						
2.Course Name	Elementary Inference Lab	**L**	**T**		**P**	
3.Course Code	17030624	0	0		4	
4.Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**OE ()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical						
8.Lectures = 0		**Tutorials = 0**	**Practical =35**			

9.Course Description:

This course introduces students to the basic theory behind the development and assessment of statistical analysis techniques in the areas of point and interval estimation, as well as hypothesis testing.

Topic includes:Point estimation and interval methods, including method of moments and maximum likelihood, unbiasedness, consistency, efficiency and sufficiency, hypothesis testing methods and related confidence interval.

10.Course Objectives:

The objective of the course are to:

1. Familiar the students about method of maximum likelihood and the properties of good estimators.
2. Familiar the students with the concept of statistical inference, point and interval estimation, hypothesis testing under a large variety of discrete and continuous probability models.
3. Familiar the students about ANOVA

11. Course Outcomes (COs):

Upon successful completion of this course the students are able to perform:

1. How to apply discrete and continuous probability distributions to various business problems.
2. Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.
3. Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit.
4. Perform ANOVA and F-test

12.Practical List:

1. If $\hat{\theta}(x_1, x_2, x_3 \ldots\ldots x_n)$ is an unbiased estimator for θ,

i) Is $\hat{\theta}^2$ an unbiased estimator of θ^2.

ii) Is $\sqrt{\hat{\theta}}$ a biased estimator of $\sqrt{\theta}$.

iii) Is $(\frac{1}{\hat{\theta}})$ an unbiased estimator of $\frac{1}{\theta}$.

2. Show that $(\bar{x} - 1)$ is a consistent estimator of μ in case of

$F(x, \theta) = 0, -\infty < x < \theta, 1, \theta \leq x < \infty.$

3. Testthe hypothesis from the population mean at 5% level of significance**.**

4.Test the hypothesis byNeyman- Pearson Lemma.

5. By hypothesis testing find critical region and the size of two types of errors.
6. Suppose that in a certain experiment an event 'A' has probability □ which is unknown. Suppose that in 50 independent trails the event 'A' occurs 23 times. Find maximum likelihood estimator of □ .
7. Perform ANOVA of any data and show that a significance test does not reject their homogeneity.
8. Perform a practical problem on Chi-square tests for goodness of fit test.
9. Perform a practical problem on small sample test (t - test) .
10. Perform a practical problem on small sample test (F test).

Note:

1. At least eight experiments are to be performed in the semester.
2. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the department as per the scope of the syllabus.

13.https://www.youtube.com/watch?v=VK-rnA3-41c
http://www.MathTutorDVD.com
https://lastmomenttuitions.com/how-to...

14.Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
2. Gupta, S.C. and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2008.
3. A.M. Mood, F.A. Graybill and D.C. Boes, Introduction to the theory of Statistics, McGraw Hill, 1974.
4. A.M. Goon, M.K. Gupta, and B. Das Gupta, Fundamentals of Statistics, Vol-II.
5. R.V. Hogg and A.T. Craig, Introduction to Mathematical Statistics.

1. Name of the Department : Chemistry						
2. Course Name	Polymer Chemistry	**L**	**T**		**P**	
3. Course Code	17030625	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

Introduction and history of polymeric materials , Classification, Functionality and its importance, Kinetics of Polymerization, Crystallization and crystallinity, Nature and structure of polymers, Determination of molecular weight of polymers, Glass transition temperature (Tg) and determination of Tg, Polymer Solution and properties of the polymers.

9. Course Objectives:

The objectives of this course are to:

1. To gain the basic knowledge of nature and structure of polymeric materials
2. Learn the kinetics of polymerization
3. Understand the properties of polymeric materials
4. To develop synthetic skills of polymeric product

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Gain the basic knowledge of Polymer chemistry
2. Explain the Mechanism and kinetics of polymerization techniques
3. Predict Molecular weight, Glass transition temperature (Tg) and determination of Tg of Polymers
4. Attain knowledge of different synthetic polymeric products

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Title of the unit: Introduction and Functionality of polymeric materials**

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of polymers. Nature and structure of polymers-Structure Property relationships. Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bi-functional systems, Poly-functional systems.

Unit – 2	**Number of lectures = 13**	**Title of the unit: Kinetics of Polymerization and crystallinity**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

Unit – 3	**Number of lectures = 13**	**Title of the unit: Molecular weight, Glass transition temperature (Tg) and determination of Tg, Polymer Solution**

Determination of molecular weight of polymers (*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.

Polydispersity index. Glass transition temperature (Tg) and determination of Tg: Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.

Unit – 4	**Number of lectures = 14**	**Title of the unit: Properties of Polymer**s

Properties of Polymers (Physical, thermal, flow & mechanical properties). Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

12. Brief Description of self-learning/ E – learning component

1. http://www.malcolmmackley.com/polymers/lecture-notes/
2. https://nptel.ac.in/courses/104103071/pdf/mod16.pdf
3. http://web.mit.edu/viveks/www/Notes_Links.html

13. Books Recommended

1. Seymour, R.B. & Carraher, C.E. Polymer Chemistry: An Introduction, Marcel, ISBN 0–8247–0806–7
2. Dekker, Inc. New York, 1981, ISBN 0-8247-**1981**-6.
3. Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004, 9780471478751.
4. Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971, ISBN 9780471072966.
5. Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991, ISBN 978-0074639948.
6. Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967 ,ISBN 978-0470526309.

1. Name of the Department: Chemistry						
2. Course Name	Polymer Chemistry Lab	**L**		**T**		**P**
3. Course Code	17030626	0		0		4
4. Type of Course (use tick mark)	**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**	
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

Experiments in this class are broadly aimed at acquainting students with the range of properties of polymers, methods of synthesis, purification and characterization including instrumental techniques such as IR, DSC, etc. Some examples of laboratory work include solution polymerization of styrene (St), Interfacial polymerization: polyester preparation, Redox polymerization of acrylamide, Precipitation polymerization of acrylonitrile, Determination of molecular weight by viscometry, Testing of mechanical properties of polymers.

9. Course Objectives:

The objectives of this course are to:

1. Gain the basic knowledge of polymer synthesis
2. To develop synthetic skills of purification and characterization of polymers.
3. Understand use of viscometer for determination of molecular weight
4.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Prepare polymeric compounds
2. Characterize polymeric compounds by using different methods.
3. Predict molecular weight by viscometer , electrophoresis of polymeric materials, hydroxyl number by colorimetry.
4. Synthesize various resins

11. List of Experiments: (Student has to perform ten experiments)

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) Acrylic acid (AA).
   a. Purification of monomer
   b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bisisobutylonitrile (AIBN)
2. Preparation of nylon 6,6
3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Determination of molecular weight by viscometry:
   a. Polyacrylamide-aq.NaNO2 solution

b. (Poly vinyl proplylidine (PVP) in water

8. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
9. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
10. Determination of hydroxyl number of a polymer using colorimetric method.
11. Estimation of the amount of HCHO in the given solution by sodium sulphite method.
12. Preparation of polyacrylamide and its electrophoresis

12. Brief Description of self-learning/ E – learning component

1. http://community.wvu.edu/~josbour1/Labs/S2017/Exp%2015%20-%20Nylon_2017.pdf
2. http://www.egyankosh.ac.in/bitstream/123456789/15899/1/Experiment-13.pdf
3. https://ocw.mit.edu/courses/chemical-engineering/10-569-synthesis-of-polymers-fall-2006/lecture-notes/lec16_10182006.pdf

13. Books Recommended

1. M.P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed., Oxford University Press, 1999, ISBN 978-0195124446.
2. H.R. Allcock, F.W. Lampe & J.E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003), ISBN 978-0130650566
3. F.W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984), ISBN 978-8126511105
4. J.R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003), ISBN 978-0133429947
5. P. Munk & T.M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002), ISBN 978-0471417163
6. L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005), ISBN 978-0471706069
7. M.P. Stevens, Polymer Chemistry: An Introduction 3rd ed. Oxford University Press (2005), ISBN 978-0195124446
8. Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013), ISBN 978-1466552036

1. Name of the Department: Chemistry						
2. Course Name	Organometallics, bioinorganic chemistry, polynuclear hydrocarbons and UV, IR spectroscopy		**L**	**T**	**P**	
3. Course Code	17030627		4	0	0	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

Chemistry of 3d metals, Organometallic Compounds, Bio-Inorganic Chemistry, Polynuclear and heteronuclear aromatic compounds, Active methylene compounds, Application of Spectroscopy to Simple Organic Molecule.

9. Course Objectives:

The objectives of this course are to:

1. Introduce the knowledge 3d complexes and organometallic compounds
2. Learn various concepts of Bio-inorganic chemistry
3. Gain knowledge of polynuclear, heteronuclear and active methylene compounds
4. Introduce the knowledge of spectroscopic applications.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Understand the applications of Inorganic and organic chemistry including spectroscopic techniques.
2. Explain properties and chemistry of 3d metals and organometallic compounds.
3. Predict role of bio inorganic chemistry in biological systems
4. Understand the preparation, properties and reactions of polynuclear, heteronuclear and active methylene compounds

11. Unit wise detailed content

Unit-1	**Number of lectures = 14**	**Title of the unit: Chemistry of 3d metals and Organometallic Compounds**

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, K2Cr2O7, KMnO4, K4[Fe(CN)6], sodium nitroprusside, [Co(NH3)6]Cl3, Na3[Co(NO2)6].

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeise salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. pi-acceptor behaviour of carbon monoxide. Synergic effects -VB approach.

Unit – 2	**Number of lectures = 12**	**Title of the unit: Bio-Inorganic Chemistry**

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na+, K+ and Mg^{2+} ions: Na/K pump; Role of Ca^{2+} in blood clotting, Metalloenzymes: chlorophyll and oxygen carriers in blood, metal toxicity and detoxification.

Unit – 3	Number of lectures = 12	Title of the unit: Polynuclear, heteronuclear aromatic compounds, and Active methylene compounds

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine.

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

Unit – 4	Number of lectures = 14	Title of the unit: Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

12. Brief Description of self-learning/ E – learning component

1. https://www.youtube.com/watch?v=XxElVpgNUF0
2. https://www.youtube.com/watch?v=KqNwAOTquwY
3. https://nptel.ac.in/courses/104101093/18
4. web.uvic.ca/~chem324/
5. web.uvic.ca/~mcindoe/423/423syllabus.html
6. https://nptel.ac.in/courses/104101091/42
7. https://www.youtube.com/watch?v=uMaKBybnfrk
8. https://nptel.ac.in/courses/102103044/3

13. Books Recommended

1. J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S., ISBN 978-8126515547
2. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons, ISBN 978-0471851516
3. I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S., ISBN 978-8177585421
4. R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons, ISBN 978-0471541936
5. R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall, ISBN 978-0136436690
6. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand, ISBN 978-8121935159
7. Advanced Organic Chemistry, S. Chand, ISBN 978-8121900614

1. Name of the Department: Chemistry						
2. Course Name	Organometallics, bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR spectroscopy Lab		**L**	**T**	**P**	
3. Course Code	17030628		0	0	4	
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 0		**Tutorials = 0**		**Practical = 52**		

8. Course Description:

This course provides students with practical experience of the techniques used in basic inorganic and organic chemistry. Some examples of the experiment are Separation of mixtures by paper chromatography, Preparation of the complexes and measurement of their conductivity, Qualitative Organic Analysis of Organic Compounds.

9. Course Objectives:

The objectives of this course are to:

1. Learn paper Chromatography for separations of various mixtures
2. Learn the preparation of different salts complexes and measure conductivity
3. Determine the conductance of the complexes of various solutions
4. Gain knowledge of qualitative analysis of selective organic compounds and their derivatives

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Separate the metal complexes by chromatographic techniques
2. Prepare the salt complexes and predict their conductivity
3. Qualitative Analysis of Organic Compounds viz., carboxylic acids and their derivatives
4. Synthesize derivatives of selected functional groups

11. List of Experiments: (Student has to perform any ten experiments)

5. Separation of mixtures by chromatography: Measure the *Rf* value in each case. (Combination of two ions to be given)
   a. Paper chromatographic separation of Fe3+, A13+ and Cr3+ or
   b. Paper chromatographic separation of Ni2+, Co2+, Mn2+ and Zn2+
6. Preparation of any two of the following complexes and measurement of their conductivity:
   a. tetraamminecarbonatocobalt (III) nitrate
   b. tetraamminecopper (II) sulphate
   c. potassium trioxalatoferrate (III) trihydrate
7. Compare the conductance of the complexes with that of M/1000 solution of NaCl,MgCl2 and LiCl3.
8. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

12. Brief Description of self-learning/ E – learning component

1. https://www.csub.edu/~agebauer/CHEM400/Chem400_LabW05.pdf
2. http://nopr.niscair.res.in/bitstream/123456789/7002/1/IJCT%2013%281%29%2084-87.pdf
3. https://books.google.co.in/books
4. https://www.youtube.com/watch?v=jyR6FG2tMBE
5. http://www.egyankosh.ac.in/bitstream/123456789/15885/1/Experiment-4.pdf

13. Books Recommended

1. A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn., ISBN 978-0582218666.
2. A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn., ISBN 978-0582226289
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996, ISBN 978-0582462366
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman,1960, ISBN 978-8131727102

1. Name of the Department: Chemistry						
2. Course Name	Chemistry of main group elements, theories of acids and bases		**L**	**T**		**P**
3. Course Code	17030629		4	0		0
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical		
Lectures = 52	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course provides students the knowledge of Acids and Bases, General Principles of Metallurgy, *s*- and *p*-Block Elements, Noble gases, inorganic polymers, etc.

9. Course Objectives:

The objectives of this course are to:

1. Introduce the knowledge of acids, bases and Metallurgy
2. Introduce the knowledge of *s*- and *p*-Block Elements
3. Learn structure, bonding, and properties of oxidising and reducing agents
4. Attain the knowledge of Noble gases and inorganic polymers.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Explain various concepts related to acids, bases, and metallurgy
2. Understand detail properties of s- and p-Block Elements
3. Explain the preparation and properties of Noble gases and inorganic polymers
4. Predict the role of oxidizing and reducing agents in chemistry

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Acids, Bases and General Principles of Metallurgy**

Brönsted–Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), Applications of HSAB process.

Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.

Unit - 2	**Number of lectures = 13**	**Title of the unit: *s*- and *p*-Block Elements**

Periodicity in *s*- and *p*-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electro negativity (Pauling scale).General characteristics of *s*-block metals like density, melting and boiling points, flame colour and reducing nature.Oxidation states of *s*- and *p*-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S.Complex forming tendency of *s* block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals.Solutions of alkali metals in liquid ammonia and their properties.Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of *s*-block metals.

Unit – 3	Number of lectures = 12	Title of the unit: Structure, bonding, properties and Applications

Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable: Diborane and concept of multicentre bonding, hydrides of Groups 13 (BH_3), 14, 15, 16 and 17.

Oxides of N and P, Oxoacids of P, S and Cl.Halides and oxohalides of P and S (PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2) .Interhalogen compounds. A brief idea of pseudohalides.

Unit – 4	Number of lectures = 14	Title of the unit: Noble gases and Inorganic Polymers

Rationalization of inertness of noble gases, clathrates, preparation and properties of XeF_2, XeF_4 and XeF_6 ,bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory. Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in $(NPCl_2)_3$.

12. Brief Description of self-learning/ E – learning component

1. https://www.chem.uci.edu/~lawm/11-4.pdf
2. https://www.slideshare.net/DevanshGupta25/classification-of-inorganic-polymers
3. http://what-when-how.com/materialsparts-and-finishes/inorganic-polymer/
4. https://www.tau.ac.il/~jortner/Publications/Pub1-200/61.pdf

13. Books Recommended

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991, 978-0412402906
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley, 978-0471505327.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons ISBN 978-0471629788
4. Greenwood, N.N. & Earnshaw. Chemistry of the Elements, Butterworth-Heinemann. 1997, ISBN 978-0750633659.
5. Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002, ISBN 978-0840068460.
6. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010, ISBN 978-0321811059.
7. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010), ISBN 978-0199236176

1. Name of the Department: Chemistry						
2. Course Name	Chemistry of main group elements, theories of acids and bases Lab		**L**	**T**		**P**
3. Course Code	17030630		0	0		4
4. Type of Course (use tick mark)		**Core ()**	**DSE (✓)**	**AEC ()**	**SEC ()**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals		
Lectures = 0	**Tutorials = 0**	**Practical = 52**

8. Course Description:

This course provides students with practical experience of the techniques of analysis of quantitative data. It is addressed to students who have little or no experience of using quantitative data and it aims to enable students to develop an understanding of basic and intermediate quantitative chemical analysis methods and the ability to use these methods. This course includes iodimetric and gravimetric titrations by considering the example of date to date life.

9. Course Objectives:

The objectives of this course are to:

1. Learn Iodometric estimations of various solutions
2. Understand Gravimetric estimation techniques
3. Attain knowledge of preparation of salt complexes
4. Learn the iodimetric estimation of different components

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Predict the application of analytical methods based on titrations viz iodimetric, gravimetric, and isolation, separations methods, etc
2. Solve most important problems of quantitative analysis
3. Synthesize the various salt complexes
4. Apply the quantitative analysis in daily life.

11. List of experiments

1. Iodometric estimation of potassium dichromate and copper sulphate
2. Iodimetric estimation of antimony in tartaremetic
3. Estimation of amount of available chlorine in bleaching powder and household bleaches
4. Estimation of iodine in iodized salts.
5. Iodimetric estimation of ascorbic acid in fruit juices.
6. Estimation of dissolved oxygen in water samples.
7. Gravimetric estimation of sulphate as barium sulphate.
8. Gravimetric estimation of aluminium as oximato complex
9. Preparation of the following: potash alum, chrome alum, tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III)any two, including one double salt and one complex).

12. Brief Description of self-learning/ E – learning component

1. https://www.academia.edu/32601929/Experiment_no._1_Iodometric_titration_of_potassium_dichromate_and_sodium_thiosulphate_Objective
2. https://www.cutm.ac.in/pdf/Env Engg Lab Manual.pdf
3. https://www.slideshare.net/Ernest13/determination-of-sulphate-as-barium-sulphate

13. Books Recommended

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012, ISBN 978-8131773710.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009, ISBN 978-8131723258

1. Name of the Department : Chemistry						
2. Course Name	Basic Analytical Chemistry	**L**		**T**	**P**	
3. Course Code	17030632	3		0	0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

This course provides students with practical experience of analytical chemistry. Some of the examples of the experiments are soil, water, food product, and cosmetic analysis. Chromatographic and instrumental techniques will also be practiced.

9. Course Objectives:

The objectives of this course are to:

1. Learn basics of analytical chemistry
2. Know about errors in chemical analysis
3. Understand the concept of solvent extraction
4. Learn principle of chromatography

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

5. Gain an understanding of application of analytical methods.
6. Attain hands-on practices of chromatographic techniques.
7. Use statistical data in chemical analysis
8. Exploit solvent extraction technique in chemistry

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction to Analytical Chemistry**
Introduction to Analytical Chemistry and its interdisciplinary nature, Chemicals and Materials analysis methods, General steps in chemical analysis, Role of Analytical Chemistry and Techniques (Evaporation and Wet Ashing). Applications of Chemical Analysis.		
Unit – 2	**Number of lectures = 9**	**Title of the unit: Errors in Chemical Analysis**
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.		
Unit –3	**Number of lectures = 11**	**Title of the unit: Solvent Extraction**
Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions, extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media.		
Unit –4	**Number of lectures = 10**	**Title of the unit: Chromatography**

Classification of chromatographic methods: Principle of differential migration, Techniques of paper chromatography: retardation factors, factors that affect the reproducibility of Rf values, selection of solvent, quantitative analysis. Applications

Principles of Thin layer chromatography: quantitative analysis & applications

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

1. https://nptel.ac.in/courses/104105084/11
2. http://www.federica.unina.it/agraria/analytical-chemistry/analytical-chemistry/
3. https://www.th-owl.de/fb8/fileadmin/download_verzeichnis/chemie/Analytical_Chemistry.pdf
4. https://nptel.ac.in/courses/102103044/28
5. https://nptel.ac.in/courses/102106048/8

13. Books Recommended

1. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6th Ed., Saunders College Publishing, Fort Worth (1992), ISBN 978-0030059384
2. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, ISBN 978-0582218666
3. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995), ISBN 978-1420061352.
4. Christian, G.D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004, ISBN 978-0471214724
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009, ISBN 978-1906574000
6. Mikes, O. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979, ISBN 978-0853120803.
7. Ditts, R.V. Analytical Chemistry; Methods of Separation, van Nostrand, 1974, ISBN 978-0442221584

1. Name of the Department : Chemistry						
2. Course Name	Fuel Chemistry	**L**	**T**		**P**	
3. Course Code	17030633	3	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 40		**Tutorials = 0**		**Practical = 0**		

8. Course Description:

This course includes study of energy sources (renewable and nonrenewable) which includes fuels, coal, gasification and liquefaction techniques, Petroleum and its applications in industries, and lubricants, Nuclear fuel and nuclear reactions.

9. Course Objectives:

The Objectives of this course are to:

1. Make the students aware of the renewable and non-renewable energy sources.
2. To build up knowledge of the concepts and theories of fuel chemistry.
3. To be familiar with the fundamental physical and chemical principles regarding formation and control of air pollutants in industrial and technological processes.
4. Give students an awareness of the Petroleum and Petrochemical Industryapplications.
5. To gain knowledge about nuclear fuel and nuclear reactions

10. Course Outcomes (COs):

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

1. Identify and characterize various renewable and non-renewable energy sources.
2. Develop an understanding of solid, liquid, gaseous and nuclear fuel.
3. Develop an understanding of the applications of Petrochemicals in Industry.
4. Use techniques such as coal liquefaction, solvent refining and gasification, etc.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Fuels and Coal**

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses.

Unit – 2	**Number of lectures = 10**	**Title of the unit: Petroleum and Petrochemical Industries**

Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation, Cracking, Reforming Petroleum and non-petroleum fuels (LPG, CNG, bio-gas, fuels derived from biomass), fuel from waste, Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Unit – 3	**Number of lectures = 10**	**Title of the unit: Lubricants**

Classification & Functions of lubricants, lubricating oils, Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination, Mechanism of Lubrication: Hydrodynamic or Fluid film lubrication, Thin film or boundary lubrication.

Unit – 4	**Number of lectures = 10**	**Tittle of the unit: Gaseous and Nuclear Fuels**

Introduction to Gaseous fuels, Natural gas, Producer gas, Water gas, Nuclear Fuels, mass defect and binding energy, Nuclear Fission, Nuclear chain reaction, Critical Mass, Mechanism of nuclear reactions, Nuclear Reactor, and Nuclear Fusion, Fusion reactors, Nuclear fission vs Nuclear fusion, Nuclear Safety.

12. Brief Description of self-learning/ E – learning component

1. https://www.svce.ac.in/departments/chemistry/CITM/CY%206251/Engg.%20Chem.%20II%20word/Unit%20V%20-%20Fuels%20&%20Combustion.pdf
2. https://nptel.ac.in/courses/112101007/
3. https://nptel.ac.in/courses/103105110/

13. Books Recommended

1. Stocchi, E. Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK (1990), ISBN 978-0134573182
2. Jain, P.C. & Jain, M. Engineering Chemistry Dhanpat Rai & Sons, Delhi ISBN 978-9384378073
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996), ISBN 978-9384378073

1. Name of the Department: Chemistry						
2. Course Name	Chemical Technology & Society		**L**		**T**	**P**
3. Course Code	17030634		3		0	0
Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals.						
Lectures = 40	**Tutorials = 0**		**Practical = 0**			

8. Course Description:

This course will introduce students to different principles of chemical technology. Important processes and equipment employed will be described. Students will also be familiarized with how processes finalized in the Research and Development Laboratories.

Scientific literacy will be inculcated in order to gain a better understanding of complex environmental issues that face the modern world.

9. Course Objectives:

The objectives of this course are to:

1. Introduce students to different principles of chemical technology
2. Learn important processes employed in chemical technology,
3. Familiarize students with principles of clean technology.
4. Induce scientific literacy to understand interdisciplinary issues.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to :

1. build a basic knowledge of the process carried out in chemical industry.
2. review the practical importance and relevance of process used in chemical industry.
3. utilize the technological methods in problem solving in process plant.
4. build a bridge between theoretical and practical concept used in industry

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Title of the unit: Fermentation industry and Technology of soaps and Surfactants**

Introduction, Types of fermentation processes, Production of ethyl alcohol by fermentation, Industrial alcohol, manufacture of industrial alcohols.

Manufacturing of soap, Detergents, Raw materials for soap industry and their selection.

Unit-2	**Number of lectures=10**	**Title of the unit: Paper and Pulp industries and polymer industry**

Raw materials, pulping processes, recovery of chemicals, stock preparation and paper. Introduction to polymerization, commodity polymers, rayon, polyester, polyamide, acrylic fibre and nylons.

Unit-3	**Number of lectures = 8**	**Title of the unit: Sulphur, Phosphorous, Nitrogen and chloro-alkali industries.**

Origin and extraction of sulphur, production routes of suphuric acid and oleum, Manufacturing of phosphorus, phosphoric acid and phosphatic fertilizers. Manufacturing of ammonia, nitric acid, nitrogenous and mixed fertilizers.

Unit – 4	**Number of lectures = 12**	**Title of the unit: Safety in Chemical Process Industries**

Concept and definitions, safety culture, storage of dangerous materials, plant and plant layout, safety system, technology and process selection, scale of disaster. Vapour cloud, explosion, control of toxic chemicals, run away reactions, fire and explosion, high pressure relief system, hazardous properties of chemicals. Identification, minimization and analysis of hazard. Tackling disaster, plant of emergency, risk management routines, emergency shutdown systems, Role of computer in safety, prevention of hazard, human element, technology and process selection.

12. Brief Description of self-learning/ E – learning component

1. https://nptel.ac.in/courses/103103029/30
2. https://www.cleaninginstitute.org/sites/default/files/assets/1/AssetManager/SoapsandDetergents Book.pdf
3. http://www.ictmumbai.edu.in/uploaded_files/Polymer_Engg_and_Tech_all_Sem._Syllabus.pdf
4. https://nptel.ac.in/courses/103107086/
5. https://www.elsevier.com/books/biermanns-handbook-of-pulp-and-paper/bajpai/978-0-12-814240-0
6. https://biokamikazi.files.wordpress.com/2013/09/principles_of_fermentation_technology-stanburry_whittaker.pdf

13. Books Recommended

1. Gopala Rao M. and Marshall S; "Dryden's Outlines of Chemical Technology- for the 21st Century", Edited by Affiliated East-West Press, ISBN 978-8185938790
2. Moulijn J. K; Makkee M. and van Diepen A; "Chemical Process Technology", Wiley, 978-1-118-57074-6
3. Basta N; "Shreve's Chemical Process Industries Handbook", 5th Ed; McGraw Hill, 978-0071350112
4. A joint venture by IISc and IITs, funded by MHRD, Govt of India John W. Hill, Terry W. McCreary & Doris K. Kolb, Chemistry for changing times 13th Ed.
5. Pulp and Paper Science & Technology Vol. I & II by C.E.Libby
6. Pulp & Paper Manufacture Vol. I, II, III by Mac Donald, ISBN 978-0070509245
7. Hand Book of Pulp and Paper Technology by K.W. Britt 2nd edition, ISBN 978-8123911441
8. F.W. Billmeyer, ―Text Book of Polymer science‖, ISBN 978-0471031963
9. M.S. Bhatnagar, ―Text Book of polymer‖, ISBN 9788121941129
10. C.E. Dryden, ―Outlines of Chemical Technology‖, Affiliated East-West Press, 1973, ISBN 978-8185938790
11. D. Venkteshwaralu, ―Chemical Technology‖, I & III manuals of Chemical TechnologyChemical Engineering. Ed. Dev. III Madras, 1977.
12. Charles D.Fleddermann, ―Engineering Ethics‖, Prentice Hall, New Mexico, 1999, ISBN 978-0132145213
13. Safety in Process Plant Design‖, Wells, G.L. Godwin, London (1980), ISBN 978-0711455061
14. Loss Prevention in Process Industries‖, Lees, F.P. Butterworth, Oxford, ISBN 978-0123971890

1. Name of the Department: Department of Chemistry						
2. Course Name	Pharmaceutical Chemistry	**L**	**T**		**P**	
3. Course Code	17030635	3	0		0	
Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC ()**	**SEC (✓)**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practicals.		
Lectures = 40	**Tutorials = 0**	**Practical = 0**

8. Course Description:

The search for new drugs to treat serious diseases such as cancer, heart disease and bacterial and viral infections remains at the forefront of cutting-edge medical research. There is a demand in the pharmaceutical industry graduates with a strong background in organic chemistry, mixed with a broad understanding of pharmacology and related biochemical areas. This course offers the opportunity to study subjects allied to medical and pharmaceutical industries.

9. Course Objectives:

The objectives of this course are to:

1. Introduce students to drug discovery, design and development
2. Introduce students to drug metabolism.
3. Familiarize students with synthesis of representative drugs of classes, *e.g.*, analgesic agents, antipyretic agents, anti-inflammatory agents, antibiotics etc.
4. Explain aerobic and anaerobic fermentation and its use in production of selected products.
5. Explain cardiovascular drugs in detail.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Understand design of drug and its pathways of metabolism
2. Recognize representative classes of drugs, *e.g.*, analgesic agents, antipyretic agents, antibiotics etc.
3. Explain the production of selected drugs and Vitamins *via* the fermentation process.
4. Attain knowledge of cardiovascular drugs

11. Unit wise detailed content

Unit-1	**Number of lectures = 11**	**Title of the unit: Drug Design and Drug Metabolism**

Biotransformation, Factors Affecting Drug Metabolism, Pathway of Drug Metabolism-Phase-I, Phase-II and conjugation Reaction, Significance of Drug Metabolism in Medicinal Chemistry, Stereochemistry and Drug Action. Isosterism and Bioisosterism, Concept of Lead Compound, Computer Aided Drug Design and Molecular Modeling.

Unit-II	**Number of lectures = 10**	**Title of the unit: Medicinal Chemistry – I**

Synthesis of the representative drugs of the following classes:
analgesics agents, antipyretic agents & anti-inflammatory agents, Antibiotics, Antibacterial and antifungal agents.
Local Anaesthetics and Antiviral agents
Central Nervous System agents.

Unit-III	**Number of lectures = 10**	**Title of the unit: Medicinal Chemistry – II**

Cardiovascular Drugs: Introduction, Classification of Cardiovascular Diseases, Synthesis, Mode of Action, Uses and Side Effects of some representative drugs.
Drugs acting on Cardiovascular System: Cardiac glycosides, Anti-Arrhythmic agents, Anti-Anginal drugs, Anti-Hypertensive, Anti-Hyperlipidemic drugs.

Unit-IV	**Number of lectures = 9**	**Title of the unit: Medicinal Chemistry – III**

Introduction, Classification, Synthesis, Mode of Action, Uses and Side Effects of some representative drugs of the class: **Antimalarial, Antineoplastics, Adrenergics, Diagnostic Agents**

Aerobic and anaerobic fermentation. Production of Ethyl alcohol and citric acid, Vitamin B2, Vitamin B12 and Vitamin C.

12. Brief Description of self-learning/ E – learning component

1. https://www.fpharm.uniba.sk/uploads/media/Seminar_1_from_Pharmaceutical_chemistry_I_02.pdf
2. http://library.umac.mo/ebooks/b28050332.pdf
3. https://www.mheducation.co.uk/openup/chapters/9780335243976.pdf
4. http://www.d.umn.edu/~jfitzake/Lectures/MedSchool/Downloads/2006HistopathAntineoplasticsI.pdf

13. Books Recommended

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK, ISBN 978-0198749691.
2. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, ISBN 9788185731.
3. William O. Foye, Thomas L.,Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi, ISBN 978-1609133450

1. Course Name	Chemistry of Cosmetics & Perfumes	L	T	P
2. Course Code	17030636	3	0	0

3. Type of Course (use tick mark)	Core ()	DSE ()	AEC()	SEC (✓)	GE ()
4. Pre-requisite (if any)	NA	5. Frequency (use tick marks)	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

6. Total Number of Lectures, Tutorials, Practical		
Lectures = 40	Tutorials = 0	Practical = 0

7. Course Description:

This course provides training in chemistry with applications in perfumery and cosmetic science. You will have an integrated learning experience where you will build a strong chemistry foundation and apply your knowledge in specific applications using your senses.

8. Course Objectives:

The objectives of this course are to:

1. Understand the science behind Perfumes and Cosmetics.
2. Gain knowledge of Physical Properties of materials potentially used in cosmetics
3. To understand the various safety testing methods to evaluate the quality of the products.
4. To understand the preparation methods of various Perfumes and Cosmetics.

9. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Discover social and scientific concepts of human beauty
2. Understand necessities of cosmetic industry
3. Differentiate between herbal and synthetic cosmetics
4. Attain the knowledge of science behind cosmetics and perfumes.

10. Unit wise detailed content

Unit-1	Number of lectures = 11	Title of the unit: Chemistry of Cosmetics & Perfumes

Preparation and uses of the following: Hair dye, hair spray, shampoo, lipsticks, talcum powder, nail enamel, creams, antiperspirants and artificial flavors. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Moscone.

Unit-2	Number of lectures = 11	Title of the unit: Cosmetic Chemistry-II

Physical Properties of materials potentially used in cosmetics. Dielectric constant, including polarization of non-polar molecules refractive index, molar refraction, optical activity, interfacial tension, cohesion, adhesion and spreading adsorption at solid / liquid and solid /gas interfaces and their applications in cosmetics

Unit-3	Number of lectures = 9	Title of the unit: Cosmetic necessities

Acids, Bases, Buffers, Topical agents. protectives and antimicrobials, Astringents. Chemistry of emulsions in cosmetic formulation. Hazards in chemistry laboratories and necessary precautions.

Unit-4	Number of lectures = 9	Title of the unit: Herbal Cosmetics

Study of the sources, characters, chemical constituents, identification test & cosmetic uses of Lipids – Castor oil, Linseed oil, Olive oil, Arachis Oil, Coconut oil, shark liver oil, lanolin.

12. Brief Description of self-learning/ E – learning component

1. https://nptel.ac.in/courses/103107082/module4/lecture1/lecture1.pdf
2. https://youtu.be/GcfNQXk4-g8
3. https://youtu.be/vFdyJKfFwwg
4. https://youtu.be/GShqaPLndho
5. http://nopr.niscair.res.in/bitstream/123456789/27249/1/IJPAP%2052%283%29%20183-191.pdf

11. Books Recommended

1. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK, ISBN 0134573188
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi, ISBN 978-9384378073
3. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House,Meerut (1996), ISBN 978-8182838291.

1. Name of the Department : Department of Chemistry						
2. Course Name	Pesticide Chemistry	**L**	**T**		**P**	
3. Course Code	17030637	4	0		0	
4. Type of Course (use tick mark)		**Core ()**	**DSE ()**	**AEC()**	**SEC (✓)**	**GE ()**
5. Pre-requisite (if any)	NA	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practicals.						
Lectures = 52		**Tutorials = Nil**	**Practical = Nil**			

8. Course Description:

This course provides training in chemistry with applications in perfumery and cosmetic science. You will have an integrated learning experience where you will build a strong chemistry foundation and apply your knowledge in specific applications using your senses.

9. Course Objectives:

The objectives of this course are to:

1. Understand the classification of pesticides.
2. Learn the preparation methods of various pesticides.
3. Attain knowledge of Biopesticides.
4. Understand the hazards of pesticides.

10. Course Outcomes (COs):

Upon successful completion of this course, the student will be able to:

1. Deliver the usage and importance of pesticides.
2. Predict pollution hazards of pesticides
3. Explain importance of Biopesticides
4. Build knowledge about synthesis and manufacture of pesticides

11. Unit wise detailed content

Unit-1	**Number of lectures = 13**	**Title of the unit: Pesticide classification and chemical nature**

Pesticides (natural and synthetic), benefits, Pesticide classification on use, chemical nature, formulation, toxicity and action. Processes for manufacturing of insecticides, fungicides and herbicides.

Unit-II	**Number of lectures = 13**	**Title of the unit: Synthesis and technical manufacture of pesticides**

Changing concepts of pesticides, structure activity relationship.Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Lindane, Aldrin, Dialdrin, Gammexene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil), Anilides (Alachlor and Butachlor).

Unit-III	**Number of lectures = 13**	**Title of the unit: Pesticides pollution**

Pesticides and pollution of the soil, water ,Pesticide handling practices to protect ground water, Pesticide management, Soil & Water Pollution from Fertilizers, Eutrophicaton, diseases due to over use of fertilizers (likeBlue baby syndrome)

Unit-IV	**Number of lectures = 13**	**Title of the unit: Biopesticides**

Biopesticides, Weedicides (Anilophos, Butachlor, Diuron, 2,4-D, Fluchlorallin, Glyphosate, Isoproturon, Paraquat dichloride) , Plant Growth Regulant(Alpha naphthalene acetic acid,

Chloromequat chloride), Fumigants(Aluminiumphasphide, Ethylene bromide, Methyl bromide) , New Generation Insecticides, Insect Growth Regulators (IGRS)
12. Brief Description of self-learning/ E – learning component

1. https://nptel.ac.in/courses/104103020/26
2. https://nptel.ac.in/courses/103107082/module9/lecture1/lecture1.pdf
3. http;//en.wikkipedia.org/wiki/Biopesticide
4. https://nptel.ac.in/courses/103107081/39

13. Books Recommended
1. Cremlyn, R. Pesticides. Preparation and Modes of Action, John Wiley & Sons, New York, 1978, ISBN 978-1107063884. 2. Ohkawa.H, Miyagawa.H and Lee.P.W. Pesticide chemistry,Wiley-VCH verlag Gmbh & Co.2007, ISBN 9783527316632.

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Note:

The syllabus to be revised and updated every two years based upon the Academic, Industrial and Scientific needs.