Pimpri Chinchwad University

PhD Entrance Exam Syllabus

Chemistry

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Organic Reaction Mechanism and Stereochemistry	Ionization of carbon hydrogen bond and prototopy, Base and acid catalyzed halogenation of ketones, keto-enol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, carbanion character in phenoxide and pyrrolyl anions, hydrolysis of haloforms, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoin condensation, alkylation of enolates, Conjugate additions, Gattermann Koch synthesis and stereochemistry
Unit 2	Carbohydrates Medicinal Chemistry	Introduction of sugars, Conformations of monosaccharides, Conformations of the five membered rings, conformations of the six memberd rings, the anomeric effect. Modified monosaccharides, Reactions of open chain form of the sugars and reactions of the cyclic form of the sugar Drug Discovery and Development Pharmacokinetics Prodrugs and Drug Metabolism
Unit 3	Principles of Physical Chemistry	Molecular and Thermodynamic Principles Fundamentals of Physical and Quantum Chemistry Chemical Energetics and Molecular Structure Quantum Mechanics, Thermodynamics, and Electrochemistry
Unit 4	Organometallic Reactions and Catalysis	Reactions involving gain and loss of ligands: ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophelic displacement, reactions involving modification of ligands: insertion, carbonyl insertion, 1-2 insertion, hydride elimination, abstraction, organometallic catalysis: Hydroformylation, Monsanto acetic acid process, Wacker Process, Hydrognation by Willkinsons catalyst, Olefin metathesis, heterogeneous catalysis: Ziegler Natta Polymerization, Water gas reduction
Unit 5	Spectroscopy	IR Spectroscopy 1H NMR Spectroscopy 13C NMR Spectroscopy Mass Spectrometry

Books Recommended:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein, F. X.Webster, D. Kiemle, 6th Ed. John Wiley and Sons.
2. One and Two dimensional NMR Spectroscopy by Atta-Ur-Rehman, Elsevier (1989)
3. Spectroscopy of organic molecule-PS Kalsi,Wiley, Esterna, New Delhi.

4. Mass Spectrometry Basics by Christopher G. Herbert Robert A.W. Johnstone
5. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press)
6. Physical chemistry by Peter Atkins, Julio De Paula, 11th Edition , 2018, Oxford University Press
7. Principals of Physical chemistry by Puri Sharma Pathania, 48th edition, Vishal Publishing Co.
8. Physical chemistry by GM borrow, 5 th edition , 2006, Mc Graw Hill Education
9. Quantum chemistry by Ira Levine, 6th Edition
10. Quantum chemistry by R.K. Prasad, 4 th Edition
11. Physical chemistry by biological sciences by Raymond Chang (Page Number 113, 135, 141)
12. Principles of Physical Chemistry by Marron and Prouton, 4 th edition
13. Physical Chemistry - A Molecular Approach by by Donald A. McQuarrie, John D. Simon (20 August 1997)
14. Organic Chemistry - Morrison and Boyd carbohydrate 7th Edition (2011)

Computer Engineering

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Data Structures & Algorithms	**Data Structures:** Arrays, linked lists, stacks, queues, trees, heaps, hash tables, graphs, and their associated operations and applications. **Algorithm analysis:** Time and Space complexity (Big-O notation), recursion, Searching and sorting techniques, Dynamic Programming, Greedy algorithms, Backtracking, Divide-and-conquer strategies, **Graph algorithms:** BFS, DFS, shortest path, and minimum spanning trees.
Unit 2	System Programming & Operating System	**System Programming:** Assemblers, linkers, loaders, macro processors, and compilers, along with system calls and low- level programming concepts. **Operating system:** Process management, Scheduling algorithms, Interprocess communication, Deadlock detection and Prevention, Memory management techniques (paging, segmentation, virtual memory), File systems, I/O systems, and device management, Concurrency, synchronization mechanisms (semaphores, monitors), and case studies of Unix/Linux-based systems.
Unit 3	Computer Network & Network Security	**Computer Network:** IP Addressing and Subnetting Routing Algorithms: Distance Vector, Link State, RIP, OSPF, BGP, Congestion Control and QoS, ICMP, ARP, DHCP, NAT TCP and UDP protocols Congestion Control, DNS, FTP, HTTP, HTTPS, SMTP, POP3 **Network Security:** Types of Attacks: DoS, Man-in- the-Middle, Replay, Phishing, Authentication, Authorization, Access Control. Firewalls, IDS/IPS, SSL/TLS, IPsec, HTTPS, S/MIME, SSH, VPNs and Secure Tunneling, Kerberos Authentication.
Unit 4	Software Engineering & Agile Methodology	**Software Engineering Foundations** Software Development Life Cycle (SDLC) **Software Process Models:** Waterfall, Incremental, Spiral, V- Model, Software Requirements Engineering: SRS, Requirement Elicitation Techniques, Feasibility Analysis, Risk Analysis **Agile Methodology** Agile Manifesto & Principles Agile vs Traditional Models Scrum Framework: Roles (Product Owner, Scrum Master), Events (Sprint, Daily Standup) Kanban, Extreme

		Programming (XP), Lean Software Development, Product Backlog, Sprint Backlog, Burndown Charts Agile Metrics (Velocity, Lead Time, Cycle Time)
Unit 5	Data Base Management System & Data Science	**Data Base Management System:** Relational Algebra and Relational Calculus SQL Queries (DML, DDL, DCL, TCL) Joins, Subqueries, Aggregation, Views, ACID Properties, Serializability, Conflict and View Serializability, Concurrency Control Techniques (Lock-based, Timestamp-based) Deadlock Handling. **Data Science:** Python Libraries: NumPy, Pandas, Matplotlib, Seaborn, Scikit-Learn, Data Wrangling, Data Cleaning Distributions: Normal, Binomial, Poisson, Confidence Intervals, p- values, t-test, ANOVA, Bayesian Thinking Matplotlib, Seaborn, Plotly.
Unit 6	Artificial Intelligence & Machine Learning	**Supervised, Unsupervised, and Reinforcement learning:** Including algorithms such as linear regression, logistic regression. Decision trees, SVMs, K-means, KNN, Naive Bayes, Neural networks, and Ensemble methods. Model evaluation techniques, Overfitting, Underfitting, Bias- variance tradeoff, and Performance metrics. Basic understanding of Probability, statistics, Optimization techniques, and Linear algebra.

Books Recommended:

1. Kurose & Ross – Computer Networking: A Top-Down Approach
2. Behrouz A. Forouzan – Data Communications and Networking
3. William Stallings – Cryptography and Network Security
4. Bruce Schneier – Applied Cryptography
5. Pressman & Maxim – Software Engineering: A Practitioner's Approach (McGraw Hill)
6. Ken Schwaber & Jeff Sutherland – The Scrum Guide
7. Ramez Elmasri & Shamkant Navathe – Fundamentals of Database Systems (Pearson)
8. Abraham Silberschatz, Henry F. Korth, S. Sudarshan
9. Practical Statistics for Data Scientist -Peter Bruce, Andrew Bruce
10. Data Structures and Algorithms in C++/Java – Michael T. Goodrich, Roberto Tamassia
11. Fundamentals of Data Structures – Ellis Horowitz, Sartaj Sahni
12. Modern Operating Systems – Andrew S. Tanenbaum, Herbert Bos
13. Operating System Concepts – Abraham Silberschatz, Peter Baer Galvin, Greg Gagne
14. Pattern Recognition and Machine Learning – Christopher M. Bishop

15. Machine Learning: A Probabilistic Perspective – Kevin P. Murphy
16. Artificial Intelligence: A Modern Approach – Stuart Russell and Peter Norvig
17. Artificial Intelligence – Elaine Rich, Kevin Knight, Shivashankar B Nair

Electronic Engineering

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit 1	Electronic Devices	Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier Transport: Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations. PNjunction, Zenerdiode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell.
Unit 2	Analog Circuits Diode Circuits	Clipping, clamping and rectifiers. BJT and MOSFET Amplifiers: Biasing, AC coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers. Op-amp Circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators.
Unit 3	Digital Circuits Number Representations	Integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders. Sequential Circuits: Latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay. Data Converters: Sample and hold circuits, ADCs and DACs. Semiconductor Memories: ROM, SRAM, DRAM. Computer Organization: Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.
Unit 4	Control Systems	Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Unit 5	Communications Random Processes	Auto correlation and power spectral density, properties of white noise, filtering of random signals through LTI systems. Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers. Information Theory: Entropy, mutual information and channel capacity theorem. Digital Communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.
Unit 6	Electromagnetics Maxwell's Equations	Rential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector. Plane Waves and Properties: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth. Transmission Lines: Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

Clinical Psychology

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Introduction to Clinical Psychology	Historical Evolution and Scope of Clinical Psychology Biological Bases of Behavior: Brain-Behavior Relationships **Psychopathology:** Classification (DSM-5-TR & ICD-11), Etiology, and Diagnosis. Personality Theories and Development Across the Lifespan. **Psychological Assessment:** Intelligence, Personality, Neuropsychological Assessments, Case History Formulation and Clinical Interviews. Cultural, Gender, and Social Contexts of Mental Health Ethical Principles and Professional Conduct (APA/RCI Guidelines).
Unit 2	Psychotherapeutic Approaches and Intervention Models	Cognitive Behavioral Therapy (CBT), Dialectical Behavior Therapy (DBT) Psychodynamic and Humanistic Therapies Family and Couples Therapy Group Therapy and Community-Based Interventions Trauma-Informed Care and Crisis Intervention Mindfulness, ACT, and Third-Wave Therapies Cross-cultural Adaptations of Therapy.
Unit 3	Research Methodology, Biostatistics, and Clinical Trials in Psychology	Research Designs in Clinical Psychology: RCTs, Longitudinal, Qualitative **Psychological Measurement:** Validity, Reliability, Item Analysis. Ethical Clearance, Informed Consent, and Confidentiality in Clinical Research. **Human Clinical Trials:** Protocols, Risk Assessment, Ethical Review. **Advanced Biostatistics:** Regression, MANOVA, Factor Analysis. **Software Use:** SPSS, R, NVivo for Mixed Methods Research. Meta-analysis, Systematic Reviews, and Practice Guidelines.
Unit 4	Neuropsychology, Psychopharmacology, and Rehabilitation	Brain Disorders: Stroke, TBI, Dementias, Epilepsy, and Neurodevelopmental Disorders. Neuropsychological Assessment and Cognitive Profiling Psychopharmacology: Mechanisms, Side Effects, Drug-Psychotherapy Interactions. Neuroplasticity and Recovery Models Psychiatric Rehabilitation and Cognitive Remediation Integrative Approaches: Yoga, Biofeedback, Art & Music Therapy Disability Certification and NeuroLegal Interface.
Unit 5	Contemporary Issues, Policy, IPR, and Innovations in Mental Health	National and International Mental Health Policies (MHCA 2017, WHO, UNCRPD) **Psychology and Law:** Forensic Psychology, Expert Testimony, Malingering

		Intellectual Property Rights (IPR) in Clinical Tools & Interventions Digital Mental Health: AI, VR Therapies, Mobile Apps, e-Counseling Ethics of Technology Use in Therapy and Data Privacy Global Mental Health, Humanitarian Psychology, and Climate Psychology Advocacy, Leadership, and Mental Health Literacy Campaigns.

Books Recommended:

1. Clinical Psychology: Science, Practice, and Culture by Andrew M. Pomerantz
2. Abnormal Psychology by Ronald J. Comer
3. Cognitive Behavior Therapy: Basics and Beyond by Judith S. Beck
4. Handbook of Clinical Psychology by Michel Hersen & Alan M. Gross
5. The American Psychiatric Publishing Textbook of Psychiatry by Robert E. Hales et al.
6. Neuropsychological Assessment by Muriel D. Lezak et al.

Nutrition and Dietetics

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Foundations of Human Nutrition and Dietetics *(The Roots)*	Nutrient Metabolism: Macronutrients and Micronutrients Nutritional Biochemistry and Human Physiology Life Cycle Nutrition (Prenatal to Geriatric) Nutrition Assessment Techniques (Anthropometry, Biochemical, Clinical, Dietary) Dietary Guidelines and Cultural Dietary Patterns Functional Foods and Traditional Diets in Health Socioeconomic and Cultural Influences on Food Choices.
Unit 2	Advanced Clinical Nutrition & Diet Therapy *(The Science of Healing)*	Nutrition in Non-Communicable Diseases (CVD, Diabetes, CKD, Cancer) Nutrition in Critical Care and Intensive Care Units (ICU) Nutritional Genomics & Personalized Dietetics Immunonutrition and Gut Microbiota in Disease Nutritional Management of Eating Disorders Therapeutic Diets and Artificial Nutrition Support (Enteral/Parenteral) Clinical Case Mapping & Evidence-Based Practice.
Unit 3	Research Methodology, Biostatistics, and Human Clinical Trials *(The Research Mind)*	Advanced Research Designs in Nutrition (Observational, Interventional, RCTs) Ethics in Human Nutrition Research (ICMR Guidelines) Human Clinical Trials: Phases, Protocol Development, Ethics Committees Nutritional Epidemiology and Population Surveillance Biostatistical Tools and Data Analysis in SPSS/R Systematic Reviews, Meta-Analysis and Evidence Synthesis Grant Writing & Research Proposal Development.
Unit 4	Nutraceuticals, Functional Foods & Regulatory Affairs *(The Interface of Innovation)*	Bioactive Compounds: Polyphenols, Probiotics, Omega-3s, etc. Nutraceutical Development: From Farm to Capsule Functional Foods and Fortification Programs. Regulatory Guidelines: FSSAI, Codex, FDA, EFSA Food Labeling, Claims, and Scientific Substantiation Pharmacokinetics of Nutrients Industry-Academia Collaborations and Translational Research
Unit 5	Nutrition Policy, IPR, and Future Frontiers *(The Global Thinker)*	National and International Nutrition Policies (POSHAN, WHO frameworks) Food Security, Sustainability & Climate-Responsive Nutrition. IPR in Nutrition Science: Patents, Copyrights, Trademarks. Tech in Nutrition: AI, Blockchain, Mobile Health & Wearables. Emerging Trends: Precision Nutrition, Cellular Agriculture, Space Nutrition. Community-Based Nutrition Interventions & Impact Evaluation. Communication for Behavior Change in Nutrition.

Books Recommended:

1. Advanced Nutrition and Human Metabolism by Sareen Gropper & Jack Smith
2. Krause's Food & the Nutrition Care Process by L. Kathleen Mahan & Janice L. Raymond
3. Modern Nutrition in Health and Disease by A. Catharine Ross et al.
4. Essentials of Human Nutrition by Jim Mann & A. Stewart Truswell
5. Clinical Nutrition and Dietetics by F.P. Antia & Shobha A. Kurpad
6. Public Health Nutrition: From Principles to Practice by Mark Lawrence & Tony Worsley

English

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Foundations of Linguistics	- Definition, scope, and branches of linguistics - Descriptive vs prescriptive linguistics - Structuralism (Saussure, Bloomfield) and Generative Grammar (Chomsky) - Language universals and typology - Competence vs performance - Langue and parole - Synchronic and diachronic linguistics -Major schools of linguistic thought: Prague School, London School, American Structuralism
Unit 2	Phonetics and Phonology	- Organs of speech and the speech mechanism - Classification and transcription of speech sounds (IPA) - Phonemes, allophones, minimal pairs - Suprasegmental features: stress, intonation, rhythm - Syllable structure and phonotactics - Phonological rules and distinctive features -Connected speech processes (assimilation, elision,liaison)
Unit 3	Semantics and Pragmatics	-Meaning types: lexical, grammatical, denotative, connotative -Semantic relations: synonymy, antonymy, hyponymy, polysemy, homonymy - Componential and structural semantics - Sense and reference -Theories of meaning: referential, truth-conditional, use theory -Pragmatics: deixis, implicature, presupposition, context - Speech act theory (Austin, Searle) - Discourse and conversation analysis
Unit 4	Stylistics and Discourse Analysis	- Definition and scope of stylistics - Levels of stylistic analysis: phonological, lexical, syntactic, semantic - Foregrounding, deviation, parallelism - Cohesion and coherence in texts - Literary and non-literary discourse - Critical discourse analysis (Fairclough, van Dijk) - Register, code-switching, idiolect, sociolect - Corpus stylistics and computational tools

Unit 5	William Shakespeare – Language, Themes and Critical Perspectives	-Shakespeare's role in shaping the English language -Language features: word coinages, iambic pentameter, rhetorical devices - Thematic studies: power, ambition, gender, identity, fate -Linguistic and stylistic features of tragedies, comedies, histories -Selected texts: Hamlet, Macbeth, King Lear, Othello, The Tempest -Shakespeare and literary criticism: feminist, psychoanalytic, cultural materialist, postmodern readings -Shakespeare in performance and adaptations

Books Recommended:

1. Course in General Linguistics – Ferdinand de Saussure

Aspects of the Theory of Syntax – Noam Chomsky

The Sounds of the World's Languages – Ladefoged & Maddieson

Principles of Phonetics – John Laver

Meaning in Language – Alan Cruse

Style in Fiction – Geoffrey Leech & Mick Short

The Routledge Handbook of Stylistics – Michael Burke (Ed.)

Language and Power – Norman Fairclough

The Oxford Shakespeare: Complete Works – Edited by Wells & Taylor

Shakespeare After All – Marjorie Garber

School of Management

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit 1	General Management	• Evolution of management thought • Management functions: Planning, Organizing, Leading, Controlling • Managerial roles and skills • Strategic management concepts • Corporate governance and ethics
Unit 2	Marketing Management	• Marketing concepts and philosophies • Consumer behavior analysis • Market segmentation and targeting • Marketing mix (4Ps) • Branding and positioning strategies • Integrated marketing communications • Digital marketing trends
Unit 3	Human Resource Management (HRM)	• HRM concepts and functions • Recruitment and selection processes • Training and development strategies • Performance management systems • Compensation and benefits • Industrial relations and labor laws • Employee engagement and retention
Unit 4	Financial Management	• Financial statement analysis • Cost and management accounting • Capital budgeting techniques • Financial planning and control • Working capital management • Risk management in finance • Corporate finance strategies

Unit 5	Organizational Behavior	• Individual and group behavior in organizations • Motivation theories and applications • Leadership styles and theories • Communication patterns in organizations • Conflict resolution and negotiation • Organizational culture and climate • Change management processes
Unit 6	Strategic Management	• Strategic planning and implementation • SWOT analysis and competitive advantage • Business-level and corporate-level strategies • Mergers, acquisitions, and alliances • Corporate social responsibility (CSR) • Sustainability and ethical considerations
Unit 7	Operations Management	• Production and operations strategies • Supply chain management • Inventory and materials management
		• Quality control and assurance • Project management techniques • Operations research applications
Unit 8	Economics for Managers	• Microeconomic concepts relevant to business • Macroeconomic indicators and their impact • Market structures and pricing strategies • Economic policies and their effects on business • Global economic environment

Books Recommended:

1. Principles of Management by P. C. Tripathi & P. N. Reddy
2. Marketing Management by Philip Kotler and Kevin Lane Keller
3. Principles of Marketing by Philip Kotler and Gary Armstrong
4. Human Resource Management by Gary Dessler
5. Principles of Corporate Finance by Richard A. Brealey, Stewart C. Myers, and Franklin Allen
6. Financial Management for Decision Makers by Peter Atrill
7. Organizational Behavior by Stephen P. Robbins and Timothy A. Judge

8. Strategic Management: Concepts and Cases by Fred R. David
9. Operations Management by William J. Stevenson
10. Managerial Economics by William F. Samuelson and Stephen G. Marks

Mathematics

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Real & Complex Analysis	Real Analysis: Sequences and series, limits and continuity, uniform convergence, Riemann integration. Complex Analysis: Analytic functions, Cauchy's theorem, residues.
Unit 2	Algebra (Linear & Abstract)	Vector spaces, basis, linear transformations, eigenvalues/ eigenvectors. Groups, rings, fields, homomorphisms, polynomial rings.
Unit 3	Topology and Functional Analysis	Metric spaces, open and closed set, compactness, connectedness. Banach and Hilbert spaces, Hahn-Banach theorem, bounded linear operators .
Unit 4	Differential Equations & Numerical Methods	ODEs: First and second-order equations, systems of ODEs. PDEs: Classification, separation of variables. Numerical methods for equations and integration.
Unit 5	Advanced Topics in Mathematics	Measure theory, Lebesgue integration, logic and set theory, probability, statistics, calculus of variations, graph theory, mathematical modelling basics.

Books Recommended:

1. Walter Rudin – Principles of Mathematical Analysis
2. Tom M. Apostol – Mathematical Analysis
3. Lars Ahlfors – Complex Analysis
4. Shanti Narayan & M.D. Raisinghania – Elements of Real Analysis
5. Satish Shirali & Harikishan L. Vasudeva – Real Analysis
6. P.K. Jain & Khalil Ahmad – Metric Spaces
7. M.L. Khanna – Complex Variables
8. P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul – Basic Abstract Algebra
9. V.K. Khanna & S.K. Bhambri – A Course in Abstract Algebra
10. T.S. Bhatia – Linear Algebra and Multivariable Calculus
11. K.C. Prasad & K.B. Datta – Modern Algebra
12. M.D. Raisinghania – Ordinary and Partial Differential Equations
13. S.S. Sastry – Introductory Methods of Numerical Analysis
14. G. Balasubramanian & M. Ramaswamy – Differential Equations
15. H.K. Dass & Rama Verma – Advanced Engineering Mathematics

Mechanical Engineering

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Engineering Mechanics & Materials:	*Engineering Mechanics* - Trusses and frames; free body diagrams and equilibrium, virtual work; impulse and momentum (linear and angular), kinematics and dynamics of particles & of rigid bodies in plane motion and energy formulations, collisions. *Mechanics of Materials* - Elastic constants, Stress and strain, Poisson's ratio, thin cylinders, shear force and bending moment diagrams, deflection of beams, bending and shear stresses, torsion of circular shafts, energy methods, Euler's theory of columns, thermal stresses, testing of materials with universal testing machine, strain gauges and rosettes, testing of hardness and impact strength. *Engineering Materials* - Phase diagrams, structure and properties of engineering materials, heat treatment, stressstrain diagrams for engineering materials.
Unit 2	Machine Design	*Machine Design* - Design for static and dynamic loading, Failure theories, fatigue strength and the S-N diagram, gears, shafts, rolling and sliding contact bearings, springs, brakes and clutches. *Vibrations* - Effect of damping, Free and forced vibration of single degree of freedom systems, resonance, vibration isolation, critical speeds of shafts.
Unit 3	Fluid Mechanics and Thermal Engineering	*Thermodynamics* - Properties of pure substances, thermodynamic systems and processes, the behaviour of ideal and real gases, calculation of work and heat in various processes, zeroth and first laws of thermodynamics, the second law of thermodynamics, thermodynamic relations and thermodynamic property charts and tables, availability and irreversibility. *Fluid Mechanics* - Fluid statics, properties, manometry, buoyancy, stability of floating bodies, forces on submerged bodies, control-volume analysis of mass, fluid acceleration, momentum and energy, differential equations of continuity and momentum, dimensional analysis, Bernoulli's equation, viscous flow of incompressible fluids, elementary turbulent flow, boundary layer, flow through pipes, bends and fittings and head losses in pipes. *Applications* - Power Engineering, I.C. Engines, Refrigeration and air-conditioning and Turbomachinery *Heat-Transfer* - One dimensional heat conduction, modes of heat transfer, lumped parameter system, unsteady heat conduction, dimensionless parameters in free and forced convective heat transfer, thermal boundary layer, heat transfer correlations for flow over flat plates and through

		pipes, heat exchanger performance, effect of turbulence, LMTD & NTU methods; Stefan-Boltzmann law, radiative
		heat transfer, Wien's displacement law, view factors, black and grey surfaces and radiation network analysis.
Unit 4	Manufacturing Engineering	Casting, Forming and Joining Processes - Casting, Different types of patterns, moulds and cores, Different types of castings, solidification and cooling, riser & gating system, fundamentals of hot and cold working processes, Plastic deformation and various forming processes of bulk (drawing, rolling, forging, extrusion) and sheet (deep drawing, shearing, bending), metal forming processes, brazing, Principles of welding, soldering & adhesive bonding. Machining & Machine Tool Operations - Basic machine tools, Mechanics of machining, single and multi-point cutting tools, tool life and wear, tool geometry and materials, the economics of machining, principles of work holding, principles of non-traditional machining processes, Computer Integrated Manufacturing - Concepts of CAD/CAM and their integration tools. Metrology and Inspection - Linear and angular measurements, Limits, fits and tolerances & comparators; gauge design, interferometry, alignment and testing methods, form and finish measurement, tolerance analysis in manufacturing and assembly.

Unit 5	Industrial Engineering	Production Planning and Control - Aggregate production planning, Operations Research - Simplex method, linear programming, transportation, network flow models, assignment, simple queuing models and PERT & CPM. Inventory Control - Safety stock inventory control systems, Deterministic models.

Books Recommended:

1. W.M Kays and M.E. Crawford, "Convective Heat and Mass Transfer", McGraw Hill Intl.
2. D. Brian Spalding, "Combustion and mass Transfer', 1st edition, Pergamon Press,1979
3. T Cebeci, "Convective Heat Transfer", Springer
4. ASHRAE HANDBOOKS (i) Fundamentals (ii) Refrigeration
5. Threlkeld J.L., "Thermal Environmental Engineering", Prentice Hall
6. Dossat R.J., Principles of Refrigeration, Pearson Education Asia
7. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
8. I.C. Engines /Ferguson/John Wiley (WE & Exclusive)
9. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
10. Analysis and performance of fibre Composites by B. D. Agarwal and L. J. Broutman, Wiley-Interscience, New York, 1980.
11. Hassan El-Hofy, "Advanced Machining Processes – Non-Traditional and Hybrid Machining Processes", Mc-Graw Hill, London, 2005
12. Brown J., "Advanced Machining Technology Handbook", Mc-Graw Hill, New York, 1998
13. Operations Management, Theory and Problems" by Joseph G. Monks, Mc Grow Hill book Company-Koga.
14. Production and Operations Management" by Chary, TaTa Mc Grow
15. Mechanical Behaviour of by Thomas H. Courtney / 2nd Edition, McGraw Hill,2000.

Pharmacy

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Pharmaceutics	• Preformulation Studies, Concept & Models for NDDS:(transdermal DDS,Targeted DDS), pharmacokinetics. • Kinetic principles and stability testing
Unit 2	Pharmaceutical Chemistry	• Reaction Mechanisms, Microwave assisted synthesis • & Structural elucidation of final compounds. Molecular basis of drug action and new drug development and lead optimization, Prodrugs. • Combinational chemistry • Computer-Aided Drug design
Unit 3	Pharmacology	• Pharmacokinetics and Pharamcodynamics • Receptor Pharmacology & Mechanisms • Drugs acting on CNS, ANS & CVS, Chemotherapy, • Endocrine Pharmacology • Organization of screening (Pharmacological)
Unit 4	Pharmacognosy	• Methods and Principles of extraction, • Elucidation of biosynthetic pathway • WHO guidelines for herbal drugs standardization • Plant Tissue Culture & its applications
Unit 5	Pharmaceutical Analysis	• Spectroscopic Methods of Analysis- IR, NMR, MASS • Chromatographic Techniques- HPLC, GC, HPTLC • Hyphenated Techniques- LC-MS, GC-MS,

Books Recommended:

1. Biopharmaceutics and Pharmacokinetics-A Treatise by D. M. Brahmankar and Sunil B. Jaiswal
2. Essentials of Medical Pharmacology by K. D. Tripathi
3. Dr Alagarsamy's Textbook of Medicinal Chemistry, Volume I & II
4. A Textbook of Organic Chemistry. By Arun Bahl & BS Bahl
5. Cooper And Gunns Dispensing For Pharmaceutical Students
6. Pharmaceutics, The Science & Dosage Form Design by M. E. Aulton.
7. Pharmaceutical Dosage Form and Drug Delivery System by H.C. Ansel
8. Organic Chemistry by Clayden, Greeves, Warren and Woihers.

9. Principles of Medicinal Chemistry by William Foye
10. Spectrometric Identification of Organic compounds by Robert M Silverstein
11. Burger's Medicinal Chemistry & Drug Discovery
12. Pharmacological Basis of Therapeutics by Goodman and Gillman.

Physics

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Mathematical Physics	Matrices; Vector calculus; curvilinear coordinates; PDEs (Laplace, Poisson, wave equation); Green's functions; tensors; eigenvalue problems, Hilbert spaces
Unit 2	Atomic & Molecular physics	Quantum states, quantum numbers, Pauli's exclusion principle, and Spin-orbit coupling, Zeeman, Paschen–Back, Stark effects, diatomic molecules: rotational spectra (rigid/non-rigid rotator) Vibrational spectra (harmonic/anharmonic), Rotation–vibration coupling, electronic spectra, Franck–Condon principle
Unit 3	Condensed Matter Physics	Crystal systems and Bravais lattices, Miller indices and X-ray diffraction, Reciprocal lattice and Brillouin zones, Crystal binding: ionic, covalent, metallic, Van der Waals, Band theory: Kronig–Penney model, Bloch theorem, Effective mass, density of states, Fermi energy and Fermi surface Hall effect and electrical conductivity, magnetic properties, Properties of a superconductor
Unit 4	Experimental Techniques and Data Analysis	Precision, accuracy, sensitivity, resolution, Static and dynamic characteristics of instruments, Signal-tonoise ratio, Transducers and sensors, Data acquisition systems, vacuum techniques and pressure measurement, thin film deposition methods (CVD, PVD, sputtering), Optical methods: interferometry, polarimetry, spectrometry, Electrical and magnetic property measurement setups
Unit 5	Modern Physics	Nuclear properties: mass, binding energy, radius, spin, isospin, Radioactive decay laws, Nuclear models (liquid drop, shell model), Nuclear reactions and Q-value, Fission, Fusion reactions, Classification of particles: leptons, mesons, baryons, Maxwell's equations (differential and integral forms), Poynting vector, energy and momentum in EM fields

Books Recommended:

1. Arfken, G.B., Weber, H.J. and Harris, F.E., 2013. *Mathematical Methods for Physicists*. 7th ed. Amsterdam: Academic Press.
2. Boas, M.L., 2006. *Mathematical Methods in the Physical Sciences*. 3rd ed. New York: Wiley.
3. Mathews, J. and Walker, R.L., 1970. *Mathematical Methods of Physics*. 2nd ed. New York: W.A. Benjamin.
4. Bransden, B.H. and Joachain, C.J., 2003. *Physics of Atoms and Molecules*. 2nd ed. Harlow: Pearson Education.
5. Foot, C.J., 2005. *Atomic Physics*. 1st ed. Oxford: Oxford University Press.
6. Herzberg, G., 1950. *Molecular Spectra and Molecular Structure: I. Spectra of Diatomic Molecules*. 2nd ed. New York: Van Nostrand Reinhold.
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Research Methodology

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Fundamentals of Research and Problem Formulation	• Meaning, objectives, and role of research in academic and applied contexts • Classification of research: o Basic and applied o Quantitative and qualitative o Exploratory, descriptive, analytical, and experimental • Scientific approach in conducting research • Identification and formulation of research problems o Key sources of research problems o Attributes of a well-defined problem o Common errors in defining research problems • Hypothesis: o Types, formulation, and features o Examples from various disciplines
Unit 2	Research Design and Literature Review	• Understanding the concept, purpose, and elements of research design • Types of research designs: o Exploratory, descriptive, analytical o Formal and informal experimental designs • Review of literature: o Objectives, sources, and search strategies o Identifying and analyzing research gaps o Techniques for critical literature review o Common errors to avoid during literature survey
Unit 3	Data Collection, Sampling, Measurement, and Scaling	• Types of data: o Primary vs. secondary o Quantitative vs. qualitative • Data collection techniques: o Interviews, focus groups, case studies (qualitative) o Surveys, structured observations, experiments (quantitative) • Sampling methods: o Probability techniques: Simple random, stratified, systematic o Non-probability techniques: Judgmental, convenience, snowball o Sample size estimation and error minimization • Measurement and scaling: o Levels of measurement: Nominal, ordinal, interval, ratio o Reliability and validity of instruments and scales

Unit 4	Data Analysis and Interpretation	• Basics of descriptive and inferential statistics • Hypothesis testing and statistical techniques: o t-test, chi-square test, F-test, ANOVA • Correlation and regression analysis: o Simple and multiple regression models • Introduction to multivariate techniques:
		o Factor analysis, discriminant analysis o Cluster analysis, multidimensional scaling • Interpretation of analytical results and significance levels
Unit 5	Research Documentation, Proposal Writing, and Ethics	• Structure and writing of research reports and theses • Components and format of a research proposal • Identifying research funding opportunities • Proposal development and submission process • Research presentation techniques: o Oral presentation, academic posters, publications • Research ethics and academic integrity: o Ethical considerations in research design and reporting o Avoiding plagiarism and ensuring proper citation o Understanding IPR, copyrights, and patents o Regulatory guidelines for ethical research conduct

Books Recommended:

1. C. R. Kothari – Research Methodology: Methods and Techniques
2. Ranjit Kumar – Research Methodology: A Step-by-Step Guide for Beginners
3. Wayne Goddard & Stuart Melville – Research Methodology: An Introduction

LAW

Unit No	Title of the Unit	Topics/Subtopics Covered
Unit-1	Indian Constitution	• Basic Constitutional Principles – constitutionalism, rule of law, separation of powers, basic structure doctrine. • Judicial Review and Constitutional Interpretation – evolving methods of interpretation and role of higher judiciary. • Fundamental Rights and Fundamental Duties – life, liberty, dignity, privacy, and new generation rights. • Federalism and Governance Structure – Centre-State relations, emergency provisions, cooperative federalism, Contemporary Reforms –

		electoral reforms, institutional accountability, constitutional morality. • Landmark Cases
Unit 2	Jurisprudence	• Schools of Jurisprudence – Natural law, positivism, historical, sociological, realist and critical schools. • Nature and Concept of Law – law, morality, justice, rights, duties, and legal validity. • Legal Reasoning and Interpretation – theories of adjudication and judicial reasoning. • Modern and Critical Legal Theories – feminist jurisprudence, CLS, postmodern legal thought. • Application of Jurisprudence in Contemporary Laws– globalization, technology, ethics, and interdisciplinary approaches.

Unit 3	Criminal Law	• Substantive Criminal Laws V/S Procedural Criminal Laws in India. • Transition from IPC–Cr.P.C to BNS–BNSS–BSA – philosophy and structural reforms, important committees and commissions. • Technology, Electronic Modes of Communication and New Criminal Laws - FIR, arrest, bail, investigation, search and seizure, and rights-based procedure. • Forensic Intervention in BNSS, BSA and BNS • Landmark Cases.
Unit 4	Human Rights Protection Mechanism and International Criminal Law	• National Human Rights Commission and State Human Rights Commission under Human Rights Protection Act, 1993 • Human Rights Protection at international platform- UDHR, ICCPR, ICESCR, UN, etc. • Adversarial V/S Inquisitorial Criminal Justice System with a special reference to Fair Trial • International Criminal Court • Landmark Cases
Unit 5	Contract Law and Law of Torts	• General Principles of Contract Law • Special Contracts and Standard Form Contracts - Use of Technology and AI in Contract Drafting • Torts Law in India- Nature of torts law, Negligence, Labilities and its types, Defamation, New Consumer Protection Mechanism in India. • Landmark Cases