Department of Chemistry

Programme: B.Sc	Year:1	**Semester:I**

Name of Faculty:

Dr. Renu Choudhary Unit III ,IV , V ,VII

Dr. Shital Panday Unit I, II, VI ,VIII

Paper-1**Subject:Chemistry**

CourseCode:B020101T	**CourseTitle:**FundamentalsofChemistry	Credits -4

Courseoutcomes:

There is nothing more fundamental to chemistry than the chemical bond. Chemical bonding is the language of logic forchemists. Chemical bonding enables scientists to take the 100-plus elements of the periodic table and combine them inmyriad ways to form chemical compounds and materials. Periodic trends, arising from the arrangement of the periodictable, provide chemists with an invaluable tool to quickly predict an element's properties. These trends exist because ofthe similar atomic structure of the elements within their respective group families or periods, and because of the periodicnature of the elements. Reaction mechanism gives the fundamental knowledge of carrying out an organic reaction in astep-by-step manner. This course will provide a broad foundation in chemistry that stresses scientific reasoning andanalytical problemsolvingwith a molecular perspective.Students will gainanunderstandingof

- Moleculargeometries,physicalandchemicalpropertiesof themolecules.
- Current bonding models for simple inorganic and organic molecules in order to predict structures and importantbondingparameters.
- ThechapterRecapitulationofbasicsoforganicchemistrygivesthemost primaryandutmostimportantknowledgeand concepts oforganic Chemistry.
- This course gives a broader theoretical picture in multiple stagesin an overall chemical reaction. It describesreactiveintermediates,transitionstatesandstatesofall thebondsbrokenandformed.It enablestounderstandthereactants,catalyst, steriochemistryand major andminor productsofanyorganicreaction.
- It describes the types of reactions and the Kinetic and thermodynamic aspects one should know for carrying outanyreaction andthe ways howthereaction mechanismcan bedetermined.

ThechaptersSteriochemistrygivestheclearpictureoftwo-dimensionalandthree-dimensionalstructureofthemolecules,andtheirrole inreaction mechanism.

Credits: 4	Elective
Max.Marks: 25+75	Min.PassingMarks-

TotalNo.ofLectures=60

Unit	**Topics**	**No. ofLectures**

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I	*Introduction to Indian ancientChemistry and contribution of Indian Chemists, in context to theholisticdevelopment of modernscienceandtechnology,shouldbeincludedunderContinues Evaluation(CIE)* **MolecularpolarityandWeakChemicalForces:** Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomicand polyatomic molecules), Percentage ionic character from dipole moment, polarizing power andpolarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waalsforces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction. Effects of weakchemical forces, melting and boiling points, solubility, energetics of dissolution process. Latticeenergyand Borrn-Haber cycle,solvationenergy, and solubilityofionic solids.	10
II	**SimpleBondingtheoriesofMolecules** Atomic orbitals, Aufbau principle, multiple bonding (σ and π bond approach) and bond lengths, thevalence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry,Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simplemoleculesandionscontainginglonepairsandbondpairsofelectrons:H_2O,NH_3,PCl_5,SF_6,SF_4, ClF_3,I_3^-,ClF_2^- andSO_4^{2-} andH_3O^+.Molecularorbitaltheory(MOT).Molecularorbitaldiagrams bondordersofhomonuclearandheteronucleardiatomicmoleculesandions(N_2,O_2,C_2,B_2,F_2,CO,NO,and theirions)	10
III	**Periodicproperties ofAtoms(withreferencetos&p-block)**: Briefdiscussion,factorsaffectingandvariationtrendsoffollowingpropertiesingroupsandperiods. Effectivenuclearcharge,shieldingorscreeningeffect,Slaterrules,Atomicandionicradii,Electronegativity,Pauling's/AllredRochow'sscales,Ionizationenthalpy,Electrongainenthalpy.	05
IV	**Recapitulation of basics of Organic Chemistry:** Hybridization, bond lengths and bond angles,bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusioncompounds, Clatherates, Charge transfer complexes, hyperconjugation, Dipole moment; ElectronicDisplacements: Inductive,electromeric,resonancemesomericeffectsandtheirapplications	05
V	**Mechanism of Organic Reactions:** Curved arrow notation, drawing electron movements withallows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types ofreagents–electrophilesandnucleophiles, Typesoforganicreactions,Energy considerations.Reactiveintermediates–Carbocations,carbanions,freeradicals,carbenes,arynesandnitrenes(withexamples).Assigningformalchargesonintermediatesandotherionicspecies.Methodsofdeterminationofreactionmechanism(productanalysis,intermediates,isotopeeffects,kineticand stereochemicalstudies).	10

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VI	**Steriochemistry**-Concept of isomerism, Types of isomerism; Optical isomerism – elements ofsymmetry,molecularchirality,enantiomers,stereogeniccenter,opticalactivity,propertiesofena ntiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo anderythrodiastereomers,mesocompounds,resolutionofenantionmer,inversion,retentionandrec emization. Relative and absolute configuration, sequence rules, D & L and R & S systems ofnomenclature. Geometric isomerism – determination of configuration of geometric isomers, E & Zsystem of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformationalisomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axialandequatorialbonds,conformationofmonosubstitutedcyclohexanederivatives,Newmanpr ojectionandSawhorseformulae,Fischer NewmanprojectionandSawhorseformulae,Fischerandflyingwedgeformulae,Differencebetwee n configurationandconformation	10
VII	**BasicComputersystem(inbrief)-** HardwareandSoftware;Inputdevices,Storagedevices,Outputdevices,CentralProcessingUnit(C ontrolUnitandArithmeticLogicUnit);Numbersystem(Binary,Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII)**;** Numeric/Stringconstants and variables. Operating Systems (DOS, WINDOWS, and Linux); Software languages:LowlevelandHighLevellanguages(Machinelanguage,Assemblylanguage;QBASIC, FORTRANandC++);SoftwareProducts(Office,chemsketch,scilab,matlab,hyperchem,etc.),int ernet application.	**05**
VIII	**MathematicalConceptsforChemistry** Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation offunctions like Kx, e^x, X^n , sin x, log x; maxima and minima, partial differentiation and reciprocityrelations, Integration of some useful/relevant functions; permutations and combinations, Factorials,Probability	**05**

SuggestedReadings:

1. Lee,J.D.ConciseInorganicChemistry,PearsonEducation2010
2. Huheey,J.E.,Keiter,E.A.,Keiter,R.L.,Medhi,O.K.InorganicChemistry,PrinciplesofS tructureandReactivity,Pearson Education 2006.
3. Douglas,B.E.andMcDaniel,D.H.,Concepts&ModelsofInorganicChemistry,Oxford,1970
4. Shriver,D.D.&P.Atkins,*InorganicChemistry2ndEd.,* Oxford UniversityPress,1994.
5. Day,M.C.andSelbin,J.TheoreticalInorganicChemistry,ACSPublications1962.
6. SinghJ.,YadavL.D.S.,AdvancedOrganicChemistry,PragatiEdition

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7. Morrison,R.N.&Boyd,R.N. *OrganicChemistry*,DorlingKindersley(India) Pvt.Ltd.(PearsonEducation).
8. Carey,F.A.,Guiliano,R.M.*OrganicChemistry*,Eighthedition,McGrawHillEducation,2012.
9. Loudon,G.M.*OrganicChemistry*,Fourthedition,OxfordUniversityPress,2008.
10. Clayden,J., Greeves, N. &Warren, S.*Organic Chemistry*,2nd edition, Oxford UniversityPress, 2012.
11. GrahamSolomons, T.W.,Fryhle, C. B. *Organic Chemistry*,JohnWiley&Sons,Inc.
12. Sykes,P.*AguidebooktoMechanism inOrganicChemistry*,PearsonEducation,2003
13. Francis**,P.G.**MathematicsforChemists,Springer,1984

Note:FortheпromotionofHindilanguage,coursebookspublishedinHindimaybeprescribed bytheUniversity

Suggested online links:http://heecontent.upsdc.gov.in/Home.aspx

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Department of Chemistry

Programme: B.Sc	Year:1	**Semester:II**

Name of Faculty:

Dr. Renu Choudhary Unit II, III, V, VII

Dr. Shital Panday Unit I, IV, VI , VIII

Paper-1 **Subject: Chemistry**

Course Code: B020201T	**CourseTitle: Bio-organic and Medicinal Chemistry**

Courseoutcomes: Biomoleculesareimportantforthefunctioningoflivingorganisms.Thesemoleculesperformortriggerimportantbiochemicalreactionsinlivingorganisms.Whenstudyingbiomolecules,onecanunderstandthephysiologicalfunctionthatregulatesthepropergrowthanddevelopmentofahumanbody.Thiscourseaimstointroducethestudentswithbasicexperimentalunderstandingofcarbohydrates,aminoacids,proteins,nucleicacidsandmedicinalchemistry.Uponcompletionofthiscoursestudentsmaygetjobopportunitiesinfood,beverageand pharmaceuticalindustries.

Credits: 4	Elective
Max.Marks: 25+75	Min. Passing Marks-
Total No.of Lectures=60	

Unit	**Topics**	**No. of Lectures**
I	**Chemistry of Carbohydrates** : Classification of carbohydrates, reducing and non-reducingsugars, General Properties of Glucose and Fructose, their open chain structure. Epimers,mutarotation and anomers. Mechanism of mutarotation Determination of configuration ofGlucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structureoffructose.Interconversionsofsugars(ascendinganddescendingofsugarseries,conversionof aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani-Fischermethod)andstepping–down(Ruff's&Wohl'smethods)ofaldoses;end-group-interchangeofaldosesLinkagebetweenmonosachharides,structureofdisacharrides(sucrose,maltose,lactose)andpolysacharrides(starchandcellulose)excludingtheirstructureelucidation	10

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II	**ChemistryofProteins:**Classification*ofaminoacids,*zwitterionstructureandIsoelectricpoint.Overviewofprimary,secondary,tertiaryandquaternarystructureofproteins.Determinationofprimarystructureofpeptides,determinationofN-terminalaminoacid(byDNFBandEdmanmethod)andC–terminalaminoacid(bythiohydantoinandwithcarboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection &C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturationMechanismofenzymeaction,factorsaffectingenzymeaction,Coenzymesandcofactorsand theirroleinbiologicalreactions,Specificityofenzymeaction(Includingstereospecifity),	10
III	**Chemistry of Nucleic Acids:**Constituents of Nucleic acids: Adenine, guanine, thymine andCytosine(Structureonly),Nucleosidesandnucleotides **(nomenclature**),Synthesisofnucleicacids,Structureofpolynucleotides;StructureofDNA(Watson-Crickmodel)andRNA(**typesofRNA**),GeneticCode,BiologicalrolesofDNAandRNA:Replication,Transcriptionand Translation	05
IV	**IntroductoryMedicinalChemistry:**Drugdiscovery,designanddevelopment;BasicRetrosynthe ticapproach.Drugaction-receptortheory.Structure–activityrelationshipsofdrugmolecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring, Synthesisoftherepresentativedrugsofthefollowingclasses:analgesicsagents,antipyreticagents,anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial andantifungalagents(Sulphonamides;Sulphanethoxazol,Sulphacetamide);antiviralagents(Acyclovir),CentralNervousSystemagents(Phenobarbital,Diazepam),Cardiovascular (Glyceryltrinitrate),HIV-AIDSrelateddrugs(AZT-Zidovudine	10
V	**SolidState** Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy ofinterfacialangles,(ii)Lawofrationalityofindicesandiii)Symmetryelementsincrystalsandlaw ofsymmetry.X-ray diffractionbycrystals.DerivationofBraggequation.Determination ofcrystalstructureofNaCl,KClandCsCl (Laue'smethod andpowder method).	05
VI	**IntroductiontoPolymer** Monomers, Oligomers, Polymers and their characteristics,Classification of polymers :Naturalsynthetic,linear,crosslinkedandnetwork;plastics,elastomers,fibres,Homopolymers and Co-polymers, Bonding in polymers : Primary and secondary bond forcesin polymers ; cohesive energy, and decomposition of polymers. Determination of Molecularmassofpolymers:NumberAveragemolecularmass(Mn)andWeightaveragemolecular mass(Mw) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii)	10

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	Gelpermeationchromatography(iv)Osmometryand Ultracentrifuging. **SiliconesandPhosphazenes**–Siliconesandphosphazenesasexamplesofinorganic polymers,natureofbondingintriphosphazenes	
VII	**KineticsandMechanismofPolymerization** Polymerization techniques, Mechanism and kinetics of copolymerization,Addition or chain-growthpolymerization,Freeradicalvinylpolymerization,ionicvinylpolymerization,Ziegler-Nattapolymerizationandvinylpolymers,Condensationorstepgrowth-polymerization, Polyesters,polyamides,phenolformaldehyderesins,ureaformaldehyderesins,epoxyresin andpolyurethanes,Naturalandsyntheticrubbers,Elementaryideaoforganicconducting polymers	05
VIII	**SyntheticDyes:**Colourandconstitution(electronicConcept),Classificationofdyes,Chemistryandsynthesisof Methylorange,Congored,Malachitegreen,crystalviolet, phenolphthalein,fluorescein,AlizarinandIndigo	05

SuggestedReadings:

1. Davis,B.G.,Fairbanks,A.J.,*CarbohydrateChemistry*,OxfordChemistryPrimer,OxfordUniversityPress.
2. Finar,I.L.*OrganicChemistry*(*Volume2),*DorlingKindersley(India)Pvt.Ltd.(PearsonEducation).
3. Nelson,D.L.&Cox,M.M. *Lehninger'sPrinciplesofBioch*emistry*7thEd.*,W. H.Freeman.
4. Berg,J.M.,Tymoczko, J.L.&Stryer, L. *Biochemistry 7th Ed.*, W. H. Freeman.
5. Morrison,R.T.&Boyd,R. N.*OrganicChemistry*,DorlingKindersley(India) Pvt.Ltd.(PearsonEducation).
6. Patrick,G.L.IntroductiontoMedicinalChemistry,OxfordUniversityPress,UK,2013.
7. Singh,H.&Kapoor,V.K.MedicinalandPharmaceuticalChemistry,VallabhPrakashan,Pitampura,NewDelhi,2012.
8. Atkins,P.W.&Paula,J.deAtkin'sPhysicalChemistryEd.,OxfordUniversityPress13(2006).
9. Ball,D.W. Physical ChemistryThomson Press,India (2007).
10. Castellan,G.W.PhysicalChemistry4thEd. Narosa(2004).
11. R.B.Seymour&C.E.Carraher:*PolymerChemistry:AnIntroduction*,MarcelDekker,Inc.NewYork,1981.
12. G.Odian: *Principles of Polymerization*, 4thEd.Wiley, 2004.
13. F.W. Billmeyer:*Textbookof Polymer Science*, 2ndEd. WileyInterscience,1971.
14. P.Ghosh:PolymerScience &Technology,Tata McGraw-HillEducation,1991

Note:ForthepromotionofHindilanguage,coursebookspublishedinHindi maybeprescribedbytheUniversity

Suggested online links:http://heecontent.upsdc.gov.in/Home.aspxhttps://nptel.ac.in/courses/104/105/104105124/https://nptel.ac.in/courses/103/106/105106204/https://nptel.ac.in/courses/104/105/104105034/https://nptel.ac.in/courses/104/103/104103121/https://nptel.ac.in/courses/104/102/104102016/https://nptel.ac.in/courses/104/106/104106106/https://nptel.ac.in/courses/104/105/104105120/

SuggestedContinuousEvaluationMethods: tests, assignments, presentations

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Curriculum Delivery and Planning

Department of Mathematics (PCM):-

Programme: B.Sc.	Year: First	**Semester**: First
Name of Faculty: Dr. Preeti Singh		
Course Title: The Differential Calculus and Integral Calculus		**Credits**: 4
Course Code: B030101T		Core Compulsory
Max. Marks: 25+75		Theory

Course Outcome:

- To give foundation knowledge for the students to understand basics of mathematics including applied aspects for developing enhanced quantitative skills and pursuing higher mathematics and research as well.
- By the time students complete the course they will have wide ranging application of the subject and have the knowledge of real valued functions such as sequences and series. They will also be able to know about convergence of sequence and series. Also they have knowledge about curvature, envelope and evolutes and trace curve in polar, Cartesian as well as parametric curves.
- The main object of the course is to equip the students with necessary analytic and technical skills. By applying the principles of integral he learns to solve a variety of practical problems in science and engineering.
- The students is equipped with standard concepts and tools at an intermediate to advance level that will serve him well towards taking more advance level course in mathematics.

Unit	Topics	No. of Lectures: 60
	Part- A **Differential Calculus**	
I	Introduction to Indian ancient Mathematics and Mathematicians should be include under continous Internal Evaluation. Neighborhood of a point bounded above sets, bounded below sets, Bounded sets, Unbounded sets, open sets/ interval, closed sets/ interval, limits points of a set isolated points. Limit, continuity and differentiability of function of single variable, Cauchy's definition uniform continuity , boundedness theorem, intermediate value theorem, extreme value theorem, Darboux's intermediate value theorem for derivatives and chain rule.	**09**
II	Rolle's theorem language and Cauchy Mean value theorems, Taylor's theorem with various forms of remainders, Successive differentiation, Leibniz theorem, Malcanrin's and Taylor's series partial differentiation Euler's theorem on homogenous function.	**07**
III	Tangent and Normal, Asymptotes, curvature, envelopes and evolutes, Tests for concavity and convexity, points of inflexion, Multiple points, parametric representation of curves and tracing of parametric curves, tracing of curves in Cartesian and Polar form.	**07**
IV	Definition of sequence, theorems or limits of sequences, bounded and monotonic sequence, Cauchy's convergence criterion, Cauchy sequence, limit superior and limit inferior of a sequence, subsequence,	**07**

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	series of non negative terms, convergence and divergence, comparison test, cauchy's integral test, Ratio tests, root test, Raabe's logarithmic test, De Morgan and Bertrand's tests, alternating series, Leibanitz' s theorem, absolute and conditional convergence.	
	Part- B **Integral Calculus**	
V	Concept of partition of interval, properties of partitions, Rienmann integral, criterion of Riemann Integrability of a function, Integrability of continuous and monotonic functions, fundamental theorem of integral calculus, Mean value theorem of integral calculus, differentiation under the sign of Integration.	**09**
VI	Improper integrals, their classification and convergence, comparison test, μ- test, Abel's test, Dirichle's test, quotation test, Beta and Gamma functions.	**07**
VII	Rectification, volumes and surfaces of solid of revolution, Pappus theorem, multiple integrals, change of order integration ,Dirichlet's theorem, liouville's theorem for multiple integrals.	**07**
VIII	Vector differentiation Gradient, Divergence and curl, Normal on a Surface, directional derivative, vector integration, statements of theorems, of Gauss, Green & Stokes, only without proof, Applications of these theorems for evaluation of double and triple.	**07**

Suggested Readings:

Part-A (Differential Calculus):-

- R.G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wily & sons, 1999
- T.M. Apostal , Clculus Vol. I , John Willy & Sons Inc. 1974
- Ajit Kumar and S. Kumarsen, A Basie Course in Real Analysis. CRC Press 2019
- G.B. Thomas and R.L. Finney, Calculus, Pearson Education , 2010

Part- B (Integral Calculus):-

- T.M. Apostal , Clculus Vol. II , John Willy & Sons Publication,1974
- Withold A.J. Kosmala. A Friendly Introduction to Analysis, Single and Multivariable, Pearson, 2003
- Shanty Narayan & P.K. Mittal Integral Calculus S. Chand, 2005
- Erwin Kreyszig Advanced Engineering Mathematics, John Willy & Sons, 20011

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Curriculum Delivery and Lesson Planning

Department of Mathematics (PCM):-

Programme: B.Sc.	Year: First	Semester: Second
Name of Faculty: Dr. Preeti Singh		
Course Title: Matrices and Differential Equations and Goemetry.		Credits: 4
Course Code: B080101T		Core Compulsory
Max. Marks: 25+75		Theory

Course Outcome:

- The subject of the course are designed in such a way that they focus on developing mathematical skills in algebra, calculus and analysis and give in depth knowledge of geometry, calculus, algebra, and other theories.
- The students will be able to find the rank, eigen values of matrices and study the linear homogenous and non- homogenous equations. The course in differential equation intends to develop problem solving skills for solving various types of differential equation and geometrical of differential equation.
- The subjects learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry.
- On successfully completion of the course students have gained knowledge about regular geometrical figures and their properties, they have the foundation for higher course in Geometry.

Unit	Topics	No. of Lectures: 90
	Part- A Matrices and differential Equations	
I	Types of matrices, elementary operations on matrices, rank of matrix system of linear homogenous and non- homogenous equations theorems on consistency of a system of linear equations. Echelon form of a matrix, normal form of a matrix, inverse of a matrix by elementary operations.	**12**
II	Eigen values, Eigen vectors and characteristics equation of matrix, Caley- Hamilton theorem and its applications in finding inverse of a matrix, Diagonalization of matrices.	**11**
III	Formation of differential equations, geometrical meaning of a differential equations, Equation of first order and first degree, Equation in which the variable are separable, Homogenous equations, Exact differential equations and equations reducible to the exact form linear differential equation.	**11**
IV	First order higher degree equations solvable for x,y,p, Clairaut's equation and singular solutions, orthogonal trajectories, linear differential equation of order greater than one with constant coefficients, Cauchy- Euler form.	**11**
	Part- B Geometry	
V	General equation of second degree. System of conics, Tracing of Conics, confocal conics, Polar equation of conics and its properties.	**12**
VI	Three dimensional coordinates. Projection and direction cosine, Plane (Cartesian and vector form), Straight line in three dimensions.	**11**
VII	Sphere, Cone, Cylinder.	**11**

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VIII	Central conicoid , Parabolas, plane section of conicoid, Generating lines, Confocal conicoid, Reduction of second degree equations.	**11**

Suggested Readings:

Part-A (Matrices and Differential Equations):-

- Shanti Narayan, A Textbook of Matrices, S Chand, 2010
- Fuzhen zhang, Matrix Theory- Basic Results and Techniques, Springer, 1999
- B Rai. D.P. Chaudhary & H.J. Freeedman, A Course in Differential Equations, Narosa, 2002
- William E Boyce and Richard C Di Prima, Elementary Differential Equations and Boundary Value Problems, John Willy and sons, 2009
- D.A. Murray, Introductory Course in Differential Equation.

Part- B (Geometry):-

- Robbert J T Bell, An Elementary Treatise on Coordinate Geometry of three dimensions. Macmillan India Ltd. 1923
- P.R.Vittal, Analytical Geometry 2D & 3D Pearson, 2013
- S.L. Loney The Elements of Coordinate Geometry McMillan and company, London, 2018

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Curriculum Delivery and Lesson Planning

Department of Physics (PCM)

Programme: B. Sc.	Year: First	Semester: First
Name of Faculty: Dr. Jyotshana Gaur		
Course Title: Mathematical Physics & Newtonian Mechanics		Credits: 4
Course Code: B010101T		Core Compulsory
Max. Marks: 25+75		Theory

Course Outcome:

- Perceive the difference between scalars, vectors, pseudo-scalars and pseudo-vectors.
- The physical interpretation of gradient, divergence and curl.
- Understand the connection and difference between Cartesian, spherical and cylindrical coordinate systems.
- Recognise the meaning of 4-vectors, Kronecker delta and Epsilon (Levi Civita) tensors.
- Study the origin of pseudo forces in rotating frame.
- Study the response of the classical systems to external forces and their elastic deformation.
- Understand the dynamics of planetary motion and the working of Global Positioning System (GPS).
- Understand the different features of Simple Harmonic Motion (SHM) and wave propagation.

Unit	Topics	No. of Lectures: 60
	Part A: Basic Mathematical Physics	
	Contribution of Indian Scientists: Contributions of Aryabhata, Vikram Sarabhai, C V Raman, S N Bose, M N Shaha, Subrahmanyam, Chandrasekhar. Chandrasekhar.	
I	**Vector Algebra:** Coordinate rotation, reflection and inversion for defining scalars, vectors, pseudo-scalars and pseudo-vectors (include physical examples). Component form in 2D and 3D. Geometrical and physical interpretation of addition, subtraction, dot product, wedge product, cross product and triple product of vectors. Position, separation and displacement vectors.	7
II	**Vector Calculus:** Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Green's theorem (statement only). Introduction to Dirac delta function.	8
III	**Coordinate Systems:** 2D & 3D Cartesian, Spherical and Cylindrical coordinate systems, basis vectors, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate	8

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	systems. Components of velocity and acceleration in different coordinate systems.	
IV	**Introduction to Tensors** Principle of invariance of physical laws w.r.t. different coordinate systems as the basis for defining tensors. contravariant, covariant & mixed tensors and their ranks, 4-vectors. Index notation and summation convention. Symmetric and skew-symmetric tensors. Examples of tensors in physics.	7
PART B: Newtonian Mechanics & Wave Motion		
V	**Dynamics of a System of Particles:** Review of historical development of mechanics up to Newton. Background, statement and critical analysis of Newton's axioms of motion. Dynamics of a system of particles, centre of mass motion, and conservation laws & their deductions. Rotating frames of reference.	8
VI	**Dynamics of a Rigid Body:** Angular momentum, Torque, Rotational energy and the inertia tensor. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants, bending of beam and torsion of cylinder.	8
VII	**Motion of Planets & Satellites:** Two particle central force problem, reduced mass, relative and centre of mass motion. Newton's law of gravitation, gravitational field and gravitational potential. Kepler's laws of planetary motion and their deductions. Motions of geo-synchronous & geo-stationary satellites and basic idea of Global Positioning System (GPS).	7
VIII	**Wave Motion:** Differential equation of simple harmonic motion and its solution, use of complex notation, damped and forced oscillations, Quality factor. Composition of simple harmonic motion, Lissajous figures. Differential equation of wave motion. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Principle of superposition of waves, stationary waves, phase and group velocity.	7

Suggested Readings:

PART A

1. Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017, 2e
2. A.W. Joshi, "Matrices and Tensors in Physics", New Age International Private Limited, 1995, 3e

PART B

3. Charles Kittel, Walter D. Knight, Malvin A. Ruderman, Carl A. Helmholz, Burton J. Moyer, "Mechanics (In SI Units): Berkeley Physics Course Vol 1", McGraw Hill, 2017, 2e
4. H. K. Malik and A.K. Singh "Engineering Physics", McGraw Hill Education (India) Private Limited, 2018, 2e.

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5. D.S. Mathur, P.S. Hemne, “Mechanics”, S. Chand Publishing, 1981, 3e

Books of local authors:

6. Mathematical Physics, B. D. Gupta, S. Chand Publiction
7. Mechanics & Wave Motion, Agrawal, Jain & Sharma, Krishna Prakashan, Meerut
8. यांत्रिकी □□□ □□□□ गति, अग्रवाल, □□□ □ □□□□□, □□□□□□ □□□□□□□, □□□□

Suggestive Digital Platforms / Web Links:

8. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
9. National Programme on Technology Enhanced Learning (NPTEL), https://www.youtube.com/user/nptelhrd
10. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchConte
11. Swayam Prabha – DTH Channel,https://www.swayamprabha.gov.in/index.php/program/current_he/8

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Ragh[illegible]duate College

Curriculum Delivery and Lesson Planning

Department of Physics (PCM)

Programme: B.Sc.	Year: First	Semester: Second
Name of Faculty: Dr. Jyotshana Gaur		
Course Title: Thermal Physics & Semiconductor Devices		Credits: 4
Course Code: B010201T		Core Compulsory
Max. Marks: 25+75		Theory

Course Outcome:

- Recognize the difference between reversible and irreversible processes.
- Understand the physical significance of thermodynamical potentials.
- Comprehend the kinetic model of gases w.r.t. various gas laws.
- Study the implementations and limitations of fundamental radiation laws.
- Utility of AC bridges.
- Recognize the basic components of electronic devices.
- Design simple electronic circuits.
- Understand the applications of various electronic instruments.

Unit	Topics	No. of Lectures: 60
	Part A: Thermodynamics & Kinetic Theory of Gases	
I	**0^{th} & 1^{st} Law of Thermodynamics:** State functions and terminology of thermodynamics. Zeroth law and temperature. First law, internal energy, heat and work done. Work done in various thermodynamical processes. Enthalpy, relation between C_P and C_V. Carnot's engine, efficiency and Carnot's theorem. Efficiency of internal combustion engines (Otto and diesel).	8
II	**2^{nd} & 3^{rd} Law of Thermodynamics:** Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes. Third law of thermodynamics and unattainability of absolute zero. Thermodynamical potentials, Maxwell's relations, conditions for feasibility of a process and equilibrium of a system. Clausius-Clapeyron equation, Joule-Thompson effect.	8
III	**Kinetic Theory of Gases:** Kinetic model and deduction of gas laws. Derivation of Maxwell's law of distribution of velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic)	7
IV	**Theory of Radiation:** Blackbody radiation, spectral distribution, concept of energy density and pressure of radiation. Derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan-Boltzmann law and Wien's displacement law from Planck's law.	7
	PART B: Circuit Fundamentals & Semiconductor Devices	

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V	**DC & AC Circuits:** Growth and decay of currents in RL circuit. Charging and discharging of capacitor in RC, LC and RCL circuits. Network Analysis - Superposition, Reciprocity, Thevenin's and Norton's theorems. AC Bridges - measurement of inductance (Maxwell's, Owen's and Anderson's bridges) and measurement of capacitance (Schering's, Wein's and de Sauty's bridges).	7
VI	**Semiconductors & Diodes:** P and N type semiconductors, qualitative idea of Fermi level. Formation of depletion layer in PN junction diode, field & potential at the depletion layer. Qualitative idea of current flow mechanism in forward & reverse biased diode. Diode abrication. PN junction diode and its characteristics, static and dynamic resistance. Principle, structure, characteristics and applications of Zener, Light Emitting, and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits and voltage regulated power supply.	8
VII	**Transistors:** Bipolar Junction PNP and NPN transistors. Study of CB, CE & CC configurations w.r.t. active, cutoff & saturation regions; characteristics; current, voltage & power gains; transistor currents & relations between them. Idea of base width modulation, base spreading resistance & transition time. DC Load Line analysis and Q-point stabilization. Voltage divider bias circuit for CE amplifier.	8
VIII	**Electronic Instrumentation:** Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance. Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, electron gun, electrostatic focusing and acceleration (no mathematical treatment). Front panel controls, special features of dual trace CRO, specifications of a CRO and their significance. Applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.	7

Suggested Readings:

1. M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997, 7e
2. F.W. Sears, G.L. Salinger, "Thermodynamics, Kinetic theory & Statistical thermodynamics", Narosa Publishing House, 1998
3. Enrico Fermi, "Thermodynamics", Dover Publications, 1956
4. S. Garg, R. Bansal, C. Ghosh, "Thermal Physics", McGraw Hill, 2012, 2e

PART B

5. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd.,
2015, 11e
6. A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015, 5e
7. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43e

Books of local authors:

1. Heat and Thermodynamics, Brij Lal Subrahmanyam
2. Refresher Course in Physics, C.L.Arora (for U.P. State Universities), S.Chand Publication
3. Kinetic Theory and Thermodynamics, Agrawal, Jain & Sharma, Krishna Prakashan, Meerut
4. Circuit fundamentals & Basic Electronics, Agrawal, Jain & Sharma, Krishna Prakashan, Meerut

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Continuous Evaluation Methods: Test and Presentation

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