Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat
Department of Physics
B.Tech. (Engineering Physics)

Second Year of Four Years B.Tech. (Engineering Physics)

Sr. No.	Subject	Code	Scheme L-T-P	Credits (Min.)	Notional hours of Learning (Approx.)
	Third Semester (2nd year of UG)				
1	Solid State Physics	EP201	3-0-2	4	85
2	Classical Mechanics	EP203	3-1-0	4	70
3	Statistical Mechanics	EP231	3-1-0	4	70
4	Elective #1	EP2AA	3-1-0	4	70
5	Professional Ethics, Economics and Business Management	MG210	3-1-0	4	70
			Total	**20**	**365**
6	Vocational Training / Professional Experience (Optional) (Mandatory for Exit)	EPV03 / EPP03	0-0-10	5	200 (20 x 10)
	Fourth Semester (2nd year of UG)				
1	Introduction to Mathematical Physics	EP202	3-1-0	4	70
2	Semiconductor Physics	EP204	3-0-2	4	85
3	Electrodynamics and its Applications	EP232	3-1-0	4	70
4	Elective #2	EP2BB	3-X-X	4/5	70/100
5	Artificial Intelligence	CS232	3-0-2	4	85
			Total	**20**	**380/410**
6	Minor / Honor (M/H#1)	EP2CC	3-1-0	4	70
7	Vocational Training / Professional Experience (Optional) (Mandatory for Exit)	EPV04 / EPP04	0-0-10	5	200 (20 x 10)

Sr. No.	Electives	Code	Scheme L-T-P
	Elective #1 (3rd semester)		
1	Advanced Quantum Mechanics	EP251	3-1-0
2	Discrete Mathematical Structure	MA205	3-1-0
3	Energy and Environmental Engineering	EG110	3-0-2
	Elective #2 (4th semester)		
1	Data Structures	CS102	3-1-2
2	Interpretative Molecular Spectroscopy	CY302	3-1-0
3	Introduction to Quantum Field Theory	EP252	3-1-0

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

24.04.2025

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech. - II, Semester - III SOLID STATE PHYSICS EP201	Scheme	L	T	P	Credit
		3	0	2	4

1.	Course Outcomes (COs): At the end of the semester students will be able to
CO1	Explain the basics of crystallography and identify the crystal structures, work out problems related to crystal structures, structure factors etc.
CO2	Demonstrate the concept of free electron theory of solids, understand Hall effect and its applications
CO3	Interpret the lattice vibrations, understand phonon and thermal properties of solids
CO4	Extend the concept of energy band theory by various methods, distinguish insulators, semiconductors, and metals
CO5	Examine the properties of superconductors and Superfluids

2.	Syllabus	
	CRYSTALLOGRAPHY	**09 Hours**
	Symmetry elements in crystals, Single crystals and usage, Defects in crystals, Techniques of growing and studying different crystals, Determination of crystal structures by X-ray diffraction, Formulations of Bragg & Von Laue equations and their equivalence, Laue condition and Ewald's construction, Rotating crystal method, Laue method, Powder crystal methods, Geometrical structure factor, Atomic form factors.	
	FREE ELECTRON THEORY	**06 Hours**
	Drude theory of metals-Widemann-Franz law, Hall effect, Sommerfeld theory of metals, Sommerfeld theory of conduction, Fermi energy, Failure of the free electron model.	
	LATTICE VIBRATION AND THERMAL PROPERTIES	**08 Hours**
	Einstein and Debye theory of specific heat, lattice vibrations in harmonic approximation, dispersion relations in monatomic and diatomic chains, optical and acoustic modes, concept of Brillouin zone, Quantization of lattice vibrations – phonons.	
	ENERGY BAND THEORY	**12 Hours**
	Band theory of solids, Periodic potentials and Schrödinger equation, Bloch theorem, Kronig-Penney model, Origin of band gap, Distinction between conductors, Insulators and semiconductors, Electrical resistance of materials, Equation of motion of an electron, Resistivity and conductivity, Brillouin zones, electron motion in one dimension, Effective mass, Concept of a hole, Tight binding method, Band structure of real semiconductors.	
	SUPERCONDUCTIVITY AND SUPERFLUIDITY	**10 Hours**

	Superconductivity: type-I and type-II superconductors, Meissner effect, London equations, BCS ground state, flux quantization in superconducting ring, Josephson junctions, high temperature superconductors., Superfluidity- Two fluid model.	
	Practical will be based on the coverage of the above topics separately	**(30 Hours)**
	(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3.	**PRACTICALS**
1	To measure Hall coefficient of Germanium and calculation of charge carrier.
2	To study of the dispersion relation for the mono-atomic lattice. Determination of the cut-off frequency of the mono-atomic lattice.
3	To determine the resistivity and energy band gap of a given material (Ge,Si) using four probe method.
4	To measure the Lande' g-factor in a free radical using an electron spin resonance spectrometer.
5	To study Crystal Growth by Solution method (KDP).
6	Ultrasonic Interferometer for the measurement of ultrasonic velocity in liquids.
7	Heat Capacity Kit for the measurement of heat capacity of solids.
8	To determine the Temperature Coefficient of a material.
9	Thermoelectric Effect Apparatus: To Study Thermoelectric Effect and to measure Seebeck and Peltier Coefficient.
10	Fourier Analysis Kit: to analyze any complex wave (square, clipped sine wave triangular wave etc.

4.	**Books Recommended**
1	C. Kittle, Introduction to Solid State Physics, Wiley India Edition, 2019.
2	S. S. Sastry, Introductory Methods of Numerical Analysis, 2nd Edition, PHI, 2012M. A. Omar, Elementary Solid State physics, Addison-Wesley Pvt. Ltd, New Delhi, 2000.
3	A. J. Dekker, Solid State Physics, Laxmi Publication, 2008
4	N. W. Ashcroft and N.D. Mermin, Solid State Physics, Holt-Saunders International Editing 1981.
5	W. A. Harrison, Solid State Theory, Tata McGraw Hill Education, 1970.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech.- II, Semester - III CLASSICAL MECHANICS EP203	Scheme	L	T	P	Credit
		3	1	0	4

1.	Course Outcomes (COs): At the end of the course, the students will be able to
CO1	Recall the terminology and concepts of Newtonian Mechanics, Lagrangian and Hamiltonian approach.
CO2	Interpret the Central force and small oscillations.
CO3	Understand the fundamentals of Lagrangian and Hamilton's principles.
CO4	Extend Lagrange's and Hamilton's equations for solving the equation of motion.
CO5	Solve problems on motion under central force and small oscillations.

2.	Syllabus	
	LAGRANGIAN FORMALISM	**(12 Hours)**
	Mechanics of single and many particles, Degrees of Freedom, Constraints, Generalized Coordinates, Principle of virtual work, D'Alembert's principle, Lagrange's equation and its applications	
	HAMILTONIAN FORMALISM	**(05 Hours)**
	Generalized momentum and conservation theorems, Hamilton's equations, Conservation of energy, Application of Hamiltonian dynamics	
	VARIATIONAL PRINCIPLE	**(06 Hours)**
	Calculus of variation, deduction of Euler-Lagrange's equations, Hamilton's principle, Δ-variation, principle of least action	
	TWO-BODY CENTRAL FORCE PROBLEM	**(07 Hours)**
	Equation of motion under a central force, Differential equation for orbits, Kepler's laws of planetary motion, Stability of orbit, scattering cross section, Rutherford scattering	
	CANONICAL TRANSFORMATION AND BRACKETS	**(08 Hours)**
	Canonical transformations, Point Transformations, generating functions, Poisson's Brackets, Angular momentum, phase space	
	SMALL OSCILLATIONS AND NORMAL MODES	**(07 Hours)**
	Potential energy in equilibrium, stable, unstable and neutral equilibrium, coupled oscillators, normal coordinates and normal modes, secular equation	

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	Tutorials will be based on the coverage of the above topics separately	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)	

3.	**Tutorials will be based on**
1.	virtual work and D'Alembert's principle
2.	Lagrangian formulation
3.	the Lagrange equation of motion
4.	Hamilton's equation in different coordinate systems
5.	Two-body central force and scattering cross-section
6.	variational principle
7.	Hamilton's principle
8.	transformations and generating functions
9.	Poisson's bracket
10.	normal mode frequencies

4.	**Books Recommended**
1.	Goldstein H., Classical Mechanics, Narosa, New Delhi, 2018.
2.	Goldstein H., Poole C. P., and Safko J., Classical Mechanics, 3rd Edition, Pearson, New Delhi, 2018.
3.	Landau L. D. & Lifshitz E. M., Course on Theoretical Physics, Vol. 1: Mechanics, Addison- Wesley, Boston, 2002.
4.	Abraham R., Marsden J. E., Foundations of Mechanics, 1st Edition, CRC Press, Boca Raton, 1994.
5.	Morin D., Introduction to Classical Mechanics With Problems and Solutions, Cambridge University Press, Cambridge, 2009.
Additional Reference Books	
1.	Thornton Stephen T., and Marion Jerry B., Classical Dynamics of Particle and Systems, Cengage Publications, Boston, 2012.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech.- II, Semester - III STATISTICAL MECHANICS EP231	Scheme	L	T	P	Credit
		3	1	0	4

1.	Course Outcomes (COs): At the end of the course, the students will be able to
CO1	Identify the correlation between statistics and thermodynamics.
CO2	Interpret the properties of microcanonical, canonical and grand canonical ensembles.
CO3	Examine the quantum statistics and density matrix for various systems.
CO4	Classify the consequences associated with Bose-Einstein and Fermi-Dirac statistics.
CO5	Analyze the phase equilibrium and transport phenomena.

2.	Syllabus	
	THE STATISTICAL BASIS OF THERMODYNAMICS	**(08 Hours)**
	The connection between statistics and thermodynamics; Concept of microstates phase space and its connection to Entropy; Classical Ideal Gas and the Maxwell Boltzmann Distribution, Entropy of mixing and Gibbs Paradox.	
	ELEMENTS OF ENSEMBLE THEORY	**(08 Hours)**
	Liouville's Theorem, Microcanonical Ensemble, Canonical Ensemble and Partition Function calculation for various systems; Energy fluctuations in the Canonical Ensemble; Grand Canonical Ensemble; Number Density and Energy Fluctuations in the Grand Canonical ensemble.	
	FORMULATION OF QUANTUM STATISTICS	**(12 Hours)**
	Quantum Statistics and calculation of the Density matrix for various systems; Indistinguishability of Particles, Symmetric and Anti - Symmetric wave functions and calculation of the Bose-Einstein and Fermi-Dirac Distribution for a quantum Ideal Gas; Thermodynamic behaviour of an Ideal Bose Gas.	
	IDEAL BOSE AND FERMI SYSTEM	**(12 Hours)**
	Black-Body radiation and other applications of Bose-Einstein statistics; Thermodynamic behaviour of an ideal Fermi gas and various applications of Fermi-Dirac statistics such as Pauli paramagnetism and calculation of Chandrasekhar limit in White Dwarf stars; Cluster expansion techniques for interacting systems.	
	PHASE EQUILIBRIUM AND TRANSPORT PHENOMENA	**(05 Hours)**
	Equilibrium conditions, classification of phase transitions, Clausius-Clapeyron and Van der waal's equation, Mean collision time, Scattering cross section, Viscosity etc.	
	Tutorials will be based on the coverage of the above topics separately.	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours= 60 Hours)	

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3.	**Tutorials will be based on**
1	the Ideal Gas and the Maxwell Boltzmann distribution.
2	the microstates and entropy.
3	the different ensemble and partition function.
4	the Liouville's theorem.
5	the number density and energy fluctuations.
6	the Fermi-Dirac distribution.
7	the Bose-Einstein distribution.
8	the Black-Body radiation and Chandrasekhar limit.
9	the ideal Bose gas.
10	the Clausius-Clapeyron and Van der Waal's equation.

4.	**Books Recommended**
1.	F. Reif, Fundamentals of statistical and thermal physics, Waveland Press, Long Grove, 2009.
2.	M. Kardar, Statistical physics of particles, Cambridge University Press, Cambridge, 2007.
3.	R. K. Pathria and P.D. Beale, Statistical Mechanics, 3rd edition, Academic Press, Cambridge, 2011.
4.	K. Huang, Statistical Mechanics, 2nd Ed., John Wiley & Sons, New York, 2008.
5.	B. B. Laud, Fundamentals of Statistical Mechanics, New Age Int. Pvt. Ltd., New Delhi, 2012.
Additional Reference Books	
1.	D. Yoshioka, Statistical Physics: An Introduction, Springer, Berlin, 2007.
2.	S. Chandra, A Textbook of Statistical Mechanics, CBS Publishers, New Delhi, 2016.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech. II, Semester - III ADVANCED QUANTUM MECHANICS EP251	Scheme	L	T	P	Credit
		3	1	0	4

1.	Course Outcomes (COs): At the end of the course students will be able to
CO1	Remember angular momentum operators and understanding their utilizations.
CO2	Interpret the fundamental phenomena associated with time-independent and time-dependent perturbation theories, and characteristics of scattering phenomena.
CO3	Explain various relativistic wave equations and applying them for solving relevant problems.
CO4	Understand and apply the Feynman formalism and path integrals for propagators.
CO5	Analyze important interpretations in quantum mechanics.

2.	Syllabus	
	INTRODUCTION	**(04 Hours)**
	Identical particles, The Variational principle, 1st and 2nd order time-independent perturbation theory.	
	THEORY OF ANGULAR MOMENTUM	**(06 Hours)**
	Finite and infinitesimal rotations, Matrix representations of J_x, J_y and J_z, Coupling of two angular momenta, Clebsch-Gordan (CG) coefficients.	
	TIME DEPENDENT PERTURBATION THEORY	**(08 Hours)**
	The interaction Picture, Time-dependent perturbation theory, Fermi's golden rule, Applications to interactions with the classical radiation field, Energy shift and decay width.	
	SCATTERING THEORY	**(10 Hours)**
	Green's functions, Lippmann-Schwinger equation, Born approximation, Optical theorem, Eikonal approximation, Scattering matrix, Free-particle states: Plane waves versus spherical waves, Method of partial waves, Low-energy scattering and the bound states, Resonance scattering, Identical particles and scattering, Symmetry considerations in scattering, Time-dependent formulation of scattering, Inelastic electron-atom scattering, Coulomb scattering.	
	RELATIVISTIC WAVE EQUATIONS	**(07 Hours)**
	Klein-Gordon equation, Continuity equation, Dirac equation, Algebra of Dirac matrices, Plane wave solutions, Prediction of antiparticles Pauli equation, Magnetic moment of the electron, Covariant form, Positiveness of probability density, Spin of electron, Pauli spin matrices, Parity, Charge conjugation, Time reversal operation.	
	PATH INTEGRALS	**(05 Hours)**
	The Dirac picture, Propagators, Transition amplitude and propagators, Sum over paths, Feynman formalism, Equivalence to Schrödinger equation, Solving for some potentials.	
	INTERPRETATIONAL PROBLEMS	**(05 Hours)**

	Double slit experiment, Born's interpretation of wave function, Schrödinger's cat experiment, Copenhagen and statistical interpretation, Hidden variable, Bell's inequality, EPR paradox.	
	Tutorials will be based on the coverage of the above topics separately	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)	

3.	**Tutorials will be based on**
1.	angular momentum matrices (J_x, J_y and J_z) and Clebsch-Gordan (CG) coefficients.
2.	time-independent perturbation theory.
3.	Zeeman effect, Stark effect and spin-orbit coupling.
4.	time-dependent perturbation theory, Fermi’s golden rule.
5.	Green’s functions and Lippmann-Schwinger equation.
6.	Born approximation, optical theorem and Eikonal approximation
7.	time-dependent formulation of scattering.
8.	inelastic electron-atom scattering, Coulomb scattering.
9.	Klein-Gordon equation, Dirac equation and algebra of Dirac matrices.
10.	important potentials using path integral technique.

4.	**Books Recommended**
1.	J. J. Sakurai, Advanced Quantum Mechanics, Pearson Education, New Delhi, 2011.
2.	N. Zettili, Quantum Mechanics: Concepts and Applications, Wiley, New Delhi, 2016.
3.	D. J. Griffiths and D. F. Schroeter, Introduction to Quantum Mechanics, Cambridge University Press, Cambridge, 2018.
4.	P. M. Mathews and K. Venkateshan, A Text book of Quantum Mechanics, McGraw Hill Education, Cambridge, 2017.
5.	R. P. Feynman and A. R. Hibbs, Feynman-Quantum Mechanics and Path Integral, Dover Publications Inc., New York, 2010.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) B. Tech. - II, Semester - III DISCRETE MATHEMATICAL STRUCTURE MA205	Scheme	L	T	P	Credit
		3	1	0	4

1.	**Course Outcomes (COs):** **At the end of the course, the students will be able to**
CO1	apply knowledge of Mathematical Logic in programming
CO2	analyze the problems for developing the solution, its correctness and performance using graphs
CO3	analyze the real-world problems using group theory, relations, lattices and Boolean algebra
CO4	develop an algorithm using Asymptotic analysis
CO5	design solutions for various types of problems in different disciplines like information security, optimization, mathematical analysis

2.	**Syllabus**	
	MATHEMATICAL LOGIC AND PROGRAM VERIFICATION	**(10 Hours)**
	Propositions, logical operators and propositional algebra, Predicates and quantifiers, Interaction of quantifiers with logical operators, Logical interference & proof techniques, Formal verification of computer programs (elements of Hoare logic).	
	GRAPH THEORY	**(10 Hours)**
	Graphs, Definition and basic concepts of finite and infinite graph, Incidence and Degree, Isomorphism, Subgraph, Walk, Path & Circuits, Operations on graphs, Connected Graph, disconnected graph and Components, Complete graph, Regular graph, Bipartite graph, Euler’s graph, Hamiltonian paths and Circuits, Weighted graphs, Applications, Directed & Undirected graphs, Connectivity of graphs.	
	TREES	**(06 Hours)**
	Definition & properties of trees, Pendent vertices in a tree, Distance between two vertices, Centre, Radius and diameter of a tree, Rooted and binary trees, Representation of Algebraic structure by Binary trees, Binary search trees, Spanning trees and fundamental circuits.	
	LATTICES	**(06 Hours)**
	Definition and properties of lattice, Sublattice, Distributive and modular lattices, Complemented andbounded lattices, Complete lattices.	

	BOOLEAN ALGEBRA	**(06 Hours)**
	Introduction, Definition, Properties of Boolean algebra, Boolean variables, Boolean expression, Boolean function, Min term, Max term, Canonical forms, Switching network from Boolean expression, Karnaugh map method.	
	ASYMPTOTIC ANALYSIS	**(07 Hours)**
	Complexity analysis, Time and storage analysis, Big-oh, Big-Omega, Big–Theta notation, Illustration and application to real problems.	
	Tutorials will be based on the coverage of the above topics separately.	**(15 Hours)**

(Total Contact Time: 45 Hours + 15 Hours= 60 Hours)

3.	**Tutorials will be based on**
1	Mathematical Logic and Verification.
2	Graph Theory.
3	Trees.
4	Lattices.
5	Boolean Algebra.
6	Asymptotic Analysis.

4.	**Books Recommended**
1	K. H. Rosen, Discrete Mathematics and its Applications, 6th Edition, McGraw-Hill, New York, 2006.
2	B. Kolman, R. C. Busby, and S. Ross, Discrete Mathematical Structure, 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3	J. P. Tremblay and R. Manohar, Discrete Mathematical Structure with Applications to Computer Science, McGraw Hill Book Co., New York, 1999.
4	N. Deo, Graph Theory with Applications to Engineering & Computer Science, Prentice Hall of India Pvt. Ltd., New York, 2000.
5	D. F. Stanat and D. F. McAllister, Discrete Mathematics in Computer Science, Prentice-Hall, New Jersey, 1977.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) B. Tech. - II, Semester – III PROFESSIONAL ETHICS, ECONOMICS AND BUSINESS MANAGEMENT MG210	Scheme	L	T	P	Credit
		3	1	0	4

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	Develop knowledge regarding Professional ethics and Economics in engineering.
CO2	Develop managerial skills to become future engineering managers.
CO3	Develop skills related to various functional areas of management (Marketing Management,Financial Management, Operations Management, Personnel Management etc.)
CO4	Build knowledge about modern management concepts.
CO5	Develop experiential learning through Assignments, Management games, Case studydiscussion, Group discussion, Group presentations etc.

2.	Syllabus	
	PROFESSIONAL ETHICS	**(06 Hours)**
	Introduction, Meaning of Ethics, Approaches to Ethics, Major attributes of Ethics, Business Ethics, Factors influencing Ethics, Importance of Ethics, Ethics in Management, Organizational Ethics, Ethical aspects in Marketing, Mass communication and Ethics - Television, Whistle blowing, Education – Ethics and New Professional, Intellectual Properties and Ethics, Introduction to Professional Ethics, Engineering Ethics.	
	ECONOMICS	**(09 Hours)**
	Introduction to Economics, Applications & Scopes Of Economics, Micro & Macro Economics, Demand Analysis, Demand Forecasting, Factors Of Production, Types Of Cost, Market Structures, Break Even Analysis.	
	MANAGEMENT	**(15 Hours)**
	Introduction to Management, Features Of Management, Nature Of Management, Development of Management Thoughts – Scientific Management By Taylor & Contribution of Henry Fayol, Coordination & Functions Of Management, Centralization & Decentralization, Decision Making; Fundamentals of Planning; Objectives & MBO; Types of Business Organizations: Private Sector, Public Sector & Joint Sector; Organizational Behavior: Theories of Motivation, Theories ofLeadership.	
	FUNCTIONAL MANAGEMENT	**(12 Hours)**
	Marketing Management: Core Concepts of Marketing, Marketing Mix (4p), Segmentation – Targeting – Positioning, Marketing Research, Marketing Information System, Concept of International Marketing, Operations Management: Introduction to Operations Management, Types of Operation Systems,	

	Types of Layouts, Material Handling, Purchasing & Store System, Inventory Management; Personnel Management: Roles & Functions of Personnel Manager, Recruitment, Selection, Training; Financial Management: Goal of Financial Management, Key Activities In Financial Management, Organization of Financial Management, Financial Institutions, FinancialInstruments, Sources of Finance.	
	MODERN MANAGEMENT ASPECTS	**(03 Hours)**
	Introduction to ERP, e – CRM, SCM, RE – Engineering, WTO, IPR etc	
	Tutorial: Case Study Discussion, Group Discussion, Management games and Assignments / Mini projects & presentation on related Topics.	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)	

3.	**Tutorials will be based on**
1	Case Study Discussion
2	Group Discussion
3	Management games
4	Assignments / Mini projects & presentation on related Topics

4.	**Books Recommended**
1	Balachandran V. and Chandrasekaran, Corporate Governance, Ethics and SocialResponsibility, PHI, 2nd Edition, New Delhi, 2011.
2	Prasad L.M., Principles & Practice of Management, Sultan Chand & Sons, 8th Edition, New Delhi, 2015.
3	Banga T. R. & Sharma S.C., Industrial Organisation & Engineering Economics, KhannaPublishers, 25th Edition, New Delhi, 2015.
4	Everett E. Adam, Ronald J. Ebert, Production and Operations Management, Prentice Hall ofIndia, 5th edition, New Delhi, 2012.
5	Kotler P., Keller K. L, Koshi A.& Jha M., Marketing Management – A South Asian Perspective,Pearson, 14th Edition, New Delhi, 2014.
Additional Reference Books	
1	Tripathi P.C., Personnel Management & Industrial Relations, Sultan Chand & sons, 21st Edition, New Delhi, 2013.
2	Chandra P., Financial Management Theory and Practice, Tata McGraw Hill, 11th Edition, New York, 2022.
3	Crane A. & Matten D., Business Ethics: Managing Corporate Citizenship and Sustainability in the Age of Globalisation, Oxford University, 4th edition, Oxford, 2016.
4	Fritzsche D. J., Business Ethics: a Global and Managerial Perspectives, McGraw Hill Irwin,Singapore, 2005.
5	Mandal S. K., Ethics in Business and Corporate Governance, Tata McGraw Hill, New York, 2011.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) B. Tech. - II, Semester - III **ENERGY AND ENVIRONMENTAL ENGINEERING EG110**	**Scheme**	**L**	**T**	**P**	**Credit**
		3	**0**	**2**	**4**

1.	**Course Outcomes (COs): At the end of the course, the students will be able to**
CO1	explain the components of ecosystems, various biogeochemical cycles and importance of different urban network services
CO2	differentiate between various types of environmental pollution along with their impacts and regulatory standards
CO3	examine various global environmental issues and their management
CO4	discuss the fundamental principles of energy, including classification, conservation and related policy frameworks and regulations**.**
CO5	get acquainted with the concept of energy systems and their components

2.	**Syllabus**	
	ENVIRONMENT AND ECOSYSTEMS	**(10 Hours)**
	Introduction: Concept of an ecosystem - structure and functions of ecosystem; Components of ecosystem - producers, consumers, decomposers; Food chains, food webs, ecological pyramids, energy flow in ecosystem; Bio-geochemical cycles, hydrologic cycle Components of environment and their relationship, impact of technology on environment, environmental degradation, environmental planning of urban network services such as water supply, sewerage, solid waste management; closed loop cycle, concepts of sustainability	
	ENVIRONMENTAL POLLUTION	**(10 Hours)**
	Water, air, soil, noise, thermal and radioactive, marine pollution - sources, effects and engineering control strategies; Centralized and decentralized treatment system, Drinking water quality and standards, ambient air and noise standards	
	GLOBAL ENVIRONMENTAL ISSUES AND ITS MANAGEMENT	**(10 Hours)**
	Engineering aspects of climate change, concept of carbon credit, CO2 sequestration, concepts of environmental impact assessment and environmental audit, life cycle assessment	
	BASICS OF ENERGY AND ITS CONSERVATION	**(07 Hours)**
	Classification of energy sources, Global and national energy scenario, Fossil and alternate fuels and its characterization. General aspects of energy conservation and management; Energy conservation act, Energy policy of company; Need for energy standards and labelling; Energy building codes.	

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	INTRODUCTION TO ENERGY CONSERVATION SYSTEMS	**(08 Hours)**
	Energy conversion systems: Working principle, Basic components, General functioning and normal rating specifications of various energy conversion systems like Power plant, Pump, Refrigerator, Air-conditioner, Internal combustion engine, Solar PV cell, Solar water heating system, Biogas plant. Wind turbine, Fuel cells.	
	Practical will be based on the coverage of the above topics separately	**(30 Hours)**
	(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3.	**Practicals will be based on**
11	Determination of I-V Characteristics of solar PV Panel.
10	Study of electricity and or gas bill
11	Study of pollutants from diesel Engine
10	Study of pollutants from petrol Engine
11	Comparison of pollutants from SI and CI Engines.
11	Determination of I-V Characteristics of solar PV Panel.
10	Study of electricity and or gas bill
11	Study of pollutants from diesel Engine
10	Study of pollutants from petrol Engine

4.	**Books Recommended**
1	Daniel B Botkin & Edward A Keller, Environmental Sciences, John Wiley & Sons, New York, 2010.
2	R. Rajagopalan, Environmental Studies, Oxford University Press, Oxford, 2015.
3	Benny Joseph, Environmental Studies, McGraw Hill publishers, New York, 2017.
4	Suresh Dhameja, Environmental Studies, S K Kataria & Sons, New Delhi, 2007.
5	U K Khare, Basics of Environmental Studies, Tata McGraw Hill, New York, 2011.
Additional Reference Books	
1	C S Rao, Environmental Pollution Control Engineering, New Age International Publishers, New Delhi, 2018.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech. II, Semester-IV INTRODUCTION TO MATHEMATICAL PHYSICS EP202	Scheme	L	T	P	Credit
		3	1	0	4

1.	**Course Outcomes (COs):** **At the end of the course, the students will be able to**
CO1	Define groups, rings, vector spaces, similar matrices, row space, column space, null space, linear functional and dual space.
CO2	Explain the Frobenius method for solving the second order ordinary differential equations.
CO3	Extend the concept of vectors to tensors and classify the tensors according to their rank, dimension and transformation law.
CO4	Show that the eigenvalues for a Hermitian matrix is always real, Legendre polynomials forms a complete basis set.
CO5	Apply the Laplace transform in the physical problems related to the solution of ordinary differential equation.

2.	**Syllabus**	
	VECTOR SPACES & LINEAR TRANSFORMATION	**(12 Hours)**
	Binary operations and relations, Introduction to Groups, Rings, Fields, Subspaces, Vector Spaces and Subspaces, Basis and dimension, Linear independence of vectors, Coordinates, Homomorphism and Isomorphism of Vector Spaces, Change of basis. Linear transformation, Algebra of linear transformations, Non-singular transformations, Representation of linear transformations by matrices, Row space, Column space, Null space, Rank-nullity theorem, Duality and transpose, Linear functional and dual space.	
	EIGEN VALUES & EIGEN VECTORS	**(11 Hours)**
	Eigen values and Eigen vectors of a matrix, Properties of Eigen-values and Eigen vectors of orthogonal, hermitian and unitary matrices, Echelon form and rank of matrix, Minimal & characteristic polynomials, similar matrices, Diagonalization and function of matrices, Cayley-Hamiliton theorem and inverse of a matrix.	
	LAPLACE TRANSFORM & TENSOR ANALYSIS	**(10 Hours)**
	Laplace Transform: Definition, Convergence, Continuity requirement and basic properties of Laplace transform, Inverse of Laplace transform, Translation theorem, Application of Laplace transform to Gamma function, periodic function, ordinary differential equation, Convolution theorem. Vectors and indices: Transformation properties of vectors, Covariant and contravariant vectors; From vectors to tensors: Algebraic properties of tensors, Metric tensor: Index raising and lowering, Index contraction	
	FROBENIUS METHOD & SPECIAL FUNCTIONS	**(12 Hours)**
	Series solution to ordinary differential equations (ODE), Singular points and their classification, Frobenius method for second order ODE, Solution to Bessel, Hermite, Legendre differential equations. Generating function and recurrence relations for Legendre polynomials, Associated Legendre functions, Spherical harmonics, Legendre functions of the second kind, Vector spherical harmonics,	

Subject Code:##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

	Bessel function of the first kind, Neumann functions, Modified Bessel's functions, Asymptotic form of Bessel and Neumann functions	
	Tutorials will be based on the coverage of the above topics separately.	**(15 Hours)**
		(Total Contact Time: 45 Hours + 15 Hours= 60 Hours)

3.	**Tutorials will be based on**
1	the concepts of groups, fields, rings and subspace.
2	the understanding difference between the basis, dimension, and coordinates.
3	Some quantum mechanical and classical mechanical problems based on linear transformation and matrix algebra.
4	Proof of rank-nullity theorem, problem based on the properties of eigen values of Hermitian matrix.
5	minimal polynomial, characteristic polynomial, and diagonalization of a matrix.
6	the Cayley-Hamilton theorem and its application to find the inverse of matrix.
7	the transformation law and algebraic properties of covariant and contravariant tensor.
8	Laplace transform and its applications.
9	the concept of singularity and classification of singularities in ordinary differential equation.
10	Bessel function, Legendre function, and spherical harmonics, and recurrence relations.

4.	**Books Recommended**
1.	Starkovich S. P., The structures of mathematical physics: An introduction, Springer, New York, 2022.
2.	Schobeiri M. T., Tensor analysis for engineers and physicists - with application to continuum mechanics, turbulence, and Einstein's special and general theory of relativity, Springer, New York, 2021.
3.	Balakrishnan V., Mathematical physics: Applications and problems, Springer, New York, 2020.
4.	Kreyszig E., Advanced Engineering Mathematics, Wiley, New York, 2020.
5.	Limaye B.V., Functional analysis, New Age International Publishers, New Delhi, 2014.
Additional Reference Books	
6.	Grinfeld P., Introduction to tensor analysis and the calculus of moving surfaces, Springer, New York, 2013.
7.	Riley K. F., Hobson M. P., and Bence S. J., Mathematical methods for physics and engineering: a comprehensive guide, Cambridge university press, Cambridge, 2006.
8.	Hoffman K. and Kunze R., Linear algebra, PHI, New Delhi, 1991.
9.	Kreyszig E., Introductory functional analysis with applications, John-Wiley & Sons, New York, 1989.
10.	Lang S., Introduction to linear algebra (Undergraduate text in Mathematics), Springer, New York, 1986.

SardarVallabhbhai National Institute of Technology (SVNIT) Surat

second Year of Four Years of B.Tech. (Engineering Physics) B.Tech. II, Semester-IV SEMICONDUCTOR PHYSICS EP204	Scheme	L	T	P	Credit
		3	0	2	4

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	Understand major properties of semiconductor materials.
CO2	Explain energy band diagrams and connections with the device structures and properties.
CO3	Identify the principle of operation and structure of Thyristor family.
CO4	Interpret the concept of heterojunction devices and their applications, and characteristics of various photonic devices.
CO5	Appraise major steps of semiconductor device fabrication and microelectronic industry trends.

2.	Syllabus:	
	INTRODUCTION	**(06 Hours)**
	Semiconductor Fundamentals, intrinsic & extrinsic semiconductors, carrier concentration and Fermi-level. Scattering and Drift, Mobility, Hall Effect, excess carriers, Metal Semiconductor Contacts (Schottky and Ohmic), Schottky barriers; Schottky barrier height, C-V characteristics, current flow across Schottky barrier: thermionic emission	
	VARIOUS FET DEVICES: INTRODUCTION, CHARACTERISTICS AND APPLICATION	**(06 Hours)**
	Types of FET, JFET, De-MOSFET, E-MOSFET, SIT, IGBT: Structure and principle of operation, FETs configuration as an amplifier, FETs analysis as resistors and capacitors, operation of CMOSFET.	
	PNPN: INTRODUCTION, CHARACTERISTICS AND APPLICATION	**(06 Hours)**
	Uni-junction Transistor UJT, Shockley Diode, silicon-controlled rectifier, Device structure, Principle of operation, Equivalent circuit, Applications.	
	DIAC, TRIAC: INTRODUCTION, CHARACTERISTICS AND APPLICATION	**(06 Hours)**
	Structure of DIAC, DIAC Principle of operation, Structure and principle of operation of TRIAC, Applications of TRIAC.	
	INTRODUCTION TO THE HETERO JUNCTIONS AND APPLICATIONS	**(06 Hours)**
	Compound semiconductors, Concept of Heterojunction, Multilayer Heterojunction, Energy band diagram for Heterojunction, Confinement of charge carrier, Application of Heterojunction. HEMT (MODFET), MESFET, HBT	
	PHOTONIC DEVICES: INTRODUCTION, CHARACTERISTICS AND APPLICATION	**(06 Hours)**
	Light Emitting Diode (LED), Characteristics of LED, Materials and wavelength of light, Laser diode, Structure, Characteristics of laser diode, Photodiode and solar cell, Display devices,	

	Operation of LCDs, LED, HDTV, Plasma displays	
	MICROWAVE DEVICES: INTRODUCTION, CHARACTERISTICS AND APPLICATION	**(06 Hours)**
	TRANSDUCERS	**(03 Hours)**
	Introduction, Passive Electrical Transducers, Resistive Transducers, Resistance Thermometers, Thermistor. Linear Variable Differential Transformer (LVDT). Active Electrical Transducers, Piezoelectric Transducer, Photoelectric Transducer.	
	Practical will be based on the coverage of the above topics separately	**(30 Hours)**
	(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3.	**Practicals will be based on**
1.	Study of the characteristics of Unijunction Transistor (UJT) and to calculate interbase resistance and intrinsic standoff ratio.
2.	To study the V-I characteristic of TRIAC with positive and negative biasing and plot the curve between V & I.
3.	To study the phenomenon of holding current and latching current in TRIAC.
4.	To study the RC Phase shift oscillator using BJT.
5.	To study the V-I characteristic of DIAC with positive biasing and plot the curve between V & I.
6.	Study and plot V-I characteristic of SCR.
7.	To study the phenomenon of holding current and latching current in SCR.
8.	To study the triggering of SCR using OP-AMP 741 and to study the application of SCR in alarm circuit.
9.	Study and plot V-I characteristic of MOSFET.
10.	Characteristics of Solar cell.

4.	**Books Recommended**
1.	M. S. Tyagi, Introduction to Semiconductor Materials and Devices, Wiley, New York, 2015.
2.	S.M. Sze (Ed), Physics of Semiconductor Devices, 3rd Edition, Wiley, New York, 2015.
3.	D. Neamen, Semiconductors Physics and Devices, 4th Ed., Tata Mc Graw Hill, New York, 2017.
4.	B. Streetman and S. Banerjee, Solid State Electronic Devices, Pearson, New Delhi, 2005.
5.	R. L. Boylestad and L. Nahselsky, Electronic Devices and Circuit Theory, Prentice Hall, New Delhi, 2005.
Additional Reference Books	
1.	Schilling D.L. and Belove, C., Electronic Circuits : Discrete and Integrated, 3rd Edition, McGraw Hill, New York, 2002.

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Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) B. Tech. - II, Semester - IV ELECTRODYNAMICS AND ITS APPLICATIONS EP232	Scheme	L	T	P	Credit
		3	1	0	4

1.	**Course Outcomes (COs):** **At the end of the course, students will be able to**
CO1	Build the concept of Maxwell's equations and make use of them to determine the boundary conditions; Explain the conservation laws in electrodynamics.
CO2	Demonstrate the propagation characteristics of electromagnetic waves in bounded and unbounded mediums.
CO3	Simplify the Maxwell's equations by writing them in terms of potentials and find out its solutions.
CO4	Analyze the various sources of electromagnetic radiations.
CO5	Explain the various applications of electrodynamics.

2.	**Syllabus**	
	ELECTRODYNAMICS	**(07 Hours)**
	Electromotive force and motional emf, Faraday's law of electromagnetic induction and energy in the magnetic fields, Maxwell's equations, Maxwell's correction in ampere's law, Maxwell's equations in matter, boundary conditions.	
	CONSERVATION LAWS IN ELECTRODYNAMICS	**(06 Hours)**
	The Continuity equation, Poynting's theorem, Newton's third law in electrodynamics, Maxwell's stress tensor, Conservation of momentum and angular momentum	
	ELECTROMAGNETIC WAVES	**(10 Hours)**
	Waves in one dimension, Electromagnetic waves in vacuum and in matter, Absorption and dispersion in matter.	
	POTENTIALS AND FIELDS	**(08 Hours)**
	Scalar and vector potentials, Gauge transformations, Coulomb gauge and Lorentz gauge, Retarded potentials, Jefimenko's equations, Lienard-Wiechert potentials, The Fields of a moving point charge	
	RADIATION	**(10 Hours)**
	Electric and magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charges, Radiation reaction.	
	APPLICATIONS OF ELECTRODYNAMICS	**(04 Hours)**

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	Guided waves, Microwaves, Optical Fiber, Antennas.	
	Tutorials will be based on the coverage of the above topics separately	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)	

3.	**Tutorials will be based on**
1.	Ohm's law, Electromotive force, Motional EMF.
2.	Faraday's law, Inductance, Maxwell's equations, Boundary conditions.
3.	Some short and long theoretical questions to understand the concept of charge, energy and momentum conservations, Poynting's Theorem, Maxwell's stress tensor.
4.	the propagation of electromagnetic waves in vacuum and matter.
5.	absorption and dispersion of EM waves in conductors.
6.	wave guides.
7.	Coulomb Gauge and Lorentz Gauze.
8.	the calculation of potentials and fields in electrodynamics.
9.	various sources of the radiation such as electric dipole, magnetic dipole and arbitrary source.
10.	the applications of electrodynamics.

4.	**Books Recommended**
1.	Classical Electrodynamics by John David Jackson, 3rd Edition, Wiley, New York, 2018.
2.	Introduction to Electrodynamics by David J. Griffiths, 3rd Edition, Pearson Educ., New Delhi, 2008.
3.	Elements of Electromagnetics by Matthew N. O. Sadiku, 6th Edition, Oxford university press, Oxford, 2014.
4.	The Classical Theory of Fields, Course of Theoretical Physics: Vol. 2 by L. D. Landau, E. M. Lifshitz, 3rd Edition, Pergamon Press, Oxford, 1967.
5.	Field and Wave Electromagnetics by David K. Cheng, 2nd Edition, Pearson Education, New Delhi, 2001.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) **B. Tech. - II, Semester - IV** **DATA STRUCTURES** **CS102**	**Scheme**	**L**	**T**	**P**	**Credit**
		3	**1**	**2**	**5**

1.	**Course Outcomes (COs):** **At the end of the course, students will be able to**
CO1	Recognize the need of different data structures and understand its characteristics.
CO2	Apply different data structures for given problems.
CO3	Design and analyze different data structures, sorting and searching techniques.
CO4	Evaluate data structure operations theoretically and experimentally.
CO5	Solve for complex engineering problems.

2.	**Syllabus**	
	BASICS OF DATA STRUCTURES	**(02 Hours)**
	Review of Concepts: Information and Meaning, Abstract Data Types, Internal Representation of Primitive Data Structures, Arrays, Strings, Structures, Pointers.	
	LINEAR LISTS	**(06 Hours)**
	Sequential and Linked Representations of Linear Lists, Comparison of Insertion, Deletion and Search Operations for Sequential and Linked Lists, Doubly Linked Lists, Circular Lists, Lists in Standard Template Library (STL), Applications of Lists.	
	STACKS	**(06 Hours)**
	Sequential and Linked Implementations, Representative Applications such as Recursion, Expression Evaluation Viz., Infix, Prefix and Postfix, Parenthesis Matching, Towers of Hanoi, Wire Routing in a Circuit, Finding Path in a Maze.	
	QUEUES	**(06 Hours)**
	Operations of Queues, Circular Queue, Priority Queue, Dequeue, Applications of Queues, Simulation of Time Sharing Operating Systems, Continuous Network Monitoring System Etc.	
	SORTING AND SEARCHING	**(04 Hours)**
	Sorting Methods, Bubble Sort, Selection Sort, Quick Sort, Radix Sort, Bucket Sort, Dictionaries, Hashing, Analysis of Collision Resolution Techniques, Searching Methods, Linear Search, Binary Search, Character Strings and Different String Operations.	
	TREES	**(08 Hours)**
	Binary Trees and Their Properties, Terminology, Sequential and Linked Implementations, Tree Traversal Methods and Algorithms, Complete Binary Trees, General Trees, AVL Trees, Threaded Trees, Arithmetic Expression Evaluation, Infix-Prefix-Postfix Notation Conversion, Heaps as Priority Queues, Heap Implementation, Insertion and Deletion Operations, Heapsort, Heaps in Huffman Coding, Tournament Trees, Bin Packing.	

	MULTIWAY TREES	**(04 Hours)**
	Issues in Large Dictionaries, M-Way Search Trees, B Trees, Search, Insert and Delete Operations, Height of B-Tree, 2-3 Trees, Sets and Multisets in STL.	
	GRAPHS	**(06 Hours)**
	Definition, Terminology, Directed and Undirected Graphs, Properties, Connectivity in Graphs, Applications, Adjacency Matrix and Linked Adjacency Chains, Graph Traversal, Breadth First and Depth First Traversal, Spanning Trees, Shortest Path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths.	
	Tutorials will be based on the coverage of the above topics separately.	**(14 Hours)**
	Practicals will be based on the coverage of the above topics separately.	**(30 Hours)**
	(Total Contact Time: 45 Hours + 14 Hours + 30 Hours = 89 Hours)	

3.	**Tutorials will be based on**
1	Problems on Array
2	Problems on Stack and Queue
3	Problems on Linked List
4	Problems on Trees
5	Problems on Graph

4.	**Practicals will be based on**
1	Implementation of Array and its applications
2	Implementation of Stack and its applications
3	Implementation of Queue and its applications
4	Implementation of Link List and its applications
5	Implementation of Trees and its applications
6	Implementation of Graph and its applications
7	Implementation of Hashing function and collision resolution techniques
8	Mini Project (Implementation using above Data Structure

5.	**Books Recommended**
1.	Trembley and Sorenson, An Introduction to Data Structures with Applications, 2nd Edition, Tata McGraw Hill, New York, 1991.
2.	Tanenbaum and Augenstein, Data Structures using C and C++, 2nd Edition, Pearson, New Delhi, 2007.
3.	Horowitz and Sahani, Fundamentals of Data Structures in C, 2nd Edition, Silicon Press, San Francisco, 2007.
4.	T. H. Cormen, C. E. Leiserson, and R. L. Rivest, Introduction to Algorithms, 3rd Edition, MIT Press, Cambridge, 2009.
5.	Robert L. Kruse, C. L. Tondo and Brence Leung, Data Structures and Program Design in C, 2nd Edition, Pearson Education, New Delhi, 2001.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B.Tech. (Engineering Physics) B.Tech. - II, Semester - IV INTERPRETATIVE MOLECULAR SPECTROSCOPY CY302	Scheme	L	T	P	Credit
		3	1	0	4

1.	Course Outcomes (COs): At the end of the course, the students will be able to
CO1	Understand the theories and basic principles of spectroscopic techniques.
CO2	Acquire knowledge on the effect of solvent and hydrogen bonding on vibrational frequencies.
CO3	Identify the organic functional groups by spectroscopic techniques.
CO4	Learn gas-phase reactions and to predict the fragmentation of organic molecules by mass spectrometry.
CO5	Interpret an unknown structure, or solve a structure-related problem by utilizing spectroscopic data.

2.	Syllabus	
	UV-VISIBLE ABSORPTION AND EMISSION SPECTROSCOPY	**(10 Hours)**
	Mechanism of absorption and emission of radiation by organic compounds, shape of absorption and emission bands and Franck-Condon principle. Various electronic transitions, Lambert-Beer law, effect of solvent on electronic transition, Ultraviolet bands for carbonyl compound, unsaturated carbonyl compounds, conjugated unsaturated compounds, Woodward-Fieser's rules for conjugated dienes and unsaturated carbonyl compounds, UV spectra of aromatic and heterocyclic compounds steric effect in biphenyls. Principles, origin of fluorescence and phosphorescence spectra, instrumentation and applications.	
	INFRARED SPECTROSCOPY	**(08 Hours)**
	Principle, Instrumentation and sample handling, modes of vibrations, force constant and bond strengths, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, carbonyl compounds, esters, amides, anhydrides, lactones and lactams. Effect of solvent and hydrogen bonding on vibrational frequencies, overtones, IR of gaseous, solids and polymeric materials.	
	NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY	**(16 Hours)**
	NMR phenomenon, spin ½ nuclei, (^{1}H, ^{13}C, ^{31}P and ^{19}F), Zeeman splitting, effect of magnetic field strength on sensitivity and resolution, chemical shift δ, inductive and anisotropic effects on δ, chemical structure correlations of δ, chemical and magnetic equivalence of spins, spin-spin coupling, structural correlation to coupling constant J, selective decoupling, use of chemical shift reagents for stereochemical assignments. ^{13}C NMR, introduction to FT technique, relaxation phenomena.	
	MASS SPECTROMETRY	**(11 Hours)**
	Basic principles, ionization techniques, isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution MS, soft ionization methods, ESI-MS and MALDI-MS, illustrative examples from macromolecules and supramolecules, Fragment ions of odd and even electron types – rearrangement ions – factors affecting cleavage patterns –simple and multicentre fragmentation	

	– McLafferty rearrangement – Retro Diels-Alder fragmentation. Mass spectra of hydrocarbons, alcohols, phenols, aldehydes, ketones, carboxylic acids, amines and their derivatives.	
	Tutorials will be based on the coverage of the above topics separately	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)	

3.	**Tutorials will be based on**
1	Calculations based on Woodward-Fieser rules for Absorption maxima of various organic compounds
2	Spectral problems for identification of organic compound 1
3	Spectral problems for identification of organic compound 2
4	Spectral problems for identification of organic compound 3
5	Spectral problems for identification of organic compound 4
6	Spectral problems for identification of organic compound 5
7	Spectral problems for identification of organic compound 6
8	Spectral problems for identification of organic compound 7
9	Spectral problems for identification of organic compound 8
10	Identification of organic functional groups based on IR and UV spectral data
11	Identification of isomers by ^{1}H and ^{13}C NMR spectral data
12	Identification of aromatic compounds by ^{1}H and ^{13}C NMR spectral data
13	Structure determination by NMR and mass spectral data
14	Identification of metal complex structures by mass spectra
15	Structure determination by mass spectrometry

4.	**Books Recommended**
1.	K. W. Silverstein, F. X. Webster, D. J. Kiemle, D. L. Bryce, Spectrometric Identification of Organic Compounds, 8th Edition, John Wiley & Sons, New York, 2014.
2.	J. R. Lakowicz, Principles of Fluorescence Spectroscopy, 3rd Ed., Springer, New York, 2006.
3.	M. Sauer, J. Hofkens, J. Enderlein, Basic Principles of Fluorescence Spectroscopy, Wiley-VCH, New York, 2011.
4.	J. H. Gross, Mass Spectrometry, 2nd Edition, Springer, Berlin, 2011.
5.	G. M. Lampman, D. L. Pavia, G. S. Kria, J. R. Vyvyan, Spectroscopy International Edition, 4th Edition, Cengage Learning India Pvt. Ltd., New Delhi, 2012.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Fourth Year of Four Years of B.Tech. (Engineering Physics) B.Tech. II, Semester-IV INTRODUCTION TO QUANTUM FIELD THEORY EP252	Scheme	L	T	P	Credit
		3	1	0	4

1.	**Course Outcomes (COs):** **At the end of the course, the students will be able to**
CO1	Define the field, charge conjugation, parity, time reversal, S matrix, etc.
CO2	Show that every continuous symmetry of the physical system corresponds to a conserved charge.
CO3	Derive the Euler-Lagrange equation for fields using the action principle.
CO4	Explain the quantization of scalar, Dirac, and gauge field.
CO5	Apply the Feynman rules to understand the structure of hadrons.

2.	**Syllabus**	
	ELEMENTS OF CLASSICAL FIELD THEORIES	**(10 Hours)**
	Space and time in relativistic quantum theory, Natural units, A quick review of particle mechanics and Poisson bracket, Action principle, Lagrangian formulation, Hamiltonian formulation, Euler-Lagrange equation for fields, Noether's theorem, Conserved current and conserved charges.	
	QUANTIZATION OF FIELDS	**(12 Hours)**
	Scalar field: Equation of motion, Canonical quantization, Fourier decomposition of scalar field, Normal ordering of Hamiltonian, Fock space, Complex scalar field, Symmetries and conserved charges, Propagator for scalar field. Dirac field: Dirac equation, Plane wave solution of Dirac equation, Properties of gamma matrices, Projection operators, Fourier decomposition and propagator for Dirac field.	
	QUANTUM ELECTRODYNAMICS AND FEYNMAN RULES	**(12 Hours)**
	Interacting field, S matrix, Wick's theorem, Feynman diagram and rules, Virtual particles, Quantization of the electromagnetic field, Problems with quantization, Modification of classical Lagrangian, Fourier decomposition and propagator for electromagnetic field, Physical states, Elementary Ideas on Radiative Corrections and Renormalization.	
	QUANTUM CHROMODYNAMICS AND HARDON STRUCTURE	**(11 Hours)**
	Strong coupling constant, Electron proton elastic scattering, Form factors, Briet Frame, Inelastic electron-proton scattering, Structure functions, Bjorken scaling and parton model, Parton distribution function, Callan-Gross relation, Sea quarks, Gluon emission, Scaling violation: DGLAP equation	
	Tutorials will be based on the coverage of the above topics separately.	**(15 Hours)**
	(Total Contact Time: 45 Hours + 15 Hours= 60 Hours)	

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3.	**Tutorials will be based on the**
1	Lagrangian and Hamiltonian formulation of fields.
2	Noether’s theorem and conserved charges.
3	Local, global, and internal symmetry of fields.
4	Quantization of fields.
5	Dirac gamma matrices.
6	Charge conjugation, parity and time reversal.
7	Wick’s theorem and S matrix
8	Feynman rules and Feynman diagram.
9	Radiative correction and renormalization.
10	Form factors and structure function.

4.	**Books Recommended**
1.	Semenoff G. W., Quantum Field Theory: An Introduction, Springer Nature, Singapore, 2023.
2.	Zee A., Quantum Field Theory as Simply as Possible, Princeton University Press, New Jersey, 2023.
3.	Klauber R.D., Student Friendly Quantum Field Theory, Sandtrove Press, Iowa, 2022.
4.	Das A., Lectures on Quantum Field Theory, World Scientific Publishing Co Pte Ltd, Singapore, 2008.
5.	Lahiri A., Pal P.B., A first book of quantum field theory, Alpha Science International Ltd., Oxford, 2005.
Additional Reference Books	
1.	Weinberg S., The Quantum Theory of Fields, Cambridge University Press, Cambridge, 2005.
2.	Peskin M.E., Schroeder D. V., An introduction to quantum field theory, CRC press, Florida, 1995.

Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Second Year of Four Years of B. Tech. (Engineering Physics) B. Tech. - II, Semester - IV **ARTIFICIAL INTELLIGENCE** **CS232**	Scheme	L	T	P	Credit
		3	0	2	4

1.	**Course Outcomes (COs):** **At the end of the course, students will be able to**
CO1	Understand the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals
CO2	Apply various knowledge representation technique, searching techniques, constraint satisfaction problem and example problems- game playing techniques.
CO3	Analyse the current scope, potential, limitations, and implications of intelligent systems.
CO4	Evaluate the AI techniques suitable for recent areas of applications like expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision.
CO5	Create AI based solutions for complex engineering problems.

2.	**Syllabus**	
	INTRODUCTION	**(04 Hours)**
	Turing Test, Foundation and History of Artificial intelligence (AI), Possible Approaches in AI, Application Domains and Modern AI, Risk and benefits of AI. Intelligent Agents: Agent and Environment, Rationality, Rational Agent, Nature of Environment, PEAS, Structure of Agents, Complex Problems and AI, Problem Representation in AI.	
	PROBLEM SOLVING BY SEARCHNG	**(12 Hours)**
	Problem solving agents, Search algorithms, Uninformed Search, Breadth first search, uniform cost search, depth first search, depth limited and iterative deepening search, Informed (Heuristic) Search, greedy best first search, A* and its varients, Heuristic function, Search in complex environment. Local Search and optimization problems, hill climbing search, simulated aneling, local beam search, Evolutionary algorithms, Genetic Algorithm, Local search in continuous space and nondeterministic actions, Constraint Satisfaction Problems, Constraint propagation.	
	ADVERSARIAL SEARCH AND GAMES	**(04 Hours)**
	Game theory, game tree, optimal decision in games, Minimax search, multiplayer, alpha-Beta, Expectimax, Monte Carlo tree search, stochastic games.	
	KNOWLEDGE REPRESENTION	**(04 Hours)**
	Logical agent, Knowledge based agent, representing simple facts in Logic, Propositional logic, First order logic, Predicate Logic, Inference in first order logic, Forward & Backward Chaining, unification, Inferencing By Resolution Refutation.	

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	UNCERTAINTY KNOWLEDGE AND REASONING	**(08 Hours)**
	Quantifying Uncertainty, Basic Probability notation, Independence, Bayes Rule and its uses, Probabilistic reasoning, Bayesian Network, Fuzzy Logic, Probabilistic reasoning over time, Hidden Markov models, Kalman filters, Making simple decision, Decisions Theory, Utility Function, Decision Network, Algorithms for Markov Decision Process, Multiagent decision making cooperative and non-cooperative game theory.	
	LEARNING AGENTS	**(05 Hours)**
	Learning Agent, Types of learning, Learning from experience: Reinforcement Learning (RL), Rewards, policy, Model based and Model free learning, Temporal difference learning (TD- Learning) and Q Learning, RL Applications, Learning from Example: Supervised learning Introduction, Perceptron, Introduction to Neural Network and Deep Learning.	
	AI APPLICATIONS AND ETHICS	**(08 Hours)**
	Algorithms for Classing planning, Motion planning and navigation, Robot introduction, Steps in Robot Motion Planning, simultaneous localization and mapping (SLAM), Configuration space, Roadmap based and cell decomposition path planning, Probabilistic Roadmap, exploring random tree (RRT). Natural language understanding, Computer Vision, AI in Healthcare, Philosophy, Ethics and safety of AI, Advance topics in AI	
	Practicals will be based on the coverage of the above topics separately.	**(30 Hours)**
	(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)	

3.	**Practicals will be based on**
1	Introduction to Prolog programming.
2	Types of agents and Problem Representation in AI.
3	Searching in graph based problem space, exploring Uninformed search Techniques.
4	Exploring Informed search Techniques (Vacuum world and Maze Problem).
5	Exploring Uninformed and Informed search Techniques (PACMAN Search Space).
6	Multi agent in a search space.
7	Introduction Logical Agent and Knowledge representation using Prolog.
8	Reasoning Under Uncertainty using Bayesian Learning.
9	Reinforcement Learning using Q-Learning.
10	Introduction to Machine Learning and Python libraries for Data Analysis (Pandas, NumPy, Matplotlib).

4.	**Books Recommended**
1	S. Russell, P. Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, 4th Ed., 2020.
2	Elaine Rich, Kevin Knight, and Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed., 2009.
3	Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.
4	J. Pearl, Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison- Wesley, 1984.
5	K.R. Chowdhary, Fundamentals of Artificial Intelligence, Springer India, New Delhi, 2020.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)