No. 2023/Admissions/Ph.D/01 Date: 20-05-2023

ADMISSION NOTIFICATION

(FULL TIME & PART TIME)

DOCTORAL PROGRAM (Ph.D) 2023-24

Applications are invited from interested and eligible candidates for admission into Full Time & Part Time Doctoral Program (Ph.D) in the faculties of Engineering, Management Studies, Liberal Arts & Sciences and Law

Online application form along with photocopies of certificates and Registration fee of **Rs.1000/-** can be submitted on or before **25.08.2023** through university website **www.aurora.edu.in**.

Admission Guidelines enclosed herewith.

Sd/-
Registrar

DOCTORAL PROGRAM ADMISSION GUIDELINES 2023

CONTENT PAGE

ELIGIBILITY CRITERIA

Candidates seeking admission to the Ph.D. Program, whether full time or part time, shall have to possess the requisite percentage of marks / grade point average in qualifying examination as indicated below:

Engineering

- B.Tech. and M.Tech. in an appropriate/relevant branch of Engineering, with at least 55% at M.Tech level

Liberal Arts & Sciences

- Master's or M.Phil Degree with attest 55% in the Master's or M.Phil Degree

Management Studies

- Master's Degree in field of Management or similar with attest 55%

Law

- Master's Degree or equivalent qualifications in Law, Management or Humanities or other cognate disciplines with atleast 55%.

or

- Candidates who have passed the Company Secretary Examination conducted by the Institute of Company Secretaries of India (ICSI) and awarded the Associate Membership of the Institute (ACS) are also eligible for admission to the programme.
- Candidates who have passed the final examination of the Institute of Chartered Accountants of India (ICAI), New Delhi.
- Candidates who have passed the final examination of Institute of Cost Accountants of India.

Foreign National Admissions

- Foreign/ NRI applicants / Applicants with a Masters' degree from a foreign university must apply with an equivalence certificate along with the Online Application Form

Part-Time Ph.D Eligibility:

Candidates who are working in reputed organisations including well equipped educational institutes / scientific and research organizations / R&D Units/industries / Governmental Organizations and in colleges affiliated to the Universities and engaged in Scientific / Technological / Engineering / Managerial activities, as the case may be are eligible to apply for part-time Ph.D.

ONLINE APPLICATION PROCESS

1. **Before registering on the website, the candidates should possess the following:**
    1. Valid E-mail ID and Mobile Number as that will be used for all communication.
    2. Candidates should have latest passport size photograph on a white background (jpg or jpeg file only upto 100 kb) for uploading with the application form.
    3. Candidates should have photograph of signature on a white background in digital format (jpg or jpeg file only upto 100 kb) for uploading with the application form.
    4. Scanned copy of all the required documents for uploading (jpg or jpeg or png file only upto 100 kb) with the application form.

2. **Documents to be uploaded by the candidates:**
    1. Date of Birth Proof (Birth Certificate/School Leaving Certificate) (jpg or jpeg or png file only upto 100 kb)
    2. Aadhar Card (jpg or jpeg or png file only upto 100 kb)
    3. Colored Passport Size Photograph (jpg or jpeg or png file only upto 100 kb)
    4. Candidates Signature (jpg or jpeg or png file only upto 100 kb)
    5. X Mark sheet (jpg or jpeg or png file only upto 100 kb)
    6. XII Mark sheet (jpg or jpeg or png file only upto 100 kb)
    7. Degree Certificate (jpg or jpeg or png file only upto 100 kb)

8. Master Degree Certificate (jpg or jpeg or png file only upto 100 kb)
9. Work Experience certificate, if any (jpg or jpeg or png file only upto 100 kb)

3. Filling up of Application

1. Go to "Admission" page at www.aurora.edu.in.
2. Read the instructions and eligibility criteria carefully.
3. Click on the link "Apply for Admission".
4. Fill up all the required fields.
5. Pay an amount of Rs 1000/- towards the application fee.
6. Ensure the information provided is correct and then click on submit. Application once submitted cannot be edited further.

4. Note: Candidates are advised in their own interest to apply online well before the closing date and not to wait till the last date to avoid the possibility of disconnection/inability/failure to log on to the website on account of any technical problem.

5. After Registration:

1. After successful submission of Online Application, the candidate must take a print out of the filled-in online application for future reference.
2. For each candidate, a unique id i.e. a "Application No." will be created on successful submission of online application and it is mandatory to mention this Reference Number in each communication during the process.
3. The exact date and time of the Computer Based Test and thereafter Personal Interview call letter to the eligible candidates will be informed through E-Mail/SMS.

ADMISSION PROCESS

Aurora shall admit candidates into the Doctoral program through a two-stage process.

Stage 1 - AURUM

The first stage of the admission process into the Doctoral Program is to apply and qualify AURUM (Aurora Deemed-to-be University Matriculation Test). The following shall be the pattern of AURUM PhD:

Maximum marks	:	100 (Hundred Marks)
Duration of Examination	:	120 minutes.
Mode of Exam	:	Online (CBT- Computer Based Test)
Nature of Test	:	Objective type questions with multiple choice in two parts
Part A	:	Teaching and Research Aptitude (50 Marks)
Part B	:	Concerned subject (50 Marks)
Syllabus	:	Enclosed as Annexure

Stage 2 - Interview

Interview will be conducted to the AURM Ph.D qualified candidates, where the candidates are required to discuss their research interest/area before a duly constituted Department Research Committee.

The University reserves the right to cancel the admission/registration of any candidate to the research program at any stage if it is noticed that the data furnished / certificates enclosed are incorrect. In case of any disputes concerning admissions to the courses of the University Hyderabad, the jurisdiction shall remain with the Courts or Consumer forum in Hyderabad only.

Exemption from AURUM Ph.D.:

Only those candidates who have successfully cleared an All India National Level Competitive Examination like NET of UGC / CSIR / ICAR (ASRB) / GPAT / ICMR / GATE / DST - INSPIRE within the last 2 years* of the PhD session they are applying in, shall be exempted from appearing AURUM Ph.D and they will be required to appear for the Interview round only. For consideration of exemption they must timely submit scanned copy of the issued certificate (and not score card) along with the application form or later via mail but not later than two days prior to the entrance examination date. Exempted Candidates will receive a message of exemption on their admission microsite/ admit card prior to AURUM and those who do not receive such a message will be required to appear for AURUM.

TUITION FEE AND OTHER PAYMENTS

On selection for admission, candidates shall be required to pay the prescribed admission fee of Rs. 5000/-, Tuition fee for first year of Rs. 1,00,000/- per annum and other admissible fee prescribed by the University for Doctoral Program. Details of examination fee and any other fee payable can be known from the office of the Director, R & D.

SUPERVISOR

1. The Research Supervisor shall be from Aurora Higher Education and Research Academy.
2. Only full-time regular teachers of the University can act as a supervisor.
3. No external supervisors are allowed.
4. However, Co-Supervisor from reputed research organizations can be allowed in inter-disciplinary areas from other departments of the same institute or from other related institutions with the approval of the Doctoral Advisory Committee (DAC) of the University.

PLACE OF RESEARCH WORK

In the case of part-time candidates, working in organisations, details regarding the availability of the required research facilities at the place of work must be given. The place of work must be recognised by the University as a place with an adequate research environment. Part-Time candidates working in the company/ organization/ college must produce, from the Head of the Organization, a "No Objection Certificate" on the organisation's letter head containing the name, designation mobile no., Email of the person issuing the certificate for the candidate to take up the Research work, and permission for the supervisor from the university to visit the organisation periodically to monitor and assess the research work of the candidate.

NUMBER OF SEATS

The University has 12 vacancies across each discipline. The University is especially seeking proposals in new and emerging areas which may have a cross-cutting focus in inter and intra-disciplinary areas. The area selected should be such that it enables the candidate to make an original contribution to knowledge. Admissions against the aforesaid vacancies shall only be made if a research proposal is found to be satisfactory and suitable. The University reserves the right not to fill the advertised seats if the Research Board does not find the requisite number of research-worthy proposals. Similarly, University may admit more candidates if the Research Board finds proposals correlating with the University's research agenda.

GENERAL INSTRUCTIONS

1. The application and the short-listing process is online. Eligible and interested candidates are required to apply online ONLY on the university website.
2. No offline communication will be entertained.
3. No other means/mode of application will be accepted.
4. Candidates are required not to send any document by post to the University with regard to application for admission
5. Before applying the candidates should ensure that they fulfil all the eligibility criteria as mentioned.
6. All correspondence with candidates shall be done only on their registered E-mail ID/mobile no. provided by the candidate.
7. If at any stage in the selection process, including joining, if any documents/certificates are not found as per the specifications of eligibility criteria, such candidate shall be terminated from the process.
8. Applications/Registration which are incomplete or not fulfilling the eligibility criteria shall not be considered "Eligible" and treated as "Rejected".
9. Selection of candidates is subject to his/her being declared qualified.
10. All such selections will also be subject to all relevant rules/policies/guidelines of Aurora.
11. For any correspondence, mark a mail to "admissions@aurora.edu.in".

TEACHING AND RESEARCH APTITUDE

The main objective is to assess the teaching and research capabilities of the candidates. Therefore, the test is aimed at assessing the teaching and general/ research aptitude as well as their awareness. They are expected to possess and exhibit cognitive abilities. Cognitive abilities include comprehension, analysis, evaluation, understanding the structure of arguments and deductive and inductive reasoning. The candidates are also expected to have a general awareness and knowledge of sources of information. They should be aware of interaction between people, environment and natural resources and their impact on quality of life. The details are given in the following sections:

Note: i) Each section gets equal weightage: five questions and 10 marks from each section

ii) Whenever pictorial questions are set for the sighted candidates a passage followed by equal number of questions should be set for the visually handicapped candidates.

1. Teaching Aptitude

a) Teaching: Nature, objectives, characteristics and basis requirements.
b) Learner's characteristics;
c) Factors affective teaching;
d) Methods of teaching;
e) Evaluation systems

2. Research Aptitude

a) Research: Meaning, characteristics, and types;
b) Steps to research;
c) Methods of research
d) Research Ethics;
e) Paper, articles, workshop, seminar, conference and symposium;
f) Thesis writing: its characteristics and format.

3. Reading Comprehension

a) A Passage to be set with questions to be answered.

4. Communication

a) Communication: Nature, characteristics, types, barriers and effective classroom communication.

5. Reasoning (Including Mathematical)

a) Number series; letter series; codes;

b) Relationships; classification.

6) Logic Reasoning

a) Understanding the structures of arguments;

b) Evaluating and distinguishing deductive and inductive reasoning;

c) Verbal analogies : Word analogy – Applied anology;

d) Verbal classification:

e) Reasoning Logical Diagrams : Simple, diagrammatic relationship, multu-diagrammatic relationship;

h) Venn diagram; Analytical Reasoning

7) Data Interpretation

a) Sources, acquisition and interpretation of data;

b) Quantitative and qualitative data;

c) Graphical representation and mapping of data.

8) Information and Communication Technology (ICT)

a) ICT : meaning, advantages, disadvantages and uses:

b) General abbreviations and terminology;

c) Basics of internet and e-mailing.

9) People and Environment

a) People and environment interaction;

b) Sources of pollution;

c) Pollutants and their impact on human life, exploitation of natural and energy resources;

d) Natural hazards and mitigation

10) Higher Education System : Governance, Polity and Administration

a) Structures of the institutions for higher learning and research in India; formal and distance education; professional/technical and general education; value education; governance, polity and administration; concept, institutions and their interactions.

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CIVIL ENGINEERING

1. STRUCTURAL ENGINEERING

a) Strength of Materials: Simple Stress and Strains, elastic constants, shear forces and bending moment diagrams for beams, principal stresses and Mohr's stress circle, bending and shear stresses, deflections, torsion, thin and thick cylinders and fixed beams, shear centre, trusses, Betti-Maxwell theorem, unsymmetrical bending.

b) Theory of Structures: Direct and bending stresses, Columns, Strain energy, Moving loads and influence lines, Arches, Suspension bridges – static and kinematic indeterminacy, Moment distribution, Slope deflection and Kani's methods applied to continuous beams and portal frames, column analogy, matrix methods.

c) Concrete Technology: Material properties, Concrete properties, Basics of Mix design.

d) Concrete Structures: Materials and stresses, IS 456-2000, stress blocks limit state and working stress methods of design of Beams, Slabs, Columns and Footings. Retaining walls, water tanks, Slab and T-Beam bridges, design for shear and torsion, yield line theory.

e) Steel Structures: Bolted and welded joints and connections, simple and compound columns, column bases, Tension members, roof trusses, plate and gantry girders, plate girder and lattice girder railway bridges and bearings. Plastic analysis and design of beams and frames.

f) Pre-stressed concrete: Basic concepts, material losses, system of pre-stressed analysis and design of beams.

2. GEOTECHNICAL ENGINEERING

a) Soil Mechanics: Physical properties of soils, Classification and Identification, Permeability, Capillarity, Seepage, Compaction, Consolidation, Shear strength, Earth pressure, Slope stability and advances in soil mechanics.

b) Foundation Engineering: Stress distribution in soils, Bearing capacity, Settlement analysis, Pile foundations, Coffer dams, Caissons, Dewatering, Bracing for excavations, Site investigations, Newmark charts, machine foundations.

c) Engineering Geology: Mineralogy, Structural Geology Groundwater Earthquake Engineering, Tunnels, Dams and Reservoirs, rock mechanics, Geological hazards.

3. HYDRAULICS AND WATER RESOURCES ENGINEERING

a) Fluid Mechanics: Basic concepts, Fluid Statics, Kinematics and Dynamics, Energy Principles, Flow Measurement , Compressible flow, Flow Through pipes, Open channel flow, Similitude Concepts and applications, Hydraulic machines-Turbines and pumps.

b) Hydrology: Rainfall, Runoff, Floods, Groundwater, hydrographs, flood control and mitigation.

c) Irrigation: Diversion Head Works, Canals, Corp water requirement, Soil agronomy, Water management, weirs, cross drainage works, canal falls.

d) Dam Engineering: Storage works, Dams, Surplus works, Energy dissipation, Earthen dams.

e) Water Power: Development, Power House Components and dimensions.

4. TRANSPORTATION ENGINEERING

a) Highway alignment, Geometric design, Traffic Engineering, Pavement material characterization, pavement design: flexible pavements, rigid pavements and advanced design approaches like mechanistic methods of pavement design, pavement maintenance, pavement evaluation and highway drainage

b) Railway Engineering: History, alignment, geometrics, rails, sleepers, ballast sub-grade preparation, curves, crossings etc.

c) Airport Engineering: Airport planning, runway orientation and design, design of taxi ways and other geometric components.

d) Traffic and Transportation planning and management

5. OTHER IMPORTANT TOPICS

Elements of Surveying: Plane table, compass, Levelling and theodolite survey; Building materials and technology; Elements of estimation & costing. Environmental Engineering: Water and Waste Water Engineering, Air Pollution, Municipal Solid Waste, Noise Pollution CPM and PERT, contracts and tenders, Building Information Modelling and Multicriteria Decision making Models (BIM & MCDM Models), remote sensing and GIS. GPS, Applications of Geospatial Techniques to Civil Engineering.

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COMPUTER SCIENCE AND ENGINEERING

Engineering Mathematics

Discrete Mathematics: Propositional and First Order Logic, Sets, Relations, Functions, Partial Orders and Lattices, Groups, Graphs: Connectivity, Matching, Coloring. Combinatorics: Counting, Recurrence Relations, Generating Functions.

Linear Algebra: Matrices, Determinants, System of Linear Equations, Eigen values and Eigen vectors, LU Decomposition.

Calculus: Limits, Continuity and Differentiability, Maxima and Minima, Mean Value Theorem, Integration.

Probability: Random Variables: Uniform, Normal, Exponential, Poisson and Binomial Distributions. Mean, Median, Mode and Standard Deviation. Conditional Probability and Bayes Theorem.

Computer Science and Information Technology

Digital Logic: Boolean algebra: Logic Gates, Number Representations, Combinational and Sequential Circuits, Flip- Flops & Counters: Minimization, and Computer Arithmetic (Fixed and Floating Point Representations).

Computer Organization and Architecture: Machine Instructions and Addressing Modes, ALU, Data and Control Unit, Instruction Pipelining, Pipeline Hazards, Memory Hierarchy: Cache, Main Memory and Secondary Storage, I/O Interface (Interrupt and DMA).

Programming and Data Structures: Programming in C, functions, Parameter Passing, Recursion, Structured Data Types: arrays, structure, union, strings, pointers, file handling. Arrays, Stacks, Queues, Linked Lists, Trees: Binary Trees, Tree Traversal techniques, Binary Search Trees, Tree Operations, Heaps, Graph terminology and representation

Algorithms: Searching, Sorting, Hashing, Asymptotic Notations, Time and Space Complexity.

Algorithm Design Techniques: Greedy, Dynamic Programming and Divide-and-Conquer. Graph traversal techniques, Spanning Trees, Shortest Path Algorithms.

Theory of Computation : Regular Expressions and Finite Automata, Context-Free Grammars and Push-Down Automata, Regular and Context-Free Languages, Pumping Lemma, Turing Machines and Undesirability.

Compiler Design: Lexical Analysis, Parsing, Syntax-Directed Translation, Runtime Environments, Intermediate Code Generation, Basics of code optimization, Local optimization, Common sub expression elimination.

Operating System: Processes, Threads, CPU Scheduling, Disk Scheduling, Inter-Process Communication, Concurrency and Synchronization, Deadlock, Memory Management and Virtual Memory, File Systems and System calls.

Databases: ER-Diagrams, Relational Model: Relational Algebra, Tuple Calculus, SQL, Integrity Constraints, Normal Forms, File Organization: Indexing, B Trees and B+ Trees, Transactions and Concurrency Control.

Computer Networks: Concept of Layering, Flow and Error Control Techniques, Switching, IPv4/IPv6, Routers and Routing Algorithms (Shortest path, flooding, Distance Vector, Link State). TCP/UDP and Sockets, Congestion Control. Application Layer Protocols: DNS, SMTP, POP, FTP, HTTP, Email. Basics of Wi-Fi, Network Security: Authentication, Basics of Public Key and Private Key Cryptography, Digital Signatures and Certificates, Firewalls.

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ELECTRICAL & ELECTRONICS ENGINEERING

Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of Linear Equations, Eigen Values and Eigen Vectors.

Calculus: Mean Value Theorems, Theorems of Integral Calculus, Evaluation of Definite and Improper Integrals, Partial Derivatives, Maxima and Minima, Multiple Integrals, Fourier Series. Vector Identities, Directional Derivatives, Line, Surface and Volume Integrals, Stokes, Gauss and Green's Theorems.

Differential Equations: First Order Equation (Linear and Nonlinear), Higher Order Linear Differential Equations with Constant Coefficients, Method of Variation of Parameters, Cauchy's and Euler's Equations, Initial and Boundary Value Problems, Partial Differential Equations and Variable Separable Method.

Complex Variables: Analytic Functions, Cauchy's Integral Theorem and Integral Formula, Taylor's and Laurent's Series, Residue Theorem, Solution Integrals.

Transforms: Fourier Series Representation of Continuous Periodic Signals, Sampling Theorem, Fourier, Laplace and Z-Transforms.

Probability and Statistics: Probability and Sampling Theorems, Conditional Probability, Probability Density Function, Mean, Median, Mode and Standard Deviation, Random Variables, Discrete and Continuous Distributions, Exponential, Poisson, Normal and Binomial Distribution, Correlation and Regression Analysis.

Numerical Methods: Solutions of Non-Linear Algebraic Equations, Single and Multi-Step Methods For Differential Equations.

Electrical Engineering

Electric circuits and fields: Ideal voltage and current sources, Dependent sources, R, L, C elements, KCL, KVL, Node & Mesh Analysis, Star-delta transformation. Thevenin's, Nortons's, Superposition & Maximum power transfer theorems, Transient response of DC & AC Networks, Sinusoidal steady state analysis, Resonance, Networks graph Theory, Two-Port Network, Balanced three phase circuits. Coulomb's law, electrical field intensity & potential due to point, line. Plane and spherical charge distribution. Gauss's Law, Ampere's Law, Biot – Savart's law, Magnetic circuits, Self and Mutual Inductance, Dielectrics and Capacitance.

Electrical Machines: Single Phase Transformer - Equivalent Circuit, Phasor Diagram, open circuit and short circuit tests, Regulation and Efficiency; Three Phase Transformers - Connections, Parallel Operation; Auto- Transformer; Electromechanical Energy Conversion Principles; DC Machines - Types, Windings, Generator & Motor

Characteristics, Armature Reaction and Commutation, Starting and Speed Control of DC Motors; AC Machines-Three Phase Induction Motors - Principles, Types, Performance, Torque speed Characteristics, Starting and Speed Control; Single Phase Induction Motors; Synchronous Machines - Performance, Regulation and Parallel Operation of Generators, Synchronous Motor Starting, Characteristics and Applications; Servo and Stepper Motors. Power Systems: Basic Power Generation Concepts; Transmission Line Models and Performance; Cable Performance, Insulators; Corona and Radio Interference; Distribution Systems; Per-Unit Quantities; Bus Impedance and Admittance Matrices; Load Flow Analysis, Voltage and frequency Control; Power Factor Correction; Symmetrical Components; Fault Analysis; Principles of Over-Current, Differential and Distance Protection; Solid State Relays and Digital Protection; Circuit Breakers; System Stability Concepts, Swing Curves and Equal Area Criterion; HVDC Transmission and FACTS Concepts, Economic Load dispatch with & without Network losses.

Control Systems: Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-State analysis of linear time invariant systems, Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, Solution of state equation, Controllability and Observability.

Analog and Digital Electronics: Characteristics of Diodes, BJT, FET; Amplifiers - Biasing, Equivalent Circuit and Frequency Response; Oscillators and Feedback Amplifiers; Operational Amplifiers - Characteristics and Applications; Simple Active Filters; VCOS and Timers; Combinational and Sequential Logic Circuits; Multiplexer; Schmitt Trigger; Multi-Vibrators; Sample and Hold Circuits; A/D and D/A Converters; 8085 Microprocessor Basics, Architecture, Programming and Interfacing.

Power Electronics and Drives: Semiconductor Power Diodes, Thyristors, Triacs, GTO's, MOSFET's and IGBT's - Static Characteristics and Principles of Operation; Triggering Circuits; Phase Control Rectifiers; Bridge Converters - Fully Controlled and Half Controlled; Principles of Choppers and Inverters; Basic Concepts of Adjustable Speed DC and AC Drives.

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ELECTRONICS AND COMMUNICATION ENGINEERING

Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order equations (Linear and Nonlinear), higher order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, partial differential equations and variable separable method.

Complex Variables: Analytic functions, Cauchy's integral formula: Cauchy's integral theorem, Taylor's and Laurent' Series, residue theorem.

Probability and Statistics: Probability, Joint and conditional probability, discrete and continuous random variables, probability distribution and density functions. Exponential, Poisson, normal and Binomial Distributions Functions. mean, mean square and standard deviation.

Numerical Methods: Solutions of non-Linear equations, single and multi-step methods for differential equations.

Electronics and Communication Engineering

Networks: Definition and properties of Laplace transform, Network Solution Methods: nodal and mesh analysis. Network Theorems: Superposition, Thevenin and Norton's Maximum Power Transfer; Wye-Delta Transformation; Steady State Sinusoidal Analysis Using Phasors; Time domain analysis of simple linear circuits, Solution of Network Equations Using Laplace Transform; Frequency Domain analysis of RLC circuits; 2-Port Network Parameters: Driving point and transfer functions. State Equations for Networks.

Signals and Systems: Continuous-time and discrete-time Fourier series, Continuous-time and discrete-time Fourier transform, DFT and FFT, Z-Transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: Definitions and properties; Causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay.

Electronic Devices: Energy bands in intrinsic and extrinsic Silicon. Carrier transport in silicon: Diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. P-N Junction diode, Zener diode, Tunnel diode, BJT, JFET,

MOS Capacitor, MOSFET, LED, PIN and Avalanche Photo Diode, Basics of Lasers. Device Technology: Integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS Process.

Analog Circuits: Small signal equivalent circuits of diodes, BJTs, MOFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of BJT and FET amplifiers. Amplifiers: singleand multi-stage, differential, operational, feedback, and power amplifiers. Frequency response of an amplifiers. Simple op-amp circuits. Filters. Sinusoidal oscillators; Criterion for oscillation; Single-Transistor and op-amp configurations. function generators and wave-shaping circuits, 555 timers. Power supplies, regulation.

Digital Circuits: Number Systems, Boolean algebra, minimization of Boolean Functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS, Number systems.). Combinatorial circuits: Arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: Latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories: ROM, SRAM and DRAM, Microprocessor (8085): Architecture, programming, memory and I/O Interfacing.

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.

Communications: Deterministic and Random Signals, types of noise, autocorrelation, power spectral density, properties of white noise, filtering of random signals through LTI systems; analog communication systems: amplitude and angle modulation and demodulation systems, spectra of AM and FM, super-heterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: Sampling Theory Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM); Digital modulation schemes: Amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK, QAM); Matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation schemes; Fundamental of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Electromagnetics: Maxwell's Equations: differential 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: Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations. Antennas: antenna types, radiation pattern, gain and directivity, return loss, Basics of Radar.

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MECHANICAL ENGINEERING

Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of Linear Equations, Eigen Values and Eigen Vectors.

Calculus: Functions of Single Variable, Limit, Continuity and Differentiability, Mean Value Theorems, Evaluation of Definite and Improper Integrals, Partial Derivatives, Total Derivative, Maxima and Minima, Gradient, Divergence and Curl, Vector Identities, Directional Derivatives, Line, Surface and Volume Integrals, Stokes, Gauss and Green's Theorems.

Differential Equations: First Order Equations (Linear and Nonlinear), Higher Order Linear Differential Equations with Constant Coefficients, Cauchy's and Euler's Equations, Initial and Boundary Value Problems, Laplace Transforms, Solutions of One Dimensional Heat and Wave Equations and Laplace Equation.

Complex Variables: Analytic Functions, Cauchy's Integral Theorem, Taylor and Laurent Series. Probability and Statistics: Definitions of Probability and Sampling Theorems, Conditional Probability, Mean, Median, Mode and Standard Deviation, Random Variables, Exponential, Poisson, Normal and Binomial Distributions.

Numerical Methods: Numerical Solutions of Linear and Non-Linear Algebraic Equations, Integration by Trapezoidal and Simpson's Rule, Single and Multi-Step Methods for Differential Equations.

Applied Mechanics and Design

Engineering Mechanics: Free Body Diagrams and Equilibrium; Friction, rolling friction, belt – pulley, screw jack, wedge Trusses and Frames; Virtual Work; Kinematics and Dynamics of Particles and Rigid Bodies in Plane Motion, Impulse and Momentum (Linear and Angular) and Energy Formulations; Impact.

Strength of Materials: Stress and Strain, Stress-Strain Relationship and Elastic Constants, Poisson’s ratio, Mohr's Circle Plane Stress and Plane Strain, Thin Cylinders; Beam Shear Force and Bending Moment Diagrams; Bending and Shear Stresses; Deflection of Beams; Torsion of Circular Shafts; Euler's Theory of Columns; Strain Energy Methods; Thermal Stresses, Testing of Materials with UTM, hardness and impact strength.

Theory of Machines: Displacement, Velocity and Acceleration Analysis of Plane Mechanisms; Dynamic Analysis of Slider- Crank Mechanism; Cam mechanism Gear and Gear Trains; Flywheels, Gyroscope and Governors, Balancing of reciprocating and rotary masses.

Vibrations: Free and Forced Vibration of Single Degree of Freedom Systems; Effects of Damping; Vibration Isolation; Resonance, Critical Speeds of Shafts.
Machine Design: Design for Static and Dynamic Loading; Failure Theories; Fatigue Strength the S-N Diagram; Principles of the Design of Machine Elements Such as Bolted, Riveted and Welded Joints, Shafts, Spur Gears, Rolling and Sliding Contact Bearings, Brakes and Clutches, Springs.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid Properties; Fluid Statics, Manometry, Buoyancy; Forces on sub merged bodies, Stability of floating bodies, Fluid Acceleration; Differential Equations of Continuity and Momentum; Bernoulli's Equation; Viscous Flow of Incompressible Fluids; Boundary Layer; Elementary Turbulent Flow; Flow Through Pipes, Head Losses in Pipes, Bends.
Heat-Transfer: Modes of Heat Transfer; One Dimensional Heat Conduction, Resistance Concept, Electrical Analogy, Heat transfer thorough fins, Unsteady Heat Conduction, Dimensionless Parameters in Free and Forced Convective Heat Transfer, Various Correlations for Heat Transfer in Flow Over Flat Plates and Through Pipes; Thermal Boundary Layer; Effect of Turbulence; Radiative Heat Transfer, Black and Grey Surfaces, Shape Factors, Network Analysis; Heat Exchanger Performance, LMTD and NTU Methods.
Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.
Applications: Power Engineering: Air compressors- Reciprocatingandrotary compressors, Rankine, Brayton Cycles with Regeneration and Reheat. I.C. Engines: Air-Standard Otto, Diesel Cycles. Refrigeration and Air-Conditioning: Vapour Refrigeration Cycle, Heat Pumps, Gas Refrigeration, Reverse Brayton Cycle; Moist Air: Psychrometric Chart, Basic Psychrometric Processes. Turbomachinery: Pelton wheel, Francis and Kaplan Turbines –Impulse and Reaction Principles, Velocity Diagrams.

Materials, Manufacturing and Industrial Engineering

Engineering Materials: Structure and Properties of Engineering Materials, Heat Treatment, Stress-Strain Diagrams for Engineering Materials, Iron-carbon diagram.
Metal Casting: Design of Patterns, Moulds and Cores; Solidification and Cooling; Riser and Gating Design, Design Considerations.

Metal Forming: Plastic Deformation and Yield Criteria; Fundamentals of Hot and Cold Working Processes; Load Estimation for Bulk (Forging, Rolling, Extrusion, Drawing) and Sheet (Shearing, Deep Drawing, Bending) Metal Forming Processes; Principles of Powder Metallurgy.

Joining Process: Physics of Welding, Brazing and Soldering; Adhesive Bonding

Machining and Machine Tool Operations: Mechanics of Machining, Basic machine tool, Single and Multi-Point Cutting Tools, Tool Geometry and Materials, Tool Life and Wear; Economics of Machining; Principles of Non- Traditional Machining Processes; Principles of Work Holding, Principles of Design of Jigs and Fixtures

Metrology and Inspection: Limits, Fits and Tolerances; Linear and Angular Measurements; Comparators; Gauge Design; Interferometry; Form and Finish Measurement; Alignment and Testing Methods; Tolerance Analysis in Manufacturing and Assembly.

Computer Integrated Manufacturing: Basic Concepts of CAD/CAM and their Integration Tools, Additive Manufacturing.

Production Planning and Control: Forecasting Models, Aggregate Production Planning, Scheduling, Materials Requirement Planning.

Inventory Control: Deterministic Models; Safety Stock Inventory Control Systems.

Operations Research: Linear Programming, Simplex Method, Transportation, Assignment, Network Flow Models, Simple Queuing Models, PERT and CPM.

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CHEMISTRY

Unit-1

Symmetry of Molecules

Concept of Symmetry in Chemistry – Symmetry Operations – Symmetry Elements: Rotational Axis of Symmetry and Types of Rotational Axes, Plane of Symmetry and types of Planes, Improper Rotational Axis of Symmetry , Inversion Center and Identity Element – More about Symmetry Elements – Molecular Point Groups: Definition and s) – Spin-Orbital coupling parameters. Effect of weak cubic crystal fields on S,P,D and F terms- Orgel Diagrams.

Coordination Equilibria

Solvation of metal ions- Metal complex formation in solution-Binary metal complexes. Stability constants (types and relationships between them). – Factors influencing the stability constants: (i) Metal ion effects (charge/size, IP, crystal field effect, John-Teller effect, Pearson theory of hard and soft acids and bases (HSAB), elecronegativity and hardness and softness, symbiosis. (ii) Ligand effects (Basicity, Substituent effect, Steric, Chelate(size and number of chelate rings), Macrocyclic and Cryptate effects- crown ethers, crypton, size match selectivity or concept of hole size, limitations, Macrocycles with pendent groups– Methods used for the determination of Stability constants (Basic Principles only): pH metric, Spectrophotometric and Polarographic methods Ternary Metal Complexes – definition – Formation of ternary metal complexes – Step- wise and simultaneous equilibria with simple examples.

Ligational Aspects of Diatomic molecules

Carbonyls:- Carbon monoxide as a ligand – Molecular orbitals of CO - Donor and Acceptor molecular orbitals of CO; Bonding modes of CO- Terminal and Bridging; Evidence for multiple bonding from Bond lengths and Stretching frequencies; 18 Valence electron rule and its application.

Metal Nitrosyls:- NO as a ligand – Molecular orbitals of NO – Donor and Acceptor components; Bonding modes of NO – Terminal (Linear, Bent) and Bridging; Structural aspects of $[IrCl(PPh_3)_2(CO)(NO)]^+$ and $[RuCl(PPh_3)_2(NO)_2]^+$.
Stereo chemical control of valence in $[Co(diars)_2(NO)]^{2+}$ and $[Co(diars)_2(NO)(SCN)]^+$.

Metal Dinitrogen complexes:- N_2 as aligand – Molecular orbitals of N_2; Bonding modes – Terminal and Bridging; Stretching frequencies; Structures of Ru (II) and Os(II) dinitrogen complexes; Chemical fixation of dinitrogen.

Metal Clusters:

Carbonyl clusters: Factors favouring Metal-Metal bonding – Classification of Clusters Low Nuclearity Clusters : M_3 and M_4 clusters, structural patterns in $M_3(CO)_{12}$ (M=Fe,Ru,Os) and $M_4(CO)_{12}$ (M=Co,Rh,Ir) Clusters. Metal carbonyl scrambling – High Nuclearity clusters M_5, M_6, M_7, M_8 and M_{10} Clusters-, Polyhedral skeletal electron pair theory and Total Electron Count theory – Capping rule – Structural patterns in $[Os_6(CO)_{18}]^{2-}$, $[Rh_6(CO)_{16}]$, $[Os_7(CO)_{21}]$, $[Rh_7(CO)_{16}]^{3-}$, $[Os_8(CO)_{22}]^{2-}$, $[Os_{10}C(CO)_{24}]^{2-}$ and $[Ni_5(CO)_{12}]$

Reaction mechanisms of transition metal complexes:

Ligand substitution reactions

Energy profile of a reaction – Transition state or Activated Complex. Types of substitution reactions (SE, SN, SN^1, SN^2). Langford and Grey classification – A mechanism, D-Mechanism, I_a, I_d, and Intimate mechanism. Ligand substitution reactions in octahedral complexes: Aquation or Acid hydrolysis reactions, Factors effecting Acid Hydrolysis , Base Hydrolysis, Conjugate Base Mechanism, Evidences in favour of SN^1CB Mechanism.

Substitution reactions with out Breaking Metal-Ligand bond. Anation reaction

Ligand Substitution reactions in Square-Planar complexes: Mechanism of Substitution in Square-Planar complexes- Trans-effect, Trans-influence, Grienberg's Polarization theory and π - bonding theory – Applications of Trans-effect in synthesis of Pt (II) complexes. Electron Transfer Reactions (or Oxidation-Reduction Reactions) in Coordination compounds: Mechanism of One-electron Transfer Reactions: Atom (or group) Transfer or Inner Sphere Mechanism, Direct electron Transfer or Outer Sphere Mechanism. Factrors affecting direct electron transfer reactions, Cross reactions and Marcus-Hush theory.

Bio coordination chemistry.

Oxygen transport and storage: Hemoglobin (Hb) and Myoglobin (Mb) primary, secondary, tertiary and quarternary structures and non-covalent bonds present in them. Oxygenation equilibria for Mb and Hb. Factor effecting oxygenation equilibria. Cooperativity and its mechanism. Spin state of iron. Spatial and electronic aspects of dioxygen binding. Allosteric models (T and R states). Role of globin. Transport of NO

and CO_2. Hemocynin (Hc) and Hemerythrin (Hr): Introduction-structure of active sites with oxygen and without oxygen.
Comparison of Hemerythrin and Hemocyanin with hemoglobin.
Photosynthesis: Structural aspects of Chlorophyll. Photo system I and Photo system II.
Vitamin B_6 model systems : Forms of vitamin B6 with structures. Reaction mechanisms of (1) Transamination (2) Decarboxylation and (3) Dealdolation in presence of metal ions.

Unit-II

Stereochemistry

Molecular representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions.
Molecular Symmetry & Chirality: Symmetry operations and symmetry elements (Cn & Sn). Criteria for Chirality. Desymmetrization.
Axial, planar and helical chirality: Axially chiral allenes,spiranes,alkylidene cycloalkanes, chiral biaryls, atropisomerism, planar chiral ansa compounds and trans- cyclooctene, helically chiral compounds and their configurational nomenclature
Relative and absolute configuration: Determination of configuration by chemical correlation methods.
Racemisation and resolution techniques: Racemisation, resolutions by direct crystallization, diastereoisomer salt formation chiral chromatography and asymmetric transformation.
Determination of configuration in E, Z-isomers: Spectral and Chemical methods of configuration determination of E,Z isomers. Determination of configuration in aldoximes and ketoximes.

Reaction mechanism

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; *anti* addition- Bromination and epoxidation followed by ring opening. *Syn* addition of OsO_4 and $KMnO_4$.
Elimination reactions Elimination reactions E2, E1, E1CB mechanisms. Orientation and stereoselectivity in E2 eliminations. Pyrolytic *syn* elimination and α-elimination, elimination Vs substitution.
Nucleophilic Aromatic substitution: Aromatic Nucleophilic substitution: $S_N1(Ar)$, S_N2 (Ar), and benzyne mechanisms; evidence for the structure of benzyne. Von Richter rearrangement.

Definition and types of ambident nucleophiles.
Neighbouring group participation : Criteria for determining the participation of neighbouring group. Enhanced reaction rates, retention of configuration, isotopic labeling and cyclic intermediates. Neighbouring group participation involving Halogens, Oxygen, Sulphur, Nitrogen, Aryl, Cycloalky l groups , σ and π- bonds. Introduction to nonclassical carbocations.

Conformational analysis

Conformational isomerism: Introduction to the concept of dynamic stereochemistry. Conformational diastereoisomers and conformational enantiomers. Study of conformations in ethane and 1,2-disubstituted ethane derivatives like butane, dihalobutanes, halohydrin, ethylene glycol, butane-2, 3-diol amino alcohols and 1,1,2,2-tetrahalobutanes. Klyne-Prelog terminology for conformers and torsion angles
Conformations of unsaturated acyclic compounds: Propylene, 1-Butene, Acetaldehyde Propionaldehyde and Butanone.
Factors affecting the conformational stability and conformational equilibrium:
Attractive and repulsive interactions. Use of Physical and Spectral methods in conformational analysis.
Conformational affects on the stability and reactivity of acyclic diastereoisomers: Steric and stereoelectronic factors-examples. Conformation and reactivity. The Winstein-Holness equation and the Curtin – Hammett principle

Pericyclic reactions

Introduction, Classification of pericyclic reactions,
Electrocyclic reactions: con rotation and dis rotation. Electrocyclic closure and opening in 4n and 4n+2 systems.
Cycloaddition reactions: suprafacial and antara facial additions in 4n and 4n+2 cycloadditions.
Sigmatropic reactions: [i, j] shifts- suprafacial and antarafacial shifts, Cope and Claisen rearrangement reactions.
Approaches for the interpretation of mechanism of pericyclic reactions: Aromatic Transition States (ATS)/Perturbation Molecular Orbitals (PMO) approach-Concept of Huckel–Mobius aromatic and antiaromatic transition states. Framing Woodward-Hofmann selection rules for all the pericyclic reactions by ATS approach. Solving problems based on ATS approach.
Molecular orbitals: ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene, allyl cation, allyl radical, pentadienyl cation, pentadienyl radical.

Frontier Molecular Orbital (HOMO-LUMO) approach-concept: Framing Woodward-Hofmann selection rules for all the pericyclic reactions by Frontier Molecular Orbital (FMO) approach. Solving problems based on FMO approach.
Conservation of orbital symmetry: (Correlation Diagrams) approach- for electrocylic and cycloadditions & cycloreversions.

Reactive intermediates and Molecular rearrangements

Reactive Intermediates: Generation, detection, structure, stability and reactions of carbocations, carbanions, carbenes, nitrenes and free radicals.
Molecular rearrangements: Definition and classification. Molecular rearrangements involving 1) electron deficient carbon: Wagner- Meerwein, Pinacol-Pinacolone, Allylic and Wolf rearrangement. 2) electron deficient Nitrogen: Hofmann, Lossen, Curtius, Schmidt and Beckmann rearrangements 3) electron deficient Oxygen: Baeyer-Villiger oxidation. 4) Base catalysed rearrangements: Benzilic acid, Favourski , Transannular , Sommlett-Hauser and Smiles rearrangement

Unit-III

Thermodynamics

Concept of Entropy, Entropy as a function of V and T, Entropy as a function of P and T. Entropy change in isolated systems- Clausius inequality. Entropy change as criterion for spontaneity and equilibrium.
Third law of thermodynamics. Evaluation of absolute entropies from heat capacity data for solids, liquids and gases. Standard entropies and entropy changes of chemical reactions.
Thermodynamic relations. Gibbs equations. Maxwell relations.
Gibbs equations for non-equilibrium systems. Clausius-Clapeyron equation. Conditions for equilibrium in a closed system. Chemical potential of ideal gases. Ideal-gas reaction equlibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant-the van't Hoff equation.
Solutions: Specifiying the Solution composition. Partial molar poperties-significance. Relation between solution volume and partial molar volume.. The chemical potential. Variation of chemical potential with T and P. Gibbs-Duhem equation-derivation and significance.
Ideal solutions. Thermodynamic properties of ideal solutions. Mixing quantities. Vapour pressure -Raoult's law. Thermodynamic properties of ideally dilute solutions. Vapour pressure- Henry's law.

Nonideal systems. Concept of fugacity, fugacity coefficeient. Determination of fugacity. Non ideal solutions. Activities and activity coefficients..
Multicomponent phase equilibrium: Vapour pressure lowering, freezing point depression and boiling point elevation

Statistical Thermodynamics:
Partition Functions: Concepts of distribution and probability, Boltzmann distribution law. Interpretation of partition functions- translational, rotational, vibrational and electronic partition functions. Relationship between partition functions and thermodynamic functions (only S & G).

Electrochemistry
Electrochemical Cells: Derivation of Nernst equation – problems. Chemical and concentration cells (with and without transference). Liquid junction potential (LJP) – derivation of the expression for LJP – its determination and elimination. Types of electrodes. Applications of EMF measurements: Solubility product, potentiometric titrations, determination of pH using glass electrode, equilibrium constant measurements.
Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required). Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel law.
Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations.

Photochemistry
Electronic transitions in molecules. The Franck Condon principle. Electronically excited molecules- singlet and triplet states. Radiative life times of excited states-theoretical treatment. Measured life times. Quantum yield and its determination. Experimental set up of a photochemical reaction. Actinometry-ferrioxalate and uranyl oxalate actinometers – problems. Derivation of fluorescence and phosphorescence quantum yields. E-type delayed fluorescence- evaluation of triplet energy splitting(ΔEST). Photophysical processes photophysical kinetics of unimolecular reactions. Calculation of rate constants of various photophysical processes-problems, State diagrams
Photochemistry: Photochemistry of π-π^* transitions: Excited states of alkenes, cis-trans isomerisation, and photo stationary state. Photochemistry of 1,3-butadiene

Electrocyclisation and sigmatropic rearrangements, di-π methane rearrangement. Intermolecular reactions, photocycloadditions, photodimeriastion of simple and conjugated olefins. Addition of olefins to α, β-unsaturated carbonyl compounds. Excited states of aromatic compounds,

Photoisimerisation of benzene Photochemistry of (n-π^*) transitions: Excited states of carbonyl compounds, hemolytic cleavage of α- bond, Norrish type I reactions in acyclic and cyclic ketones and strained cycloalkane diones.

Intermolecular abstraction of hydrogen: photoreduction-influence of temperature, solvent, nature of hydrogen donor and structure of the substrate.

Intramolecular abstraction of hydrogen: Norrish type II reactions in ketones, esters and 1,2 diketones, Addition to carbon-carbon multiple bonds, Paterno-Buchi reaction, Photochemistry of nitrites-Barton reaction.

Quantum Chemistry

A brief review of Black body radiation-Planck's concept of quantization-Planck's equation, average energy of an oscillator (derivation not required), Wave particle duality and uncertain principle-significance of these for microscopic entities. Emergence of quantum mechanics. Wave mechanics and Schrödinger wave equation.

Operators- Operator algebra. Commutation of operators, linear operators. Complex functions. Hermitian operators. Operators ∇ and $\nabla 2$ Eigenfunctions and eigenvalues. Degeneracy. Linear combination of eigenfunctions of an operator. Well behaved functions. Normalized and orthogonal functions.

Postulates of quantum mechanics: Physical interpretation of wave function. Observables and Operators. Measurability of operators. Average values of observables. The time dependent Schrodinger equation. Separation of variables and the time-independent Schrodinger equation. Theorems of quantum mechanics. Real nature of the eigen values of a Hermitian operator-significance. Orthogonal nature of the eigen values of a Hermitian operator-significance of orthogonality. Expansion of a function in terms of eigenvalues. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle. Particle in a box- one dimensional and three dimensional. Plots of Ψ and Ψ^2-discussion. Degeneracy of energy levels. Calculations using wave functions of the particle in a box-orthoganality, measurability of energy, position and momentum, average values and probabilities. Application to the spectra of conjugated molecules.

Cartesian, Polar and spherical polar coordinates and their interrelations.
Schrodinger equation for the hydrogen atom- separation into three equations. Hydrogen like wave functions. Radial and angular functions. Quantum numbers *n, l and m* and their importance. The radial distribution functions. Hydrogen like orbitals and their representation.
Polar plots, contour pots and boundary diagrams.
Many electron systems. Approximate methods. The variation method-variation theorem and its proof. Trial variation function and variation integral. Examples of variational calculations.

Chemical Kinetics

Theories of reaction rates: Collision theory, steric factor. Transition state theory. Thermodynamic formulation of transition state theory. Potential energy surface diagram, Reaction coordinate, Activated complex. Activation parameters and their significance. The Eyring equation. Unimolecular reactions and Lindamann's theory.
Complex reactions- Opposing reactions, parallel reactions and consecutive reactions (all first order type). Chain reactions-general characteristics, steady state treatment. Example- H_2-Br_2 reaction. Derivation of rate law.
Effect of structure on reactivity- Linear free energy relationships. Hammett and Taft equations-substituent (σ and σ^*) and reaction constant (ρ and ρ^*) with examples. Deviations from Hammett correlations, reasons- Change of mechanism, resonance interaction. Taft four parameter equation. Correlations for nucleophillic reactions. The Swain – Scott equation and the Edward equation. Reactions in solutions: Primary and secondary salt effects.
The reactivity-selectivity principle – Isokinetic temperature -Isoselectivty rule, Intrinsic barrier and Hammond's postulate.

Solid state chemistry

Electronic properties of metals, insulators and semi-conductors: Electronic structure of solids, Band theory, band structure of metals, insulators and semi-conductors. Electrons, holes and Excitons. The temperature dependence of conductivity of extrinsic semi-conductors. Photo conductivity and photovoltaic effect – p-n junctions. Superconductivity: Occurrence of superconductivity. Destruction of superconductivity by magnetic fields – Meissner effect. Types of superconductors. Theories of super conductivity – BCS theory.

High temperature superconductors: Structure of defect perovskites. High T_c superconductivity in cuprates. Phase diagram of Y-Ba-Cu-O system. Crystal structure of $YBa_2Cu_3O_{7-x}$. Prepartion of 1-2-3 materials. Origin of high Tc superconductivity.

Nanoparticles:

Introduction to nanoparticles. Reduced dimensionality in solids – zero dimensional systems, fullerenes, quantum dots. One dimensional systems, carbon nano tubes, preparation of nano particles –top down and bottom up methods. Preparation of nanomaterials- – sol gel methods, and chemical vapour deposition method; thermolysis.

Unit-IV

Techniques of Chromatography

Introduction, Classification of chromatographic techniques, differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity factor, selectivity factor. Efficiency of separation- resolution, diffusion, plate theory and rate theory.

GC: Principle, instrumentation, detectors- TCD, FID, ECD. Derivatisation techniques, PTGC.

HPLC: Principle, instrumentation, detectors- UV detectors, Photodiode array detector, fluorescence detector.

NMR spectroscopy

^{1}H NMR spectroscopy: Magnetic properties of nuclei, Principles of NMR Instrumentation, CW and pulsed FT instrumentation, equivalent and non equivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

Applications of ^{1}H NMR spectroscopy: Reaction mechanisms (cyclic bromonium ion, electrophilic and nucleophilic substitutions, carbocations and carbanions), E, Z isomers, conformation of cyclohexane and decalins, keto-enol tautomerism, hydrogen bonding, proton exchange processes (alcohols, amines and carboxylic acids), C-N rotation. ^{1}H NMR of organicmolecules

First order and non first order spectra e.g., AX, AX_2, AX_3, A_2X_3, AMX and AB, ABC. Simplification of complex spectra: increased field strength, deuterium exchange,

Lanthanide shift reagents and double resonance techniques. Discrimination of enantiomers by use of chiral NMR solvents (CSAs), chiral lanthanide shift reagents and Mosher's acid. Nuclear Overhauser enhancement (NOE). Fluxional moleculesbullvalene, [η5-C_5H_5M], [η5-$(C_5H_5)_2$ Ti η1-$(C_5H_5)_2$] and [η4$C_8H_8Ru(CO)_3$].

Mass spectrometry

Origin of mass spectrum, principles of EI mass spectrometer. Types of fragments: odd electron and even electron containing neutral and charged species (even electron rule), Nitrogen rule, isotopic peaks, determination of molecular formula, metastable ion peaks. High resolution mass spectrometry. Salient features of fragmentation pattern of organic compounds including β-cleavage, Mclafferty rearrangement, retro Diels – Alder fragmentation and ortho effect. Principle of EI, CI

Microwave Spectroscopy: Classification of molecules based on moment of inertia. Diatomic molecule as rigid rotator and its rotational energy levels. Selection rules (derivation not required). Calculation of bond lengths from rotational spectra of diatomic molecules. Isotope effect on rotational spectra. Calculation of atomic mass from rotational spectra. *Brief description of microwave spectrometer.*

Vibrational Spectroscopy: Vibrational energy levels of diatomic molecules, selection rules (derivation not required). Calculation force constant from vibrational frequency. Anharmonic nature of vibrations. Fundamental bands, overtones and hot bands, Fermi Resonance. Vibrationrotation spectra diatomic molecules. Vibrations of poly atomic molecules. Normal modes of vibration, concept of group frequencies. Characteristics of vibrational frequencies of functional groups; Stereochemical effects on the absorption pattern in carbonyl group, cis-trans isomerism and hydrogen bonding. Isotopic effect on group frequency.

Raman Spectroscopy- Classical and Quantum theories of Raman effect. Rotational Raman and Vibrational Raman spectra, Stokes and anti- Stokes lines. Complementary nature of IR and Raman spectra.

Electronic spectroscopy: Electronic spectra: Elementary energy levels of molecules-selection rules for electronic spectra; types of electronic transitions in molecules. Chromophores: Congugated dienes, trienes and polyenes, unsaturated carbonyl compounds, Benzene, mono substituted derivative (Ph-R), di substituted derivative (R-C_6H_4-R') and substituted benzene derivatives (R-C_6H_4-COR'), Woodward-Fieser rules.

Polynuclear aromatic compounds (Biphenyl, stilbene, naphthalene, anthracene, phenanthrene and pyrene). Heterocyclic systems. Absorption spectra of charge transfer complexes. Solvent and structural influences on absorption maxima, stereochemical factors. Cis-trans isomers, and cross conjugation.

Electro and thermal Analytical Techniques

I: Types and Classification of Electro analytical Methods:

a) D.C Polarography:. Instrumentation - Dropping mercury electrode- -polarogram. Types of Currents: Residual, Migration, Limiting. Two and Three electrode assemblies. Ilkovic equation (derivation not necessary) and its consequences..

b) Brief account of following techniques and their advantages over conventional d.c.polargraphy.

(i) A.C.polarography (ii) Square-wave polarography (iii) Pulse polarography (iv) Differential pulse polarography

c) Amperometric titrations: Principle, Instrumentation. Types and applications of amperometric titrations.

d) Cyclic Voltammetry: Principle, instrumentation, Applications. Cyclic voltammetric study of insecticide parathion.

II: Thermal Analysis: Thermal techniques-Introduction, types of thermo analytical methods. Thermogravimetry principle and applications of thermogravimetry, differential thermal analysis- principle and applications of DTA. Differential scanning calorimetry. DSC: Principle, and application of DSC.

Photoelectron Spectroscopy

Principle and Instrumentation, Types of Photoelectron Spectroscopy – UPS & XPS. Binding Energies, Koopman's Theorem, Chemical Shifts. Photoelectron Spectra of Simple Molecules: N2, O2, F2, - Vibrational Structure of PES Bands, ESCA in qualitative analysis, Principles of Auger electron spectroscopy.

Electron Spin Resonance

Introduction, principle, instrumentation, selection rules, interpretation of Lande's factor 'g'. Hyperfine and super hyperfine Coupling. Anisotropy in 'g' values and hyperfine coupling constants. Zero field splitting, Kramer's degeneracy and quadrupolar interactions.

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COMMERCE

Unit-I: Accounting, Cost & Management Accounting and Financial Management:

(a) Accounting: Concept – Evolution – Accounting as Information System – Users of Accounting Information – Accounting Principles: Concepts & Conventions – Accounting Standards.

(b) Cost Accounting: Cost Concepts – Marginal Costing, Absorption Costing and Differential Costing – Managerial Application of Marginal Costing– Process Costing.

(c) Management Accounting: Ratio Analysis – Funds Flow Analysis - Cash Flow Analysis - Human Resource Accounting – Responsibility Accounting – Inflation Accounting -

(d) Financial Management: Capital Budgeting Decisions — Financing Decisions – Dividend Decisions –Working Capital Management.

(e) Investment Management: Indian Capital Markets – Risk and Return Analysis – Portfolio Analysis – Portfolio Selection.

Unit-II: Managerial Economics and Business Environment:

(a) Demand Analysis: Individual Demand and Market Demand – Elasticity of Demand – Demand Estimation and Forecasting.

(b) Production and Cost Analysis: Production Function – Law of Diminishing Marginal Returns – Short-run Cost Functions and Long-run Cost Function.

(c) Market Structure: Perfect, Imperfect, Monopoly, Monopolistic, Oligopoly Markets.

(d) Liberalisation, Privatisation and Globalisation: New Economic Policy – Nature and Forms of Privatisation – Stages and Consequences of Globalisation.

(e) WTO and Trade Policy: AOA – GATS – TRIPS – TRIMS – Regional Economic Integration – Regional Trade Agreement – EU – ASEAN – SAARC – NAFTA – BRICS – India's Trade Policy.

Unit-III: Marketing Management, Organisation Behaviour and Human Resource Management:

(a) Marketing: Evolution of Marketing Concepts- Production – Product – Marketing Myopia- Selling – Marketing – Societal - Segmenting, Targeting and Positioning -Target Market – Diffused Market – Concentrated Market – Clustered Market – Market Segmentation Concept and Bases – Product Positioning – Concept and Bases.

(b) Marketing Mix: Product, Price, Promotionand Place.

(c) Marketing Research, Source of Market Information and Marketing-mix Research

(d) Organisational Behaviour: Understanding Individual Behaviour: Personality – Learning – Perception – Attitude – Individual Behaviour – Group Behaviour: Fundamentals of Groups – Stages of Development – Team Effectiveness – Cohesiveness.

(e) Human Resource Management: Human Resource Planning - Recruitment – Selection – Training – Development – Performance Management – Empowerment – Knowledge Management – Virtual Organisations.

Unit-IV: Quantitative Techniques and Research Methodology:

(a) Data Collection, Presentation and Analysis: Sources of Data: Primary and Secondary Sources – Designing Questionnaire / Schedule – Census Vs. Sampling – Measurement and Scaling – Processing and Presentation of Data – Editing – Coding – Classification – Tabulation – Graphic and Diagrammatic Presentation.

(b) Hypothesis Testing: Parametric tests: Z-test, t-test, ANOVA – Non-Parametric tests: Chi-Square, Sign test – Paired Sample Sign Test, Mann-Whiteny Test (UTEST), One-Sample Run Test, Kruskal – Wallis test (H-Test), Rank Correlation Test.

(c) Statistical Decision Theory: Nature of Decision – State of Nature – Pay-off Tables – Expected Pay-off – Expected Opportunity Loss – Value of Perfect Information – Types of Decision Situation.

(d) Game Theory and Linear Programming: Characteristics – Two Persons Zero Sum Game – Maximum and Minimax Strategies – Saddle Point – Dominating Strategy – Mixed Strategy – Linear Programming – Graphical Solutions with two variables.

(e) Interpretation and Report Writing:– Interpretation: Essentials - Precautions – Conclusions & Generalisation – Statistical Fallacies – Report Writing: Meaning –Types of Reports – Stages in Preparation of Reports – Characteristics – Structure – Documentation – Footnotes and Bibliography.

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ECONOMICS

Income and Substitution Effects (Slutsky and Hicks), Consumer surplus – implications. Revealed Preference Analysis, Hicks" Revision of Demand Theory. Isoquant Production Function; Returns to Scale; Linear Homogeneous Production function – Cobb Douglas production function, Hicks and Harrod Technical Progress. Cost Functions – short run and long run costs. Features of perfect competition. Determination of Market price and quantity, Short Run and Long run equilibrium of the firm and industry, Derivation of Supply curve, Monopoly: Short and long run equilibrium, Price discrimination. Monopoly power, Control and regulation of monopoly. Monopsony, Bilateral Monopoly; Chamberlain"s Monopolistic Competition – Short and Long run equilibrium. Duopoly Models: Cournot, Bertrand, Edge worth and Stackelberg Models. Oligopoly: Characteristics, Sweezy"s kinked Demand model, Models of cartels and price leadership. Alternative Theories of the Firm: Baumol's Model, Williamson, and Marries models, , Bain"s Limit pricing, Sylos-Labini and Modigliani's models.

Distribution: Ricardian and Modern Theories of Rent, Marginal Productivity theory of wages, neo-classical theory of interest, and theories of profit. Product Exhaustion theorem. Equilibrium Analysis: General Equilibrium: Walrasian model, Features of Market Equilibrium: Existence, Stability (Marshall and Walrasian conditions), Uniqueness. Cob-web models. Welfare Economics: Pigovian welfare economics, Pareto optimum conditions. Social welfare functions, Compensation principles, Arrow"s impossibility theorem. Economics of Risk and Uncertainty: Role of expectations, Consumer"s choice involving risk (risk takers, risk averse and risk neutral), Neumann – Morgenstern Index, Savage Hypothesis, Gambling and Insurance. National Income Accounting: Approaches of Macro Economics and Variables – Circular Flow of Income in two, three and four-sector economy; different forms of national income accounting – social accounting method.

Consumption Function: Consumption function – Keynes psychological law of consumption – implication of the law; short-run and long-run consumption function; Empirical evidence on consumption function; income – consumption relationship – absolute income, relative income, permanent and life cycle income hypotheses. Investment Function: Marginal efficiency of capital and investment. The accelerator, profit and theories and investment. Financial theory of investment Institutions and capital market in India. Primary and secondary markets and regulation of capital markets.

Supply of Money: Measures of Money Supply, theories of money supply, monetary transmission mechanism and monetary transmission mechanism in India, High powered money and money multiplier; monetary policy. Demand for Money and Investment Determination: Theories of demand for money – Classical approach to demand for money – Quantity theory approach, Cambridge quantity theory, Keynes liquidity preference approach, modern theory of interest rate determination. Post-Keynesian Theories of Demand for Money: Post-Keynesian approaches to demand for money – Patinkin and the Real Balance Effect, Approaches of Baumol and Tobin; Friedman and the modern quantity theory; Crisis in Keynesian economics and the revival of monetarism – Friedman Restatement of quantity of money and its critical appraisal.

Neo-classical and Keynesian Synthesis: Neo-classical and Keynesian views on interest; The IS-LM model; Extension of IS-LM model with government sector; Relative effectiveness of monetary and fiscal policies; IS-LM model in open economy, Monetary approach to balance of payments. Capital flows with fixed exchange rate, trade and capital flows with flexible exchange rate and critical look at IS-LM model. Theory of Inflation: Classical, Keynesian and Monetarist approaches to inflation; Structuralist theory of inflation; Philips curve analysis – Short run and long run Philips curve; the natural rate of unemployment hypothesis; Tobin"s modified Philips curve and policies to control inflation. Business Cycles: Business Cycles – Theories of Schumpeter, Samuelson and Hicks – Interaction of multiplier and accelerator model, control of business cycles – relative efficacy of monetary and fiscal policies – Monetary policy and its objectives with special reference to Indian Economy. New Classical Macroeconomics: The new classical macroeconomic approach; Policy implications of new classical approach – Rational expectations theory, Role of expectations in macroeconomic analysis – Additive expectations. Supply side economics assumptions and evaluation.

Uses and limitations of Mathematics in Economics, Concept of function and type of functions, Concepts of derivative, Rules of differentiation. Interpretation of revenue, Cost demand, supply functions, Elasticities. Determinants and their Basic Properties, Solution of Simultaneous equations through Crammer"s rule Matrices – Concept and types, Simple operation on matrices, matrix inversion, rank of matrix, concept of vector and its properties, Introduction to input-output analysis. Multivariable functions, Concept and types of production functions, rules of partial differentiation and

interpretation of partial derivatives, Problems of maxima and minima in single and multivariable functions. Constrained optimization, Lagrangian function, simple economic applications, maximization of utility and maximization of profits, Introduction to linear programming, formulation of linear programming problem – its structure and variables, Nature of feasible, basic, optimal solution, Solution of linear programming through graphic method.

Definition of Statistics, Uses and limitation of Statistics in Economics, Methods of collecting data – census and sampling – their advantages and disadvantages, Measures of Central tendency – mean, median and mode, Measures of Dispersion – range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation, Gini coefficient. Basic concept of sampling – random and non-random sampling, simple random, stratified random sampling. Formulation of statistical hypotheses – null and alternative, Testing of hypothesis. Concept of correlation, Karl Pearson"s Coefficient of correlation, Spearman"s rank coefficient of correlation, Simple regression, Estimation of regression coefficients by ordinary least square methods, standard error or regression line. Concept of probability, Classical and empirical definitions of probability, laws of addition and multiplication, discrete random variable – its concept, mean and variance, Normal distribution – its concept and properties. Methods of constructing Index numbers and their uses, weighted and unweighed indices, Laspeyer"s, Pasche"s and Fisher"s indices, Cost of living index numbers. Time series and analysis, components of time-series data, determination of secular trend by moving average and ordinary least square methods, Uses of seasonal indices, Estimation of linear and compound growth rate using OLS method.

Growth and Development -Measuring of Growth and Development – factors affecting Economic growth -traditional approach- Welfare oriented approach - Human Development approach essential components of Human Development- Human Development Index. Theories of Development Growth Models - Classical and Neo-Classical theories of Development - Schumpeter and Capitalist Development - Rostow's Stages of Economic Growth - Marxian Growth Sates and Development Model. Harrod-Domar Growth Model - R.M. So lows Model, Approaches to Development – Partial Theories of growth and development – The theory of the Big Push- Critical Minimum Effort and low level Equilibrium Trap.

The Theory of Balanced and Unbalanced Growth- Lewis Model of unlimited supply of labour - Simon Kuznets Economic Structure and Change. Choice of Techniques -

Capital, labour and appropriate technology – Romar"s endogenous growth model. Allocation of Resources - Investment Criteria – Role of labour orientation methods in the development of third world countries – Role of capital formation in developing countries-spread effects and backwash effects. Role of Technology in Economic Development. Theories of International Trade –Neo- Classical Theories; Heberler"s Opportunity Cost Approaches; Modern theories of Trade – Hecksher and Ohlin Model; Leontief Paradox; Factor Price Equalization theorem. Gains from Trade: Measurement of Gains from Trade and their distribution; concepts of Terms of Trade – Income and Factorial Terms of Trade; Hypothesis of Secular deterioration of terms of trade and its implications for less developed countries – Immeserising Growth – Trade as an Engine of Economic Growth. Theory of Interventions: Tariff Issues, Quotas and its Economic effects; the political economy of non-tariff barriers and the implications-nominal, effective and optimum rates of tariffs - their impact and welfare implications; Trade under imperfective competitive market – EEC. Balance of Payments: Meaning and components of Balance of Payment, causes for disequilibrium in BOP and measures to correct; Expenditure reducing and switching policies, Marshall and Lerner"s conditions.

Indian Economy during British rule, Commercialization of Agriculture, Process of Industrialization. Composition of Foreign Trade, GNP and Occupation, Trends in NI Growth & Structure; Physical Quality Life Index (PQLI), Human Development Index (HDI): GEM Nature and Magnitude of Workforce and Unemployment, Poverty and Inequality. Planning and NITI Aayog: Six decades of planned development - The National Institution for Transforming India (NITI Aayog) - Recent trends in sectoral rates of Growth in India – Indian Economy- inter-State variations in Development - Lopsided development – Organized and unorganized Sectors emergence of informal sector in India. Industrial Sector- Industrial policies, Public and Private sector performance, Growth and pattern of industrialization, Small Scale sector, Privatization, Disinvestment and Exit Policy. Fiscal Federalism- Central state financial relations, finances of Central and state governments- Parallel economy, fiscal sector reforms in India, Monetary and Credit policies and financial sector reforms in India. Economic Reforms: Changing Role of State; Globalization of Indian Economy, WTO and its Impact, National agenda for Governance. Issues in Export – Import Policy and Foreign Exchange Management Act (FEMA); Exchange Rate Policy, Foreign Capital and MNCs in India; Trade Reforms in India.

Foreign exchange Rate : Foreign Exchange rate determination under the Gold Standard, Fixed and Flexible exchange rate, Purchasing Power Parity theory – India"s foreign exchange reserves, convertibility of rupee, FEMA (Foreign Exchange Management Act)- Importance of International Trade for a Developing economy. Trade Problems of Developing Countries – Prebisch Singer and Unequal Hypothesis – Rise and Fall of Gold Standard and emergence of Brettonwoods system; role of International Institutions – IBRD, IMF, ADB in relation to Developing Countries. The Theory of Regional Blocs: Forms of Economic Co-operation; Inter- Regional Trade, SAARC/ SAPA and ASEAN Regions, Problems and prospects of Customs Union, Regionalism (EU, NAFTA), Multilateralism and WTO. India"s International Trade – Problems of Trade and Trade Policies in India for the last five decades, changes in the direction and composition of trade and their implications. New Trade Policy in the Reform Period. India"s balance of payment- Pre and Post Globalization Period. Management of balance of payments- Fiscal and external policies, trade strategy, exchange rate management, reserve management strategy,- Trade reforms and its effect on balance of payments and growth. Trade and Development – Commercial Policy and Economic Development of less developed countries, Foreign Capital and Developing Countries, Problems of India"s International Debt, Export Promotion Strategies and EXIM Policies.

Public Finance: Role of the state in Economic activity – Multiple theory of public house hold –distinction between private & public fiancé – public fiancé in developing countries. The Principle of maximum Social advantage – Musgrave"s views – Mrs. Hicks optima of Public policy – Externalities and public goods – theory of second best – public choice theory. Taxation; Theories of Incidence - Traditional and Modern Approaches - Benefit Approach - Ability to Pay Approach - Neutrality Approach - Laffer Curve-Taxable capacity. Public Expenditure - Wagner's Law - Peacock - Wiseman Hypothesis - Criteria for Public Investment - Social Cost - Benefit Analysis - Budget Classification - Programming Budget - Zero – Based Budgeting. Public Debt - Burden Controversy - Debt Management - Redemption of Public Debt- Public Debt and third World Countries. Federal Finance and Development Finance - Principles of Federal Finance - Centre- State Financial Relations – Source of income and expenditure of the Central and State Governments- problems in resource mobilization by the state. Finance Commissions in India - Devolution of Resources and Grants - Functional Finance – Latest Finance Commission – Main recommendations - Deficit Financing objectives, justification – Causes of Deficit Financing. Pricing Policy in Public Enterprises – Disinvestment and Privatisation of Public Enterprises -Recent trends in the

functioning of Private Sector in India – Policy Changes – Socio - Economic Implications. Fiscal Policy - Objectives of Fiscal Policy - Interdependence between Monetary and Fiscal Policies - Alternative Measures for Resource Mobilization - their Impact on Growth & Distribution - Balanced Budget Multiplier. Indian Public Finance - salient features of Indian Tax system - Trends in Indian Tax Revenues - Revenues of the Union, State and Local Bodies - Non- Tax Revenues, Tax Buoyancy and Elasticity –GST Pattern of Expenditure & Debt in India - Tax and Expenditure Reforms - Major Recommendations of the committees.

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ENGLISH

English Language Teaching

- The Origin of Language: The Bow-wow theory, the Ding-dong theory, the Pooh-pooh theory, the Gesture theory
- Descent of English: Indo-European Family of Languages and its Branches; Grimm's Law
- The Old English (Anglo-Saxon) Period: Important Features of Old English
- The Middle English Period: The Norman conquest; Major Changes in the English Language during Middle English Period: Changes in Pronunciation, Spelling, and Vocabulary; The Evolution of 'Standard English'
- General Characteristics of the Modern English
- Foreign Contribution to the Growth of Vocabulary: Influence of Greek, Latin, French and German on the English language
- Word Formation—Different Processes
- Change of Meaning—Different Processes
- Structure of the English Noun Phrase; Structure of the English Verb Phrase
- The Simple Sentence—its types, constituents and organization; Coordination and Subordination—their semantic implications
- Varieties of Language: Dialect, Idiolect, Style, Register, Jargon, Slang, Pidgin, Creole
- British English and American English: Major Differences
- Language as a System of Communication: Features of Human Communication, Differences between Animal and Human Communication
- Verbal Communication: Formal and Informal Communication, One way and Two-way Communication; Non-verbal Communication: Aspects relating to body language
- Articulatory Phonetics: Definition, Organs of Speech, Speech Mechanism (air-stream mechanism); Classification of English Phonemic Sounds (IPA), Phonemic transcription (word and sentence levels); Description of Consonant sounds: Place of articulation and Manner of articulation; Vowel Sounds: Monophthongs, Diphthongs, and Triphthongs
- Word Accent/Stress: Syllable, Primary and Secondary Stress, Rules of Word Stress, Consonant clusters; Aspects of Connected Speech: Weak forms and Elision; Intonation: Tones, Semantic Implications (Functions) of Intonation

- Phonology: Definition, Scope and Other Aspects; Morphology: Definition, Scope and Other Aspects; Syntax: Definition, Scope and Other Aspects
- History of English in India (Pre-Independence):The Charter; Charles Grants" recommendations on English education in India; Wilberforce's Resolution (1793 Resolution) and its impact on Indian education; The Charter Act (1813 Resolution), Macaulay's Minute (1835) - The Objectives of the Minute, Transplantation versus Evolution approach, The effects of the Minute on Indian education; Wood's Despatch (1854); The beginning of the spread of English in India; The Indian Education Commission (1882), The India Universities Commission (1902); Government of India Resolution on Educational Policy (1904); Indian Universities Act (1904); Government of India Resolution on Educational Policy (1913); Calcutta University Commission (1917-19); National Education Movement
- English in India (Post-independence): The Identity Phase: The University Education Commission(Radha krishnan Commission, 1948-9); Secondary Education Commission (Mudaliar Commission,1953); Official Languages Commission (1956-58) — recommendations, anti-Hindi movement; Chief Ministers" Conference, 1961 (recommendation of three-language formula), Official Language Amendment Act (1967), The Education Commission (Kothari Commission, 1964-6), National Policy on Education (1968) - its Policy Statement on the development of languages; National Education Policy (1986); Acharya Ramamurti Commission (1990); Curriculum Development Centre (1989); National Curriculum Framework (2005); National Curriculum Frame work for Teacher Education (2009); The notion of Indian English; English as a second language in India; English as a global language (Kachru"s and Tom McArthur"s Circles); the changing role of English in India
- Definitions of approach, method and technique; Structural Approach; Structural-Oral-Situational approach; Grammar-Translation Method; Direct Method or Natural Method; Audio-lingual Method Reading Method, Bilingual Method; Communicative Language Teaching Approach (CLT), Humanistic approaches: The Silent Way, Suggestopedia, Total Physical Response, Community Language Learning, The Natural Approach, Cooperative Learning
- Beyond Methods: The concept of method - Language-centered methods, Learner-centered methods, Learning-centered methods; Limitations of the concept of method; Dissatisfaction with method; Post method condition; Postmethod pedagogy; Macrostrategic Framework: Maximizing learning opportunities, Minimizing perceptual mismatches, Facilitating negotiated interaction, Promoting learner autonomy, Fostering language awareness,

Activating intuitive heuristics, Contextualizing linguistic input, Integrating language skills, Ensuring social relevance, Raising cultural consciousness

- The Human Brain and its Functions; First Language Acquisition: Stages of Language Development in a Child; Learning Disabilities with special focus on Aphasia; Differences between First Language Acquisition and Second Language Learning; Behaviourism and its implications for ELT: J.B. Watson's Experiment, Pavlo's Classical Conditioning, Thorndike's Connectionism, Skinner's Operant Conditioning; Cognitivism & its implications for ELT: Chomsky's Innateness Theory (Language Acquisition Device), Limitations of Chomsky's Theory; Difference between Competence and Performance, Dell Hyme's Communicative Competence
- Krashen's Hypotheses about Second Language Acquisition: The Acquisition-Learning distinction, The Natural Order Hypothesis, The Monitor Hypothesis, The Input Hypothesis, The Affective Filter Hypothesis; Models of Second Language Acquisition: The Linguistic Process Focus: The Monitor Model, The Conscious Reinforcement Model, The Strategy Model; The Social Process Focus: The Social Psychological Model, The Acculturation Model, The Social Context Model, The Intergroup Model
- Language Learning Strategies (LLS) Definition, Early Research on LLS, The Good Language Learner Research; Modern Research on LLS: Rebecca Oxford's Classification of LLS: Direct Strategies: Memory Strategies, Cognitive Strategies, Compensation Strategies; Indirect Strategies: Metacognitive Strategies, Affective Strategies, Social Strategies
- Learning Styles: Definition, Cognitive Learning Styles, Sensory Learning Styles, Affective/Temperament Learning Styles (Personality Learning Styles); Willing's Learning Styles: Communicative, Analytic, Authority Oriented, Concrete; Kolb's Learning Styles: Diverging, Assimilating, Converging, Accommodating
- Gardener's Multiple Intelligences: Verbal / Linguistic, Logical / Mathematical, Spatial / Visual, Musical, Bodily-Kinaesthetic, Interpersonal, Intrapersonal
- Mind Mapping: Definition; MM and thinking process; Advantages of MM, MM for Learning languages
- Learner Autonomy: Definition, Skills that Autonomous Learners Need, Developing Learner Autonomy; Constraints of Learner Autonomy: Influence of Culture on Learner Autonomy
- Curriculum Design: Definition; Major Steps in Curriculum Development Process; Process of Curriculum Design: Elements of Curriculum Design, Curriculum Design Team, Curriculum Design Approaches – Topic-Driven Approach and Backward

Design Approach, Curriculum Mapping, Use of Bloom's Taxonomy; Models of Curriculum Development: Product Models: Nation and Macalister Model – Outer Circle and Inner Circle; Ralph W. Tyler Model; Process Model: Lawrence Sternhouse Model

- Syllabus Design: Difference between Curriculum and Syllabus, Types of Syllabi: Structural Syllabus, Notional-Functional Syllabus, Task-based Syllabus, Communicative Syllabus; Principles of Designing English Syllabus for ESP Courses – EAP, EST, EOP
- Classroom Approaches: Teacher Centred Approach: Lecture Method – Advantages and Disadvantages, Learner-Centred Approach: Teaching Large Classes, Team Teaching, Classroom Discussions, Techniques of Pair Work, Group Work, Role Play
- Teaching Aids: Use of the Blackboard, Pictures (Charts, Flash Cards, Flannel Board), Flip Charts, OHP, Realia; Using Technology: Use of Audio-Visual systems, Conventional Language Lab, Computer Assisted Language Learning (CALL), Social Media Platforms - Blogs, Facebook, Whats App, Podcasts, and YouTube
- Techniques of Teaching Prose, Poetry, Drama; Teaching Language through Literature – Important Techniques; Stylistic Approaches to the Teaching of Literature: Norm, Deviation, Foregrounding
- Techniques of Teaching Listening, Reading, and their Sub-skills; Techniques of Speaking, Writing, and their Sub-skills
- Error Analysis; Remedial Teaching; Techniques of Teaching Grammar and Vocabulary;
- Language Testing and Evaluation: Definition of Testing, Difference between Testing and Evaluation; Types of Testing: Achievement Tests, Progress Tests, Diagnostic Tests, Placement Tests, Proficiency Tests; Types of Testing Items; Types of Evaluation: Formative Evaluation, Summative Evaluation; Characteristic Features of an Effective Test: Validity, Reliability, Feasibility / Practicality; Steps to Design a Standard Test; Wash back/Backwash Effect; Designing Effective Tests for Listening, Speaking, Reading, Writing, Vocabulary, and Grammar Skills

English Poetry

Background: Renaissance-Reformation; Neo-Classicism; Romanticism; Pre-Raphaelites; War Poetry; Modernism

Poems:

- Geoffrey Chaucer: The General Prologue To The Canterbury Tales (Tran. NevillCoghill) lines 1-42 ("When inApril … I therefore will begin")

- John Milton: Paradise Lost (Bk I)
- John Donne: "A Valediction", "The Canonization",
- Alexander Pope: "The Rape of the Lock" (Canto I)
- William Blake: From Songs of Innocence("The Lamb", "The Chimney Sweeper"); From Songs of Experience("The Tyger", "London")
- William Wordsworth: "Tintern Abbey", "Anecdote for Fathers"
- P B Shelley: "Ode to the West Wind", "To a Skylark"
- John Keats: "Ode on a Grecian Urn", "Ode to a Nightingale"
- Elizabeth Barrett Browning: Sonnets from the Portuguese14 ("If thou must love me …"), 43 ("How do I love thee …")
- Alfred Lord Tennyson: "Ulysses", "The Sailor Boy"
- Robert Browning: "My Last Duchess", "The Lost Leader"
- Matthew Arnold: "Self-Dependence", "Dover Beach"
- T S Eliot:"The Waste Land"
- Phillip Larkin: "Best Society", "Churchgoing"
- Seamus Heaney: "Digging", "Alphabets"
- Carol Ann Duffy: "Originally", "Havisham"

English Drama

Background: Origin and Development of British Drama (till the 17th Century); Tragedy; Comedy; Restoration Drama; Theatre of the Absurd; Postmodernism

Texts:

- Christopher Marlowe: *Doctor Faustus*
- William Shakespeare: *King Lear*
- William Shakespeare: *The Tempest*
- Aphra Behn: *The Rover (Part I)*
- Oscar Wilde: *The Importance of Being Earnest*
- GB Shaw: *Saint Joan*
- John Osborne: *Look Back in Anger*
- Caryl Churchill: *Top Girls*
- Tom Stoppard: *Indian Ink*

One-act Plays

- JM Synge: "Riders to the Sea"
- Harold Pinter: "The Dumb Waiter"
- Alan Ayckbourn: "Mother Figure"

English Prose

Background: Origin and Development of the English Essay; Utopia; Translation of the Bible; Allegory; Satire

Texts:

- Philip Sidney:*An Apologie for Poetrie*
- Francis Bacon: "Of Studies", "Of Truth", "Of Revenge"
- John Bunyan:*The Pilgrim's Progress* (from "As I walked through the wilderness of this world …" till the paragraph ending with the line "The name of the one was Simple, another Sloth, and the third Presumption.")
- Jonathan Swift: "The Battle of the Books"
- Joseph Addison: "Sir Roger in Church", "The Aims of the Spectator"
- Samuel Johnson: *Preface to Shakespeare* (Up to the paragraph beginning "So careless was this great poet…")
- Charles Lamb: "Dream Children", "Old China"
- William Hazlitt: "The Indian Jugglers", "On People with One Idea"
- John Ruskin: *Unto This Last* (Section I)
- Bertrand Russell: "The Ethics of War", "Education and Discipline"
- Virginia Woolf: *A Room of One's Own*
- George Orwell: "Politics and the English Language", "Reflections on Gandhi"

English Fiction

Background: The Rise of Novel; The Gothic Novel; Realism-Naturalism; Bildungsroman; Stream of Consciousness; Magic Realism

Texts:

- Daniel Defoe:*Robinson Crusoe*
- Jane Austen:*Emma*
- Charlotte Brontë:*Jane Eyre*
- Charles Dickens:*Hard Times*
- Thomas Hardy:*Tess of the d'Urbervilles*
- Joseph Conrad:*Heart of Darkness*
- DH Lawrence:*Sons and Lovers*
- William Golding:*Lord of the Flies*
- Zadie Smith:*White Teeth*

Short Stories:

- Rudyard Kipling: "Lispeth", "Thrown Away"
- HG Wells: "The New Accelerator", "The Man Who Could Work Miracles"

- Roald Dahl: "The Umbrella Man", "Lamb to the Slaughter"

Modern Indian Literatures in Translation

Background: Concept of Sahitya; Indian Concept of Translation; Tradition-Modernity; Progressive Writers Movement; Indian Dramatic Traditions; Dalit Aesthetics

Poetry

- Jibanananda Das: "Banalata Sen", "Naked Solitary Hand","This Earth"
- MakhdoomMohiuddin: "The Heart of Silence", "Prison","Darkness"
- GajananMadhavMuktibodh: "The Orang-Outang", "The Void Within","A Single Shooting Star"
- NamdeoDhasal: "The Day She Was Gone", "New Delhi,1985", "On the way to the dargah"

Fiction

- U R AnanthamurthySamskara: A Rite For A Dead Man
- Mahasweta Devi: Mother of 1084
- Bama:Karukku

Drama

- Rabindranath Tagore:Chandalika
- Vijay Tendulkar: Silence! The Court is in Session
- Girish Karnad:Hayavadana

Women's Writing

Background: Sex and Gender; Women"s Liberation Movement; Feminisms; Women and the Canon; Gynocriticism

Poetry

- AemiliaLanyer: "Eve"s Apology in Defense of Women"
- Sylvia Plath: "Lady Lazarus", "The Applicant", "Daddy"
- Grace Nichols: "Waterpot", "A Praise Song for Mother","The Fat Black Woman Goes Shopping"
- Luci Tapahonso: "Blue Horses Rush in", "Leda and the Cowboy", "Raisin Eyes"

Fiction

- Jean Rhys:*Wide Sargasso Sea*
- Toni Morrison:*The Bluest Eye*
- Chimamanda Adichie:*Americanah*

Prose

- Mary Wollstonecraft: *Vindication of the Rights of Women*(Introduction and Chapter 2)

- Adrienne Rich: "When We Dead Awaken: Writing as Re-Vision"
- SunitiNamjoshi(*From Feminist Fables*): From the Panchatantra, The Little Princess, The Gods, Perseus and Andomeda, Case History, The Runner

Twentieth Century Literary Criticism and Theory

Background: New Criticism; New Historicism; Structuralism and Poststructuralism; Reader Response Theories; Psychoanalytical Criticism

Texts

- Cleanth Brooks: "The Language of Paradox"(from *The Well Wrought Urn*)
- Northrop Fry: "Archetypes of Literature" (from *Fables of Identity*)
- Mikhail Bakhtin: "Discourse in the Novel"(from *The Dialogic Imagination*)
- Michel Foucault: "The Unities of Discourse"(from *The Archaeology of Knowledge*)
- Roland Barthes: "The Death of the Author" (from *Image-Music-Text*)
- Raymond Williams: "Literature" (from *Marxism and Literature*)
- Edward Said: "Introduction" (from *Orientalism*)
- Elaine Showalter: "Feminist Criticism in Wilderness"(from *The New Feminist Criticism*)
- Henry Louis Gates Jr.: "Editor's Introduction: Writing 'Race' and the Difference It Makes" (Sec 1-5)

American Literature

Background: Antebellum and Postbellum America; Puritanism; Transcendentalism; The American Romantics; American Frontier; American Dream; Race; Ethnicity; Multiculturalism; Realism

Poetry

- William Cullen Bryant: "A Forest Hymn", "The Yellow Violet","America"
- Edgar Allen Poe: "Raven", "Dream Land"
- Emily Dickinson: "Because I could not stop for death","I taste a liquor neverbrewed", "Hope" is the thing with feathers"
- Walt Whitman: "Out of the Cradle Endlessly Rocking" "When Lilacs Last in the Dooryard Bloom'd"
- Robert Frost: "Home Burial", "Birches", "After Apple Picking"
- Wallace Stevens: "Emperor of Ice-cream", "Showman", "Thirteen Ways of Looking at a Blackbird"

Fiction

- Nathaniel Hawthorne:*The Scarlet Letter*
- Herman Melville:*Billy Bud*

- Mark Twain:*The Adventures of Huckleberry Finn*
- Scott Fitzgerald:*The Great Gatsby*
- Ernest Hemingway:*The Old Man and the Sea*
- Saul Bellow:*Seize the Day*

Drama

- Eugene O"Neill:*Desire Under the Elms*
- Tennessee Williams:*The Glass Menagerie*
- Arthur Miller:All My SonsLorraine Hansberry *A Raisin in the Sun*
- Edward Albee:*Who's Afraid of Virginia Woolf?*
- August Wilson:*The Piano Lesson*

Prose and Short Fiction

- Ralph Waldo Emerson: "The American Scholar"
- Henry David Thoreau: "Civil Disobedience"
- William Faulkner: "Wealthy Jew"
- Alice Walker: "In Search of our Mother's Gardens"
- Bernard Malamud: "The Magic Barrel"
- Issac Asimov: "Bicentennial Man"

Indian Writing in English

Background: 19 Century Reform Movements in India; The Indian National Movement; Rise of the Indian Novel; Caste-Class; The New Indian Woman; Partition Literature; Nation-Nationalism; Counter Discourse; Sub alternity; Identity Movements

Poetry

- Henry Derozio: "The Harp of India", "To My Native Land"
- Toru Dutt: "Sita", "Our Casuarina Tree", "My Vocation"
- Sri Aurobindo: "Silence is all", "Is this the end?","The Dual Being"
- Sarojini Naidu: "The PardahNashin", "Ghanashyam","The Gift of India"
- Nissim Ezekiel: "EnterpriseII', "Poet, Lover, Birdwatcher", "Philosophy"
- A K Ramanujan: "Love Poem for a Wife-1II", "Obituary", "Small-scale Reflections on a Great House"
- Kamala Das: "An Introduction", "The Old Playhouse", "Words"
- ArunKolatkar: "Scratch", "A Low Temple", "An Old Woman"

Fiction

- Bankimchandra Chatterjee:*Rajmohan's Wife*
- KrupabaiSatthianadhan:Kamala: *a Story of Hindu Life*
- ZeenuthFutehally:*Zohra*

- Mulk Raj Anand:*Untouchable*
- Raja Rao:*Kanthapura*
- R K Narayan:*The Man-Eater of Malgudi*
- Anita Desai:*Voices in the City*
- Salman Rushdie:*Midnight's Children*
- Shashi Deshpande:*The Binding Vine*

Short Stories

- Bharti Mukherjee:"Management of Grief" (from *The Middleman and Other Stories*)
- Rohinton Mistry: "Swimming Lessons" (from *Tales from FirozshaBaag*)
- JhumpaLahiri: "Interpreter of Maladies" (from *Interpreter of Maladies*)

Prose

- B R Ambedkar: "The Annihilation of Caste"
- Jawaharlal Nehru: "The Quest" (Chapter 3; *The Discovery of India*)
- Arundhati Roy: "The Ladies Have Feelings, So...Shall We LeaveIt To The Experts?"

Drama

- Asif Currimbhoy:*Goa*
- Mahesh Dattani: Final Solutions
- Manjula Padmanabhan:*Harvest*

Postcolonial Literature

- Background: Colonialism-Postcolonialism; Decolonization-Neocolonialism; Mimicry-Hybridity; Universalism-Eurocentrism; Myth-History

Poetry

- Judith Wright: "Eve to Her Daughters", "Bullocky","Request to a Year"
- Phyllis Webb: "Marvel"s Garden", "Breaking", "Ah Ghalib …"
- Kamau Brathwaite: "Calypso", "Bread", "Limbo"
- Christopher Okigbo: "Overture", "Elegy for Alto", "Banks of Reed"

Fiction

- Chinua Achebe:*Things Fall Apart*
- VS Naipaul:*The Mimic Men*
- Margaret Atwood:*The Edible Woman*

Drama

- Wole Soyinka:*Kongi's Harvest*
- Derek Walcott:*Dream on Monkey Mountain*
- Drew Hayden: *Taylor alterNatives*

South Asian Literature

Background: South Asia—History and Geography; South Asian Diaspora; Migration and Exile; SouthAsia and Globalization; Ethnicity-Gender

Poetry

- Lakshmi Prasad Devkota:"Lunatic"
- Jean Arasanaygam: "Apocalypse", "Durga Pooja", "Nallur"
- Kaiser Haq: "As Usual", Liking It", "Poor Man Eating"
- Imtiaz Dharker: "Purdah I", "The right word", "A century later"

Fiction

- BapsiSidhwa:*Ice Candy Man*
- Michael Ondaatje:*Anil's Ghost*
- Khaled Hosseini:*The Kite Runner*

Prose

- Hanif Kureishi:"Something Given: Reflections on Writing
- Romesh Gunesekera: "A long, slow descent into hell"
- Manjushree Thapa: "Educating the Influential Foreigner", "The Difficulty of Being Nepali" (from *The Lives We Have Lost*)

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MATHEMATICS

1. Abstract Algebra: Automorphisms, Conjugacy and G – sets, Normal series, Solvable groups, Nilpotent groups, Direct product - Finitely generated abelian groups - Invariants of a finite abelian group, Sylow's theorems, Groups of orders p^2 and pq, Ideals and homomorphisms , Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and nil ideals, Zorn's lemma, Unique factorization domains, Principal ideal domains, Euclidean domains, Polynomial rings over Unique Factorization Domains, Rings of Fractions.

2. Fields and Galois Theory: Irreducible polynomials and Eisenstein criterion, Adjunction of roots, Algebraic extensions, Algebraically closed fields, Splitting fields, Normal extensions, Multiple roots, Finite fields, Separable extensions, Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of Algebra, Roots of unity and cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Ruler and Compass constructions.

3. Mathematical Analysis: Metric spaces, Compact sets, Perfect sets, Connected sets, Limits of functions, Continuous functions, Continuity and compactness, Continuity and connectedness, Discontinuities, Monotone functions, Riemann - Steiltjes integral, Definition and Existence of the Integral, Properties of the integral, Integration of vector valued functions - Rectifiable curves, Sequences and series of functions: Uniform convergence Uniform convergence and continuity - Uniform convergence and integration, Uniform convergence and differentiation - Approximation of a continuous function by a sequence of polynomials.

4. Lebesgue Measure & Integration: Algebra of sets, Borel sets, Outer measure, Measurable sets and Lebesgue measure, A non – measurable set, Measurable functions, Littlewood three principles, the Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure, The integral of a non - negative function, The general Lebesgue integral, Convergence in measure, Differentiation of a monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, The L_{p} – spaces, The Minkowski and Holders inequalities, Convergence and completeness.

5. Complex Analysis: Regions in the Complex Plane, Functions of a Complex Variable, Mappings, Mappings by the Exponential Function, Limits, Limits Involving the Point at Infinity, Continuity, Derivatives, Cauchy Riemann Equations, Sufficient Conditions for Differentiability, Analytic Functions, Harmonic Functions, Uniquely determined Analytic Functions, Reflection Principle, The Exponential Function, The Logarithmic Function, Some Identities Involving Logarithms, Complex Exponents, Trigonometric Functions, Hyperbolic Functions, Derivatives of Functions w(t), Definite Integrals of Functions w(t), Contours, Contour Integrals, Some Examples, Examples with Branch Cuts, Upper Bounds for Moduli of Contour Integrals, Anti derivatives, Cauchy Goursat Theorem, Simply Connected Domains, Multiply Connected Domains, Cauchy Integral Formula, An Extension of the Cauchy Integral Formula, Liouville's Theorem and the Fundamental Theorem of Algebra, Maximum Modulus Principle, Convergence of Sequences, Convergence of Series, Taylor Series, Laurent Series, Absolute and Uniform Convergence of Power Series, Continuity of Sums of Power Series, Integration and Differentiation of Power Series, Uniqueness of Series Representations, Isolated Singular Points, Residues, Cauchy's Residue Theorem, Residue at Infinity, The Three Types of Isolated Singular Points, Residues at Poles, Examples, Zeros of Analytic Functions, Zeros and Poles, Behavior of Functions Near Isolated Singular Points, Evaluation of Improper Integrals, Improper Integrals from Fourier Analysis, Jordan's Lemma, Indented Paths, Definite Integrals Involving Sines and Cosines, Argument Principle, Rouche's Theorem, Linear Transformations, The Transformation $= \frac{1}{z}$, Mappings by $\frac{1}{z}$, Linear Fractional Transformations, An Implicit Form, Mappings of the Upper Half Plane.

6. Ordinary and Partial Differential Equations: Existence and Uniqueness of solution of $\frac{dx}{dy} = f(x, y)$ and problems there on, The method of successive approximations, Picard's theorem , Non-Linear partial differential equations of order one, Charpit's method, Cauchy's method of Characteristics for solving non-linear partial differential equations, Linear Partial Differential Equations with constant coefficients. Partial Differential Equations of order two with variable coefficients - Canonical form , Classification of second order Partial Differential Equations, separation of variables method of solving the one– dimensional Heat equation, Wave equation and Laplace equation, Sturm-Liouville's boundary value problem, Power Series solution of ordinary differential equations, ordinary and Singular points, Series solution about an ordinary point, Series solution about Singular point, Frobenius Method.

Legendre Polynomials : Legendre's equation and its solution, Legendre Polynomial and its properties, Generating function, Orthogonal properties, Recurrance relations, Laplace's definite integrals for Pn(x), Rodrigue's formula.

Bessels Functions: Bessel's equation and its solution, Bessel function of the first kind and its properties, Recurrence Relations, Generating function, Orthogonality properties.

Hermite Polynomials: Hermite's equation and its solution, Hermite polynomial and its properties, Generating function, Alternative expressions (Rodrigue's formula), Orthogonality properties, Recurrence Relations.

7. Theory of Ordinary Differential Equations :

Linear differential equations of higher order: Introduction, Higher order equations, A Modelling problem, Linear Independence, Equations with constant coefficients, Equations with variable coefficients, Wronskian, Variation of parameters, Some Standard methods.

Existence and uniqueness of solutions: Introduction, Preliminaries, Successive approximations, Picards theorem, Continuation and dependence on intial conditions, existence of solutions in the large, existence and uniqueness of solutions of systems, fixed point method.

Analysis and methods of non - linear differential equations: Introduction, Existence theorem, Extremal solutions, Upper and Lower solutions, Monotone iterative method and method of quasi linearization, Bihari's inequality, Application of Bihari's inequality.

Oscillation theory for linear Differential Equation of Second order: The adjoint equation, Self adjoint linear differential equation of second order, Abel's formula, the number of zeros in a finite interval, The sturm separation theorem, the strum comparison theorem, the sturmpicone the Bocher Osgood theorem, A special pair of solution, Oscillation on half axis.

8. Discrete Mathematics:

Mathematical Logic: Propositional logic, Propositional equivalences, Predicates and Quantifiers, Rule of inference, direct proofs, proof by contraposition, proof by contradiction.

Boolean Algebra: Boolean functions and its representation, logic gates, minimizations of circuits by using Boolean identities and K – map.

Basic Structures: Sets representations, Set operations, Functions, Sequences and Summations, Division algorithm, Modular arithmetic, Solving congruences, applications of congruences.

Recursion: Proofs by mathematical induction, recursive definitions, structural induction, generalized induction, recursive algorithms.

Counting: Basic counting principle, inclucombinations, Binomial coefficient and identities, generalized permutations and combinations, Binomial coefficient and identities, generalized permutations and combinations.

Recurrence Relations: introduction, solving linear recurrence relations, generating functions, principle of inclusion - exclusion, applications of inclusion - exclusion.

Relations: relations and their properties, representing relations, closures of relations, equivalence relations, partial orderings.

Graphs: Graphs definitions, graph terminology, types of graphs, representing graphs, graph isomorphism, connectivity of graphs, Euler and Hamilton paths and circuits, Dijkstras algorithm to find shortest path, planar graphs, Eulers formula and its applications, graph coloring and its applications.

Trees: Trees definitions, properties of trees, applications of trees BST, Haffman Coding, tree traversals, pre-order, in-order, post-order, prefix, infix, postfix notations, spanning tress DFS, BFS, Prims, Kruskals algorithms.

9. Integral Transforms:

Laplace Transforms: Introduction, Existence theorem, Laplace transforms of derivatives and integrals, Shifting theorems, Transform of elementary functions, Inverse Transformations, Convolution theorem, Applications to ordinary and Partial differential equations.

Fourier Transforms: Introduction, Sine and cosine transforms, Inverse Fourier Transforms (Infinite and Finite Transforms), Applications to ordinary and Partial differential equations.

Hankel Transforms: Introduction, Hankel Transform of the derivatives of a function, Application
of Hankel Transforms in boundary value problems, The finite Hankel Transofrm.

Mellin Transforms: Introduction, The Mellin inversion theorem, some elementary properties of Mellin Transforms and Mellin Transfroms of derivatives, Mellin Integrals, Convolution Theorem.

10. Integral Equations & Calculus of Variations:

Volterra Integral Equations: Basic concepts, Relationship between Linear differential equations and Volterra Integral equations, Resolvent Kernel of Volterra Integral equation, differentiation of some resolvent kernels, Solution of Integral equation by Resolvent Kernel, The method of successive approximations, Convolution type equations, Solution of Integro-differential equations with the aid of the Laplace

Transformation , Volterra integral equation of the first kind, Euler integrals, Abel's problem, Abel's integral equation and its generalizations.

Fredholm Integral Equations: Fredholm integralequations of the second kind , Fundamentals, The Method of Fredholm Determinants, Iterated Kernels constructing the Resolvent Kernel with the aid of Iterated Kernels, Integral equations with Degenerated Kernels, Hammerstein type equation, Characteristic numbers and Eigen functions and its properties, Green's function, Construction of Green's function for ordinary differential equations, Special case of Green's function, Using Green's function in the solution of boundary value problem.

Calculus of Variations: Introduction, The Method of Variations in Problems with fixed Boundaries, Definitions of Functionals, variation and its properties, Euler's' equation, Fundamental Lemma of Calculus of Variation, The problem of minimum surface of revolution, Minimum Energy Problem Brachisto chrone Problem, Variational problems involving several functions, Functional dependent on higher order derivatives, Euler Poisson equation, Functional dependent on the functions of several independent variables-Euler's equations in two dependent variables, variational problems in parametric form, Applications of Calculus of Variation, Hamilton's principle, Lagrange's Equation, Hamilton's equations.

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PHYSICS

UNIT I- Mathematical Physics and Statistical Physics

Mathematical Physics

Linear differential equations; Special functions (Hermite, Bessel, and Legendre); Fourier and Laplace transforms; Error analysis, propagation of errors,least square fitting, curve fitting-linear and polynomial regression analysis Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods;

Statistical Physics

Phase space, micro- and macrostates; ensembles, Liouville's theorem. Microcanonical, canonical and grandcanonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; Firstand second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion;

Unit II- Classical Mechanics, Quantum Mechanics and Electromagnetic Theory

Classical Mechanics

Newton's laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudoforces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations;

Quantum Mechanics

Basic principles of Quantum mechanics -Dirac's bra and ket notation; Schroedinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Uncertainity principle; Orbital angular momentum, Time-independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

Electromagnetic Theory

Electrostatics: Gauss' Law and its applications; Laplace and Poisson equations,; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel's Law, Radiation from moving charges, dipoles and retarded potentials.

UNIT III- Atomic & Molecular Physics and Nuclear Physics

Atomic & Molecular Physics

Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length

Nuclear Physics

Basic nuclear properties: size, shape, charge distribution, spin and parity; Interaction of chargesd particles with matter; Range-Energy relation; Interaction of r-radiation with matter, Photoelectric effect, Compton effect and pair production; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion;

UNIT IV- Solid State Physics and Electronics

Solid State Physics

Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding in solids; phonons, lattice specific heat; Free electron theory and electronic specific heat; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type – I and type – II superconductors, Josephson junctions; Defects and dislocations; Ionic conductivity and diffusion

Electronics

Semiconductor devices including diodes, transistors, field effect transistors and their characteristics; Regulated power supply; RC coupled amplifier ; Sinusoidal Oscillators Optoelectronic devices - solar cells, photodetectors, and LEDs;Wave form generators Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics. Amplitude and Frequency Modulation.

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POLITICAL SCIENCE

UNIT – I: POLITICAL THOUGHT

Western Political Thought:

Hobbes, Locke, Rousseau, Bentham, J.S. Mill, Hegel, Karl Marx, Robert Nozick and John Rawls and the Concept of Multi Culturalism

Indian Political Thought:

Buddha, Kautilya, Raja Ram Mohan Roy, Jyoti Rao Phule, Gandhi and Ambedkar

UNIT – II: INTERNATIONAL RELATIONS

Theories of International Relations: Realist, Neo-Realists, Marxist and Feminist
Concept of Power and Security, Geopolitics, Geo-economics and Multipolarity
The United Nations, Arms Control and Disarmament
Globalization, Centre-Periphery, Development and Underdevelopment
India's Foreign Policy: Past and Present

UNIT – III INDIAN GOVERNMENT AND POLITICS

Liberal and Marxist Approaches to the Study of Indian Politics
Philosophical Foundations of Indian Constitution
Indian Federalism and Centre-State Relations
Fundamental Rights and Directive Principles of State Policy in India
Challenges to the Indian Political System
Major Issues in the Politics of Andhra Pradesh

UNIT – IV: PUBLIC POLICY & POLITICAL ANALYSIS

Political Science as Policy Science
Systems Analysis, Structural-Functionalism, Group Theory, Elite Theory and Game Theory
Policy Formation and Process: Legislature, Executive and Judiciary, Political Parties, Pressure Groups and Mass Media
Analysis of Policies of Land Reforms, Education and Health

UNIT V: COMPARATIVE GOVERNMENT AND POLITICAL SOCIOLOGY

Social Stratification: Caste, Class, Gender
Political Modernization, Culture, Communication and Participation
Constitutionalism, Role of Military, Comparative Federalism
Comparative Political Processes of Western and Non-Western Societies
Judicial Review and Judicial Activism

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PUBLIC ADMINISTRATION

ADMINISTRATIVE THEORY

Administrative Theory:

1. Significance and importance of theory
2. Evolution and Emerging Trends in Administrative Theory
3. Oriental Thought: Kautilya and Sun Tzu

Administrative Structure and Process:

1. Foundations of Management
2. Frederick Winslow Taylor-Scientific Management
3. Luther Gulick and Lyndall Urwick-Science of Administration

Classical Thought: Bureaucracy:

1. Max Weber–Bureaucracy
2. Karl Marx–State and Bureaucracy
3. Samuel Krislov and Donald Kingsley–Representative Bureaucracy

Social System Thought:

1. Mary Parker Follett–Constructive Conflict and Leadership
2. Elton Mayo–Human Relations Movement
3. Chester Barnard Formal and Informal Organizations and Functions of Executive

Writers on Administration:

1. Problems of Science of Administration
2. The Administrative State and Future of Public Administration
3. Public Administration as Developing Discipline

Behaviouralism:

1. Herbert Simon: Behaviouralism and Decision-Making
2. Appreciative System
3. Changing Organizations

Organizational Humanism–I:

1. Abraham Maslow :Needs Hierarchy
2. Victor Vroom: Expectancy Theory of Motivation
3. Douglas McGregor : Theory X and Theory Y

Organizational Humanism–II:

1. Frederick Herzberg: Hygiene and Motivation Factors
2. Chris Argyris: Integrating the Individual and the Organization
3. Rensis Likert: Systems Management

Market Theories

1. Public Choice
2. Knowledge Based Organization
3. Governing the Commons

Emerging Trends

1. Critical Social Theory
2. New Public Service
3. Post-Modernism and Post Structuralism
4. Administrative Theory: A Critical Review

INDIAN POLITY AND ADMINISTRATION

Historical Background

1. Evolution of Indian Administration
2. Socio-Economic, Political and Cultural Context of Indian Administration
3. Indian Administration: Continuity and Change

Constitutional Framework of Government

1. Constitutional Context of Indian Administration: Parliament, Executive, Judiciary–structures, functions, and work-processes
2. President, Prime Minister and Council of Ministers-
3. Cabinet and Cabinet Committees

System of Government

1. Federal and Unitary Features of the Constitution
2. Centre-State Relations and Trends in Centre–State Relations
3. Inter State relations-Emerging Issues and Resolution Mechanism

Constitutional Authorities

1. Election Commission

2. Finance Commission
3. Union Public Service Commission
4. National Commission for Schedule Caste & National Commission for Schedule Tribes

Statutory and Non-Statutory Authorities

1. NITI AAYOG
2. National Informatics Center(NIC)
3. National Human Rights Commission, National Commission for Women, and National Commission for Minorities

COMPARATIVE PUBLICADMINISTRATION

Introduction:

1. Nature, Scope, Characteristics and Importance of Comparative Public Administration
2. Evolution of Comparative Public Administration
3. International Comparative Public Administration
4. Critique of Comparative Public Administration

Approaches:

1. Bureaucratic Approach
2. General Systems Approach
3. Decision Making Approach
4. Ecological Approach

CPA: Contributions of F. W. Riggs:

1. Structural-Functional Approach
2. Theory of Prismatic Society
3. Development Models

Comparative Administrative Systems:

1. Classical Administrative System–France
2. Developing Administrative System–India
3. Developed Administrative Systems–USA and UK
4. Modern Administrative Systems–Japan and Korea

Development Administration:

1. Nature, Scope and Elements of Development Administration
2. Goals and Challenges of Development Administration
3. Models of Development Administration: Sustainable Development, Human Development &Inclusive Development

INDIAN ADMINISTRATIVE SYSTEMS

Constitutional Profile of State Administration:

1. Center-State Relations,
2. Role of Governor,
3. State Legislature and Council of Ministers,
4. Role of Chief Minister

State Administration:

1. Secretariat: Position and Role
2. Chief Secretary and GAD
3. Directorate: Relationship between Secretariat and Directorate

State Services:

1. Components of Civil Service: All India Services, State Services, Inter-relationship and Inter Linkages,
2. Classification of State Services,
3. Recruitment of State Civil Services,
4. Composition, Functions, and Role of State Service Commission

Administration at Local Level:

1. District Administration and District Collector
2. Mandal Administration (Revenue and Development)
3. Village Administration (Revenue and Development)
4. Decentralization Debate

Emerging Issues:

1. State Finances
2. Permanent and Political Executives
3. Generalists and Specialists
4. Pressure Groups
5. Citizen Grievances: Corruption

PUBLICFINANCIAL GOVERNANCEIN INDIA

Introduction

1. Public Finance: Evolution, Meaning, and Scope
2. Public Revenue: Meaning, Need, Classification and Principles of Revenue
3. Public Expenditure: Meaning, Need, and Classification

Budget and Governance

1. Public Budget: Meaning, Purpose, and Significance
2. Budget Preparation, Enactment and Execution
3. Types of Budget: Line-Item Budget, Performance Budget, PPB Sand Zero –Based Budgeting
4. Gender Budget, Green Budget, and Sunset Legislation

Financial Management in India

1. Fiscal Federalism-Center State Financial Relations, Distribution of Resources
2. Finance Commission–Composition, Powers, Functions and Role
3. Public Debt and Deficit Financing
4. Monetary Policy and Fiscal Policy

Tax Governance

1. Tax Governance in India
2. Principles of Taxation and Tax Administration in India
3. Priorities for Improving Tax Governance

Control over finances

1. Accounting and Audit Reforms in India
2. Types of Audit-Internal and External Audit-Standards of Public Accounting
3. Parliamentary Financial Committees and Comptroller & Auditor General of India

INFORMATION & COMMUNICATION TECHNOLOGY AND PUBLIC ADMINISTRATION

Introduction:

1. Public Administration and Information Technology
2. Information Technology: Evolution and Significance
3. National Policy on Information Technology 2012 and National Cyber Security Policy 2013

IT and Administration:

1. Information Systems: Issues in Centralization and Decentralization
2. IT Systems and Inter Governmental Coordination
3. Computer Networking and Citizen Participation

IT in Administration:

1. IT Techniques in Administration
2. Capacity Building for IT
3. E-Governance: Opportunities and Challenges

IT Administration at State Level:

1. Computerization of Mandal Revenue Administration,
2. Computer – Aided Administration of Registration Department (CARD)
3. E-Seva and MeeSeva

IT and Development:

1. Technology, Social Progress, and Empowerment
2. Human Factors and Information Technology
3. Cybernetic State and Digital Governance: Perspectives

RURALDEVELOPMENT & PANCHAYATHI RAJ

Introduction

1. Democracy, Development and Decentralization
2. Rural Development: Perspectives
3. Rural Policies and Strategies in India
4. Rural Development and Panchayat Raj

Rural Institutions-Panchayat Raj

1. Panchayat Raj in India– An Evaluation
2. Reforms in Panchayat Raj (73rdCAAandafter)
3. Panchayat Raj in Telangana State
4. e-Panchayats

Resources and Development

1. Rural Credit and Cooperatives
2. Self – Help Groups
3. Technical Assistance in Rural Governance

Rural Development Programmes and Agencies

1. Rural Development Programmes: IRDP,SGSY&MGNREGA
2. Governance in Tribal and Scheduled Areas
3. Village Administration: Stakeholder Committees

Issues in Rural Governance

1. Land Reforms
2. Rural Unrest :Caste, Class and Gender
3. Governing Elite and Rural Social Change
4. Bureaucracy

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LAW

1. JURISPRUDENCE

Meaning and Definition of Jurisprudence - General and Particular Jurisprudence - Elements of Ancient Indian Jurisprudence - Schools of Jurisprudence - Analytical, Historical, Philosophical and Sociological Schools of Jurisprudence. Theories of Law - Meaning and Definition of Law – The Nature and Function of Law - The Purpose of Law - The Classification of Law - Equity, Law and Justice - Theory of Sovereignty.

Sources of Law - Legal and Historical Sources - Legislation - Definition of legislation - Classification of legislation- Supreme and Subordinate Legislation - Direct and Indirect Legislation - Principles of Statutory Interpretation. Precedent - Definition of Precedent - Kinds of Precedent - Stare Decisis- Original and Declaratory Precedents - Authoritative and Persuasive Precedents. Custom - Definition of Custom – Kinds of Custom – General and Local Custom – Custom and Prescription - Requisites of a valid custom - Relative merits and demerits of Legislation, Precedent and Custom as a source of Law. Codification - Advantages and disadvantages of codification. Persons - Nature of personality - Legal Status of Lower Animals, Dead Persons and Unborn persons - Legal Persons - Corporations - Purpose of Incorporation - Nature of Corporate Personality Rights and Duties - Definition of Right - Classification of Rights and Duties - Absolute and Relative Rights and Duties - Rights and Cognate concepts like Liberty, Power, Immunity, Privilege etc.Obligation - Nature of Obligation - Obligation arising out of Contract, Quasi Contract, trust and breach of obligation etc. Liability - Nature and kinds of liability - Acts - Men's Rea - Intention and Motive - Relevance of Motive - Negligence – Strict Liability - Accident - Vicarious Liability - measure of Civil and Criminal Liability. Ownership - Definition and kinds of Ownership - Possession - Elements of Possession -Relation between Ownership and Possession - Possessory Remedies - Property - Meaning - Kinds of Property - Modes of Acquisition of Property - Legal Sanctions - Meaning of Sanction - Classification of Sanctions - Civil and Criminal Justice - Concept of Justice - Theories regarding purpose of Criminal Justice - Deterrent, Preventive, Reformative and Retributive theories.

2. LAW OF CONTRACT

Definition and essentials of a valid Contract - Definition and essentials of a valid Offer - Definition and essentials of valid Acceptance - Communication of Offer and Acceptance - Revocation of Offer and Acceptance through various modes including electronic medium - Consideration - salient features - Exception to consideration - Doctrine of Privity of Contract - Exceptions to the privity of contract - Standard form of Contract.

Capacity of the parties - Effect of Minor's Agreement - Contracts with insane persons and persons disqualified by law - Concepts of Free Consent - Coercion - Undue influence - Misrepresentation - Fraud - Mistake - Lawful Object - Immoral agreements and various heads of public policy - illegal agreements - Uncertain agreements - Wagering agreements – Contingent contracts - Void and Voidable contracts. Discharge of Contracts - By performance - Appropriation of payments - Performance by joint promisors - Discharge by Novation - Remission - Accord and Satisfaction - Discharge by impossibility of performance (Doctrine of Frustration) - Discharge by Breach - Anticipatory Breach - Actual breach. Quasi Contract - Necessaries supplied to a person who is incapable of entering into a contract - Payment by an interested person - Liability to pay for non- gratuitous acts - Rights of finder of lost goods – Things delivered by mistake or coercion - Quantum merit - Remedies for breach of contract - Kinds of damages – liquidated and unliquidated damages and penalty - Duty to mitigate. Specific Relief - Recovering possession of property - Specific performance of the contract – Rectification of instruments - Rescission of contracts - Cancellation of instruments.

Declaratory Decrees-Preventive Relief-Injunctions - Generally - Temporary and Perpetual injunctions - Mandatory & Prohibitory injunctions – Injunctions to perform negative agreement. Indemnity and Guarantee - Contract of Indemnity, definition - Rights of Indemnity holder - Liability of the indemnified - Contract of Guarantee - Definition of Guarantee – Essential characteristics of Contract of Guarantee - Distinction between Indemnity and Guarantee – Kinds of Guarantee - Rights and liabilities of Surety - Discharge of surety. Contract of Bailment - Definition of bailment - Essential requisites of bailment - Kinds of bailment - Rights and duties of bailor and bailee - Termination of bailment - Pledge - Definition of pledge – Rights and duties of Pawnor and Pawnee - Pledge by non-owner. Contract of Agency - Definition of Agent – Creation of Agency - Rights and duties of Agent – Delegation of authority - Personal liability of agent - Relations of principal and agent with third parties - Termination of Agency. Contract of Sale of Goods - Formation of contract - Subject matter of sale - Conditions and Warranties - Express and implied conditions and warranties - Pricing - Caveat Emptor - Hire Purchaser Agreements.

3. FAMILY LAW–I

Sources of Hindu Law – Scope and application of Hindu Law – Schools of Hindu Law – Mitakshara and Dayabhaga Schools – Concept of Joint Family, Coparcenary, Joint Family Property and Coparcenary Property - Institution of Karta- Powers and Functions of Karta - Pious Obligation - Partition - Debts and alienation of property.

Marriage - Definition - Importance of institution of marriage under Hindu Law – Conditions of Hindu Marriage - Ceremonies and Registration - Monogamy -

Polygamy-Recent Trends in the institution of marriage. Matrimonial Remedies under the Hindu Marriage Act, 1955 – Restitution of Conjugal Rights - Nullity of marriage - Judicial separation - Divorce - Maintenance pendent lite - importance of conciliation- Role of Family Courts in Resolution of matrimonial disputes. Concept of Adoption – Historical perspectives of adoption in India – In country and intercountry adoptions - Law of Maintenance - Law of Guardianship – The Hindu Adoption and Maintenance Act, 1956 – The Hindu Minority and Guardianship Act 1956.
Succession – Intestate succession – Succession to the property of Hindu Male and Female; Dwelling House – The Hindu Succession Act, 1956 as amended by the Hindu Succession (Andhra Pradesh Amendment) Act, 1986 & the Hindu Succession (Amendment) Act, 2005 – Notional Partition - Classes of heirs – Enlargement of limited estate of women into their absolute estate – Daughter's right to inherit ancestral property and impact of recent changes in law.

4. CONSTITUTIONAL LAW Constitution-

Meaning and Classification of Indian Constitution - Historical Perspectives - Government of India Act, 1919-Government of India Act, 1935-Drafting of Indian Constitution - Role of Drafting Committee of the Constituent Assembly. Nature and Salient Features of Indian Constitution - Preamble to Indian Constitution - Union and its Territories-Citizenship - Fundamental Rights Directive Principles of State Policy – Relationship between Fundamental Rights and Directive Principles - Fundamental Duties –Legislature under Indian Constitution - Union and State Legislatures - Composition, Powers, Functions and Privileges - Executive under Indian Constitution - President and Union Council of Ministers Governor and State Council of Ministers - Powers and position of President and Governor: Judiciary under Constitution - Supreme Court - Appointment of Judges, Powers and Jurisdiction – High Courts – Appointment and Transfer of Judges - Independence of judiciary - Judicial Accountability 3 Centre State Relations - Legislative, Administrative and Financial Relations - Cooperation and Coordination between the Centre and States - Judicial Interpretation of Centre-State Relations – Doctrines evolved by Judiciary Liability of State in Torts and Contracts - Freedom of Interstate Trade, Commerce and Inter course - Services under the State - All India Services - Public Service Commission's - Emergency – Need of Emergency Powers - Different kinds of Emergency - National, State and Financial emergency - Impact of Emergency on Federalism and Fundamental Rights - Amendment of Indian Constitution and Basic Structure Theory

5. LAW OF TORTS

Nature of Law of Torts - Definition of Tort - Elements of Tort - Development of Law of Torts in England and India - Wrongful Act and Legal Damage - Damnum Sine Injuria

and Injuria Sine Damno - Tort distinguished from Crime and Breach of Contract - General Principles of Liability in Torts - Fault - Wrongful intent - Malice - Negligence - Liability without fault - Statutory liability - Parties to proceedings.

General Defences to an action in Torts – Vicarious Liability - Liability of the State for Torts – Defence of Sovereign Immunity – Joint Liability – Liability of Joint Toreadors – Rule of Strict Liability (Ryland's V Fletcher) – Rule of Absolute Liability (MC Mehta vs. Union of India) – Occupiers liability – Extinction of liability – Waiver and Acquiescence – Release – Accord and Satisfaction - Death. Specific Torts - Torts affecting the person - Assault - Battery – False Imprisonment – Malicious Prosecution - Nervous Shock - Torts affecting Immovable Property - Trespass to land - Nuisance - Public Nuisance and Private Nuisance - Torts relating to movable property – Liability arising out of accidents (Relevant provisions of the Motor Vehicles Act).

Defamation - Negligence - Torts against Business Relations - Injurious falsehood – Negligent Misstatement - Passing off - Conspiracy - Torts affecting family relations - Remedies – Judicial and Extra-judicial Remedies –Damages – Kinds of Damages – Assessment of Damages – Remoteness of damage - Injunctions - Death in relation to tort - Action personalismoritur cum persona. Consumer Laws: Common Law and the Consumer - Duty to take care and liability for negligence - Product Liability - Consumerism - Consumer Protection Act, 1986- Salient features of the Act - Definition of Consumer - Rights of Consumers - Defects in goods and deficiency in services – Unfair trade practices- Redressal Machinery under the Consumer Protection Act - Liability of the Service Providers, Manufacturers and Traders under the Act – Remedies.

6. LAW OF CRIMES

Concept of crime - Definition and meaning of crime - Distinction between crime and tort – Stages of crime - Intention, Preparation, Attempt and Commission of Crime - Elements of Crime – Actus Reus and Mensrea - Codification of Law of Crimes in India - Application of the Indian Penal Code - Territorial and Extra Territorial application - General Explanations - Punishments. General exceptions - Abetment - Criminal Conspiracy - Offences against the State - Offences against public peace and Tranquility – Increasing tendency of offences under S.153-A and S.153-B

Offences affecting human body (offences affecting human life) Culpable Homicide and Murder – Hurt and Grievous Hurt - Wrongful restraint and Wrongful confinement - Criminal force and Assault - Kidnapping and Abduction - Sexual offences - Unnatural offences. Offences affecting the public health, safety, convenience, decency and morals - Offences against Property - Theft - Extortion - Robbery & Dacoity - Cheating - Mischief - Criminal Trespass – Criminal misappropriation and Criminal breach of trust. Offences by or relating to public servants – False Evidence and Offences against

Public Justice - Offences relating to documents - Offences relating to Marriage - Cruelty by husband and relatives of husband - Defamation.

7. LAW OF EVIDENCE

The Indian Evidence Act, 1872 — Salient features of the Act – Meaning and kinds of Evidence – the impact of the Information Technology Act, 2000 on the Indian Evidence Act - Interpretation clause — May Presume, Shall presume and Conclusive proof - Fact, Fact in issue and Relevant facts —Distinction between Relevancy and Admissibility - Doctrine of Res gestae — Motive, preparation and conduct - Conspiracy -When Facts not otherwise relevant become relevant - Right and custom - Facts showing the state of mind etc. Admissions & Confessions: General Principles concerning Admissions – Differences between "Admission" and "Confession" - Confessions obtained by inducement, threat or promise – Confessions made to police officer - Statement made in the custody of a police officer leading to the discovery of incriminating material — Admissibility of Confessions made by one accused person against co-accused. Dying Declarations and their evidentiary value — Other Statements by persons who cannot be called as Witnesses - Admissibility of evidence of witnesses in previous judicial proceedings in subsequent judicial proceedings.

Relevancy of Judgments - Opinion of witnesses - Expert's opinion - Opinion on Relationship especially proof of marriage - Facts which need not be proved - Oral and Documentary Evidence - General Principles concerning oral evidence and documentary evidence - Primary and Secondary evidence - Modes of proof of execution of documents - Presumptions as to documents - General Principles regarding Exclusion of Oral by Documentary Evidence - Relevance of social media in the law of evidence. Rules relating to Burden of Proof - Presumption as to Dowry Death - Estoppels - Kinds of estoppels - Res Judicata, Waiver and Presumption. Competency to testify Privileged communications - Testimony of Accomplice - Examination in Chief, Cross examination and Re-examination - Leading questions - Lawful questions in cross examination - Compulsion to answer questions put to witness - Hostile witness - Impeaching the credit of witness - Refreshing memory - Questions of corroboration - Improper admission and rejection of evidence.

8. COMPANY LAW

Corporate Personality - General Principles of Company Law - Nature and Definition of Company - Private Company and Public Company - Characteristics of a Company - Different kinds of Company - Registration & Incorporation of Company - Lifting the Corporate Veil - Company distinguished from Partnership, HUF and LLP-Position under the Companies Acts of 1956 and 2013.Promoters - Memorandum of Association -

Doctrine of Ultravires - Articles of Association - Doctrine of Indoor Management - Prospectus - Civil and Criminal liability for misstatement in prospectus - Statement in lieu of Prospectus - Preincorporation Contracts - Membership in a Company – Borrowing Powers - Debentures & Charges-Position under the Companies Acts of 1956 and 2013. Shares & Stock - Kinds of shares - Statutory restrictions on allotment of shares - Intermediaries – Call on shares for future of shares- Transfer of shares – Transmission of shares – Reduction on transfer of shares - Rectification of register on transfer - Certification and issue of certificate of transfer of shares - Limitation of time for issue of certificates - Object and effect of share certificate-Position under the Companies Acts of 1956 and 2013.

Directors – Different kinds of Directors - Appointment, position , qualifications and disqualifications- powers of Directors - Rights and Duties of Directors - Meetings and proceedings - kinds of meetings - Statutory meeting- Statutory report - Annual General Meeting - Extraordinary meeting - Power of the Tribunal to order meeting – class meetings - Requisites for a valid meeting - Chairman for meetings - Duties of Chairman - Proxy - Resolutions – Minutes Shareholders Activism-Corporate Social Responsibility- Position under the Companies Acts of 1956 and 2013. Accounts and Audit – Inspection and Investigation - Compromises, Reconstruction and Amalgamation - Majority rule and Rights of minority shareholders - Prevention of oppression and mismanagement – Revival and rehabilitation of sick industrial companies - Mergers, Amalgamation and Takeover - Dissolution of a company – Winding up of companies-Modes of winding up of companies – consequences of winding up - The insolvency and Bankruptcy Code, 2016 in relation to winding up of companies –Authorities under the Act- Department of Company Affairs - NCLAT, NCLT, Company Law Board, Regional Directors, ROC, Public Trustee or Advisory Committee & SFIO -Their powers and functions- – Jurisdiction of Courts - The impact of the Companies Act, 2013.

9. INTELLECTUAL PROPERTY LAW

Intellectual Property-Meaning, Nature and Classification –Significance and need of protection of Intellectual Property — Main forms of Intellectual Property : Patents, Trademarks, Industrial designs, Geographical Indications of Goods, Copyright and Neighboring Rights-New forms of Intellectual Property: Plant Varieties Protection and Biotechnology, GRTK, Layout Designs, Computer Programs.

Evolution of International Protection of IPRs-Introduction to the leading International instruments concerning Intellectual Property Rights –General Principles of Protection-The Paris Convention,1883- The Berne Convention,1886 - The Madrid Agreement,1891- The Patent Co-operation Treaty,1970 - The World Intellectual Property Organization (WIPO) Conventions- TRIPS Agreement,1994.Copyright:

Meaning, Nature, historical evolution and significance- The Copyright Act, 1957 – Salient Features-Idea-Expression Dichotomy-Subject matter of Copyright Protection-neighboring rights - Ownership of Copyright - Rights of Authors and owners - Assignment of copyright – Collective management of copyright- infringement of copyright and Criteria - Exceptions to infringement - Authorities under the Act - Remedies for infringement of copyright. Intellectual Property in Trademarks and the rationale of their protection – The Trade Marks Act, 1999 - Definition of Trademarks - Distinction between Trademark and Property Mark - Registration - Passing off - Infringement of Trademark - Criteria of Infringement - Remedies-Concept of Industrial designs-The Designs Act, 2000 - Definition and characteristics of Design - Law in India - Protection and rights of design holders - Copyright in design - Registration - Remedies for infringement. Patents - Concept of Patent - Historical overview of the Patent Law in India - The Patents Act, 1970 and its salient features - Patentable Inventions - Kinds of Patents - Procedure for obtaining patent in India and in other countries - Rights and obligations of a patentee - Limitations on patent rights: compulsory licensing, acquisition by government and secrecy directions- Infringement of patent rights and remedies available.

10. ALTERNATE DISPUTE RESOLUTION

There shall be classroom instruction on the following topics: Unit-I: Alternate Dispute Resolution - Characteristics - Advantages and Disadvantages - Unilateral - Bilateral - Triadic(Third Party) Intervention - Techniques and processes - Negotiation – Conciliation - Arbitration - Distinction between Arbitration, Conciliation and Negotiation. The Arbitration and Conciliation Act, 1996 -Historical Background and Objectives of the Act - Definitions of Arbitration, Arbitrator, Arbitration Agreement - Appointment of Arbitrator - Termination of Arbitrator - Proceedings in Arbitral Tribunal - Termination of Proceedings - Arbitral Award - Setting aside of Arbitral Award - Finality and Enforcement of Award - Appeals - Enforcement of Foreign Awards. Conciliation - Appointment of Conciliators - Powers and Functions of Conciliator - Procedure - Settlement of disputes through conciliation6: Other Alternative Dispute Resolution Systems -Tribunals - Lokpal and Lokayukta-LokAdalats- Family Courts. Section 89 and Order X, Rules 1A, 1B and 1C of Civil Procedure Code.

11. LABOUR LAW

Concept of Labour through the ages - Trade Unions: History of Trade Union Movement - The Trade Union Act 1926 - Definitions - Registration - Rights and Liabilities of Registered Trade Unions - Immunities - Amalgamation and dissolution of Unions - Reorganization of Trade Unions. Prevention and Settlement of Industrial Disputes in India - The role of State in Industrial Relations – The Industrial Disputes Act 1947 -

Definition of industry - Industrial Dispute - Individual Dispute - workman- Lay off - Retrenchment - Closure -Award – Strike - Lockout ,Authorities under the ID Act – Works committee - Conciliation - Court of inquiry - Labour Courts- Tribunal - Powers and functions of authorities - Voluntary Arbitration - Provisions under Chapter V-A & V- B of the Act- Alteration of conditions of service - Management rights of action during pendency of proceedings - Recovery of money due from employer – Unfair labour practices - miscellaneous provisions of the Act ,Standing Orders - Concept and Nature of Standing Orders - scope and coverage Certification process - its operation and binding effect - Modification and Temporary application of Model Standing Orders - Interpretation and enforcement of Standing Orders and provisions contained in the Industrial Employment (Standing Orders) Act 1946. Disciplinary Proceedings in Industries - Charge sheet - Explanation - Domestic enquiry - Enquiry officer – Enquiry report - Punishment - Principles of Natural Justice.

The Remunerative Aspects - Wages - Concepts of wages - Minimum, Fair, Living Wages - Wage and Industrial Policies - Whitley Commission Recommendations - Provisions of Payment of Wages Act 1936 - Timely payment of wages - Authorized deductions - Claims - Minimum Wages Act 1948 - Definitions - Types of wages - Minimum rates of wages - Procedure for fixing and revising Minimum Wages - Claims -Remedy. Bonus - concept - Right to claim Bonus - Full Bench formula - Bonus Commission - Payment of Bonus Act 1965 - Application - Computation of gross profit, available, allocable surplus - Eligibility of Bonus - Disqualification of Bonus - set on - set off of allocable surplus- Minimum and Maximum Bonus-Recovery of Bonus. Employees Security and Welfare aspect - Social Security - Concept and meaning - Social Insurance - Social Assistance Schemes. Social Security Legislations - Law relating to workmen's compensation – The Employee's Compensation Act 1923 – Definitions -Employer's liability for compensation - Nexus between injury and employment - payment of compensation - penalty for default - Employees State Insurance Act 1948 –Application - Benefits under the Act - Adjudication of disputes and claims – ESI Corporation.

12. INTERNATIONAL LAW

Definition, Nature, Scope and Importance of International Law - Relation of International Law to Municipal Law - Sources of International Law - Codification. State Recognition - State Succession - Responsibility of States for International delinquencies – State Territory - Modes of acquiring State Territory, Position of Individual in International Law - Nationality - Extradition - Asylum - Privileges and Immunities of Diplomatic Envoys - Treaties - Formation of Treaties - Modes of Consent, Reservation and termination. The Legal Regime of the Seas - Evolution of the Law of the Sea - Freedoms of the High Seas - Common Heritage of Mankind - United Nations

Convention on the Law of the Seas - Legal Regime of Airspace - Important Conventions relating to Airspace – Paris, Havana, Warsaw and Chicago Conventions – Five Freedoms of Air – Legal Regime of Outer space – Important Conventions such as Outer space Treaty, Agreement on Rescue and Return of Astronauts, Liability Convention, and Agreement on Registration of Space objects, Moon Treaty - Uni space. International Organizations - League of Nations and United Nations - International Court of Justice - International Criminal Court - Specialized agencies of the UN - WHO, UNESCO, ILO, IMF and WTO.

Concept of marriage - Validity of marriage, Formal validity of Marriage (English Law, Indian Law) matrimonial causes , Dissolution of marriage, Grounds of Divorce, Recognition of Foreign Divorces, Nullity of marriage, Recognition of Foreign Nullity Decrees, Judicial separation, Grounds for Judicial separation, Recognition of foreign decrees of Judicial Separation - Restitution of Conjugal Rights, Matrimonial Reliefs in respect of Polygamous marriages, Enforcement of foreign maintenance orders, Foreign Custody Orders, Indian Law, English Law, Choice of Law. Legitimacy, jurisdiction of courts, Legitimation, Jurisdiction of court, Recognition of foreign legitimation, Indian Law, English Law, choice of law-Adoption, jurisdiction of courts, recognition of foreign adoptions, adoption by foreign parents, Indian Law, English Law. Guardianship and custody, jurisdiction, recognition and enforcement of foreign guardianship and custody orders, Indian law, choice of law. Commercial contracts - Proper law of contract, capacity to contract, Formal and informal contracts.

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PSYCHOLOGY

Unit 1: Cognitive Psychology and Cognitive Science

Introduction to cognitive Psychology and Cognitive Science; Cognition and Brain: Basic Principles; Behavioral, Electrophysiological, and Neuroimaging methods; Attention and consciousness; Memory: Visual Memory, STM and Working memory, and Long term Memory; Language, Brain and Cognition; Speech Recognition; Language Development; Reading development; Reading process; Reasoning and Decision making; Gene-Brain-Behavior Link.

Unit 2. Psychological Testing Clinical Assessment and Clinical Assessment

Functions, origins, and application of psychological testing; Item development and item validation; Development of norms and the meaning of test scores; Reliability and Validity of tests; Types of tests. Principles and methods of clinical assessment; Assessment of cognitive functions; Assessment of personality; Assessment of deviance and pathology.

Unit 3: Biological basis of behavior

Neurons; Nerve impulse propagation; Structure and functions of Nervous system; Diversity of life; Structure of genes; Protein synthesis; Cell division; Mendel and post Mendellian developments; Evolution; Behavior genetics – Introduction and Methods.

Unit 4. Research Methodology & Statistics

Variables; Hypothesis; Measurement and scales; General Principles of Research; Types of Research Designs; Sampling methods; Analyzing and reporting results; Quantitative methods; Analyzing and reporting results - Qualitative methods; computer and its use in data analysis

Probability; Binomial and Normal Distribution and Hypothesis Testing; Correlation and Regression; ANOVA, MANOVA and other Multivariate Statistics; Nonparametric Statistics.

Unit 5. Learning Theories

Functionalistic Theories (Thrndike, Skiiner, and Hull); Associationistic Theories (Pavlov, Guthrie, and Estes); Cognitive Theories (Gestalt, Piaget, Tolman, and Bandura); Biological Theories (Hebb, and Bolles).

Unit 6. Personality

Psychodynamic perspective (Freud, Jung, Adler, Horney, Erikson); Humanistic and Existential perspective (Erich Fromm, Carl Rogers, Maslow); Cognitive perspective (George Kelly, Rotter, Bandura); and Eastern perspective (Indian).

Unit 7. Child and Adult Psychopathology

Attention Deficit Disorder; Appositional Defiant and Conduct Disorder-causes and management; Childhood Anxiety and Depression Disorders; Enuresis, Encopresis, Sleep walking-Causes and Management; Learning Disability; Autism-causes and management; Mental Retardation-Types, Classifications-causes, prevention and Management. Theories and Models of Anxiety Disorders; Theories and Models of: Somatization, Somatoform and Dissociative disorders; Theories and Models of: Mood, Schizophrenia, and Delusional disorders; Models of personality disorder (Psychodynamic, Behavioral, Cognitive and Biological models).

Unit 8. Psychotherapy and Counseling

Psychoanalytic Technique; Techniques based on Counter Conditioning; Techniques based on Operant conditioning; Techniques based on Cognitive Behavioral Approaches: Beck, Ellis. Person-centred and Gestalt therapies; Family and marital therapies; Transpersonal approach; Body-centred therapy, Yoga and Holistic approach.

Individual counseling – approaches and techniques; Group counseling – approaches and techniques; Counseling for career planning and decision making, Life skills and counseling.

Unit 9. Organizational Behavior and Organizational Development:

Introduction to Organizational Behavior; Leadership and Teams at work; Motivation in Organization; Communication and Decision Making.

Overview of organization Development; The Process of Organization Development - Diagnosing the problems; Designing Interventions and Leading and Managing Change.

Unit 10. Organizational Psychology and Human Resource Development

The field of organizational behavior (history, subject matter, and scope); Leadership and Teams at work; Motivation in Organization; Communication and Decision Making; Training and development; Need Assessment, Training Design & Implementation; Evaluating the training Effectiveness; Performance Appraisal; HR Planning and recruitment; Future challenges: Indian & Global.

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MANAGEMENT

MODULE-1

Introduction, Definition of Management, Nature, Purpose and Functions, Levels and Types of Managers, Managerial Roles, Skills for Managers, Evolution of Management Thought, Contributions Made by Taylor, Fayol, Hawthrone experiments, A Broad Sweep of other Important Management Gurus, Is Management a Science or Art, Recent Trends in Management. Meaning, Nature and Importance of Planning, Steps in Planning, Types of Plans, Barriers to Effective Planning, Planning Premises, Policies, Forecasting and Planning. Principles of Organizing, Types of Organization Structure, Departmentation, Span of Management, Centralization and Decentralization, Authority and Power, Delegation, Delegation of Authority. - Concept, Manpower Planning, Recruitment & Selection, Training and Development, Performance Appraisal, Leadership Style, Motivation theories, Morale Building Communication. Need for Co-ordination Principles, Techniques of Co-ordination. Control; Process of Control; Techniques and Tools of control, Management by Objectives.

Module-2

Production Functions, Cobb-Douglas Production Function, cost-input relationship, Returns to scale, factors of productivity, Cost concepts – cost output relationships in the short run and the long run, economies of scale, Break-even analysis. Market Structure–perfect competition, monopoly, monopolistic competition, oligopoly, kinked demand curve. Price output decisions under different market structures, Price discrimination. Pricing Strategies and Methods - Cost plus pricing, Marginal cost pricing, Cyclical pricing, Penetration Pricing, Price Leadership, Price Skimming, Transfer pricing, Behavior of the Firm and Profit Theories.

Module-3

Introduction, meaning of probability, assigning probability to events, calculation of probability, probability rules, addition and multiplication law of probability, Baye"s theorem, binomial, Poisson and normal distribution. Introduction, measures of central tendency for grouped data: mean, median and mode; measures of central tendency for ungrouped data: mean, median and mode, Geometric mean and harmonic mean, quartiles and percentiles. Measures of dispersion: Range, variance, standard deviation, coefficient of variation.

Module-4

Introduction, Definitions of market and marketing, Fundamental Marketing Concept, The Exchange Process, Elements of Marketing Concept, Functions of Marketing, Marketing Environment, Techniques Used in Environment Analysis, Elements of Marketing Mix. Consumer Buying Behavior Process, Factors influencing Consumer Behavior, Determinants of Consumer Behavior, Models of Consumer Behavior, Market Research and Market Intelligence. Marketing Information System Concept of Market Segmentation, Benefits, Bases for Segmenting Consumer Markets, Targeting - Bases for Identifying Target Customer, Target Marketing strategies, Positioning - Meaning, Product Positioning Techniques.

Module-5

Human Resource Management – Concept, Perspectives, Influences and Recent Trends Human Resource Planning, Recruitment and Selection, Induction, Training and Development, Job Analysis, Job Evaluation and Compensation Management, Strategic Role of Human Resource Management, Competency Mapping & Balanced Scoreboard, Career Planning and Development, Performance Management and Appraisal, Organization Development, Change & OD Interventions, Talent Management & Skill Development, Employee Engagement & Work Life Balance

Module-6

Accounting for Managers and Financial Management

Accounting Principles and Standards, Preparation and Analysis of Financial Statements, Preparation of Cost Sheet, Marginal Costing, Cost Volume Profit Analysis, Standard Costing & Variance Analysis. Financial Management, Concept & Functions, Capital Structure – Theories, Cost of Capital, Sources of Finance; Budgeting and Budgetary Control, Types and Process, Zero base Budgeting, Leverages, EBIT–EPS Analysis, Financial Breakeven Point & Indifference Level. Time Value of money, Valuation of Bonds and Shares, Risk and Returns; Capital Budgeting, Dividend – Theories and Determination, Mergers and Acquisition – Corporate Restructuring, Value Creation, Merger Negotiations, Leveraged Buyouts, Takeover, and Portfolio Management.

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