Syllabus for Forest Ranger

1. **Compulsory Subjects:-**

a) General knowledge----------100 Marks
b) English----------100 Marks

2. **Optional Subjects**:- ----------200 Marks each.

MPSC-Forest Ranger
Syllabus
Agricultural Engineering

Paper - I
Section A

- **Soil and Water Conservation:**

- Scope of soil and water conservation.
- Mechanics and types of erosion, their causes.
- Rainfall, runoff and sedimentation relationships and their measurement.
- Soil erosion control measures - biological and engineering including stream bank protection-vegetative barriers, contour bunds, contour trenches, contour stone walls, contour ditches, terraces, outlets and grassed waterwyas.
- Gully control structures - temporary and permanent - design of permanent soil conservation structures such as chute, drop and drop inlet spillways.
- Design of farm ponds and percolation ponds.
- Principles of flood control-flood routing.
- Watershed Management - investigation, planning and implementation - selection of priority areas and water shed work plan, water harvesting and moisture conservation.
- Land development - levelling, estimation of earth volumes and costing.
- Wind Erosion process - design fo shelter belts and wind brakes and their management.
- Forest (Conservation) Act

Aerial Photography and Remote Sensing:

- Basic characteristics of photographic images, interpretation keys, equipment for interpretation, imagery interpretation for land use, geology, soil and forestry.
- Remote sensing - merits and demerits of conventional and remote sensing approaches.
- Types of satellite images, fundamentals of satellite image interpretation, teachniques of visual and digital interpretations for soil, water and land use management.

- Use of GIS in planning and development of watersheds, forests including forest cover, water resources etc.

Section B:

Irrigation and Drainage:

- Sources of water for irrigation.
- Planning and design of minor irrigation projects.
- Techniques of measuring soil moisture - laboratory and in situ, Soil-water plant relationships.
- Water requirement of crops.
- Planning conjunctive use of surface and ground weater.
- Measurement of irrigation water, measuring devices - orifices, weirs and flumes. Methods of irrigation - surface, sprinkler and drip, fertigation.
- Irrigation efficiencies and their estimation.
- Design and construction of canals, field channels, underground pipelines, head-gates, diversion boxes and structures for road crossing.
- Occurrence of ground water, hydraulics of wells, types of wells (tube wells and open wells) and their construction.
- Well development and testing.
- Pumps-types, selection and installation. Rehabilitation of sick and failed wells.
- Drainage causes of waterlogging and salt problem.
- Methods of drainage of irrigated and unirrigated lands, design of surface, sub-surface and vertical drainage systems.
- Improvement and utilization of poor quality water.
- Reclamation of saline and alkali soils.
- Economics of irrigation and drainage systems.
- Use of waste water for irrigation â€" standards of waste water for sustained irrigation, feasibility and economics.

Agricultural Structures:

- Site selection, design and construction of farmstead - farm house, cattle shed, dairy bam, poultry shed, hog housing, machinery and implement shed, storage structures for food grains, feed and forage.
- Design and consturction of fences and farm roads. Structures for plant environment - green houses, poly houses and shade houses.
- Common building materials used in construction - timber, brick, stone, tiles, concrete etc and their properties.
- Water supply, drainage and sanitation system.

Paper – II

Section A

Farm Power and Machinery:

- Agricultural mechanization and its scope. Sources of farm power - animate and electro-mechanical.
- Thermodynamics, construction and working of internal combustion engines.
- Fuel, ignition, lubrication, cooling and governing system of IC engines.
- Different types of tractors and power tillers. Power tramsmission, ground drive, power take off (p.t.o.) and control systems.

- Operation and maintenance of farm machinery for primary and secondary tillage.
- Traction theory.
- Sowing transplanting and interculture implements and tools.
- Plant protection equipment - spraying and dusting.
- Harvesting, threshing and combining equipment.
- Machinery for earth moving and land development - methods and cost estimation.
- Ergonomics of man-machine system.
- Machinery for horticulture and agro-forestry, feeds and forages.
- Haulage of agricultural and forest produce.

Agro-energy:

- Energy requirements of agricultural operations and agro-processing.
- Selection, installation, safety and maintenance of electric motors for agricultural applications.
- Solar (thermal and photovoltoic), wind and bio-gas energy and their utilization in agriculture.
- Gasification of biomass for running IC engines and for electric power generation.
- Energy efficient cooking stoves and alternate cooking fuels.
- Distribution of electricity for agricultural and agro-industrial applications.

Section B:

Agricultural Process Engineering:

- Post harvest technology of crops and its scope.
- Engineering properties of agricultural produces and by-products.
- Unit operations - clearning grading, size reduction, densification, concentration, drying/dehydration, evaporation, filtration, freezing and packaging of agricultural produces and by-products.
- Material handling equipment - belt and screw conveyors, bucket elevators, their capacity and power requirement.
- Processing of milk and dairy products - homogenization, cream separation, pasteurization, sterilization, spray and roller drying, butter making, ice cream, cheese and shrikhand manufacture.
- Waste and by-product utilization - rice husk, rice bran, sugarcane bagasse, plant residues and coir pith.

Instrumentation and computer applications in Agricultural Engineering:

- Electronic devices and their characteristics - rectifiers, amplifiers, oscillators, multivibrators.
- Digital circuits â€" sequential and combinational system.
- Application of microprocessors in data acquisition and control of agricultural engineering processes- measurement systems for level, flow, strain, force, torque, power, pressure, vaccum and temperature.
- Computers â€" introduction, input/output devices, central processing unit, memory devices, operating systems, processors, keyboards and printers.
- Algorithms, flowchart specification, programme translation and problem analysis in Agricultural Engineering. Multimedia and Audio-Visual aids.

MPSC- Forest Ranger

Syllabus

Chemical Engineering

Paper – I

Section A

(a) Fluid and Particle Dynamics

Viscosity of fluids. Laminar and turbulent flows. Equation of continuity and Navier-Stokes equition-Bernoulli's theorem. Flow meters. Fluid drag and pressure drop due to friction, Reynold's Number and friction factor - effect of pipe roughness. Economic pipe diameter. Pumps, water, air/steam jet ejectors, compressors, blowers and fans. Agitation and mixing of liquids. Mixing of solids and pastes. Crushing and Grinding - principles and equipment. Rittinger's and Bond's laws. Filtration and filtration equipment. Fluid-particle mechanics - free and hindered settling. Fluidisation and minimum fluidization velocity, concepts of compressible and incompressible flow. Transport of Solids.

(b) Mass Transfer

Molecular diffusion coefficients, First and second law and diffusion, mass transfer coefficients, film and penetration theories of mass transfer. Distillation, simple distillation, relative volatility, fractional distillation, plate and packed columns for distillation. Calculation of theoretical number of plates. Liquid-liquid equilibria. Extraction - theory and practice; Design of gas-absorption columns. Drying. Humidification, dehumidification. Crystallisation. Design of equipment.

(c) Heat Taransfer

Conduction, thermal conductivity, extended surface heat transfer. Convection - free and forced. Heat transfer coefficients - Nusselt Number. LMTD and effectiveness. NTU methods for the design of Double Pipe and Shell & Tube Heat Exchangers. Analogy between heat and momentum transfer. Boiling and condensation heat transfer. Single and multiple-effect evaporators. Rediation - Stefan-Boltzman Law, emissivity and absorptivity. Calculation of heat load of a furnace. Solar heaters.

Section B

(d) Noval Separation Processes

Equilibrium separation processes - ion-exchange, osmosis, electro-dialysis, reverse osmosis, ultra-filtration and other membrane processes. Molecular distillation. super critical fluid extraction.

(e) Process Equipment Design

Fractors affecting vessel design criteria - Cost considerations. Design of storage vessels-vertical, horizontal spherical, underground tanks for atmospheric and higher pressure. Design of closures flat and eliptical head. Design of supports. Materials of construction-characteristics and selection.

(f) Process Dynamics and Control

Measuring instruments for process variables like level, pressure, flow, temperature pH and concentration with indication in visual/pneumatic/analog/digital signal forms. Control variable, manipulative variable and load variables. Linear control theory-Laplace, transforms. PID controllers. Block diagram represenation transient and frequency response, stability of closed loop system. Advanced control strategies. Computer based process control.

Paper - II
Section A
(a) Material and Energy Balances

Material and energy balance calculations in processes with recycle/bypass/purge. Combustion of solid/liquid/gaseous fuels, stoichiometric relationships and excess air requirements. Adiabatic flame temperature.

(b) Chemical Engineering Thermodynamics

Laws of thermodynamics. PVT relationships for pure components and mixtures. Energy functions and inter-relationships - Maxwell's relations. Fugacity, activity and chemical potential. Vapour-liquid equilibria, for ideal/non-ideal, single and multi component systems. eriteria for chemical reaction equilibrium, equilibrium constant and equillibrium conversions. Thermodynamic cycles - refrigeration and power.

(c) Chemical Reaction Engineering :

Batch reactors - kinetics of homogeneous reactions and interpretation of kinetic data. Ideal flow reactors - CSTR, plug flow reactors and their perofrmance equations. Temperature effects and run-away reactions. Heterogeneous reactions - catalytic and non-catalytic and gas-solid and gas-liquid reactions. Intrinsic kinetics and global rate concept. Importance of interphase and intraparticle mass transfer on performance. Effectiveness factor. Isothermal and non-isothermal reactors and reactor stability.

Section B

(d) Chemical Technology

Natural organic products - Wood and wood-based chemicals, pulp and paper, Agro industries - sugar, Edible oils extraction (including tree based seeds), Soaps and detergents. Essential oils - Biomass gasification (including biogas). Coal and coal chemical. Petroleium and Natural gas-Petroleum refining (Atomospheric distillation/cracking/reforming) - Petrochemical industries - Polyethylenes (LDPE/HDPE/LLDPE), Polyvinyl Chloride, Polystyrene. Ammonia manufacture. Cement and lime industries. Paints and varnishes. Glass and ceremics. Fermentation - alcohol and antibiotics.

(e) Environmental Engineering and Safety

Ecology and Environment. Sources of pollutants in air and water. Green house effect, ozone layer depletion, acid rain. Micrometeorology and dispersion of pollutants in environment. Measurement techniques of pollutant levels and their control strategies. Solid wastes, their hazards and their disposal techniques. Design and performance analysis of pollution control equipment. Fire and explosion hazards rating - HAZOP and HAZAN. Emergency planning, disaster management. Environmental legislations - water, air environment protection Acts. Forest (Conservation) Act.

(f) Process Engineering Economics :

Fixed and working capital requirement for a process industry and estimation methods. Cost estimation and comparison of alternatives. Net present value by discounted cash flow. Pay back analysis. IRR, Depreciation, taxes and insurance. Break-even point analysis. Project scheduling - PERT and CPM. Profit and loss account, balance sheet and financial statement. Plant location and plant layout including piping.

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Syllabus

Computer Science/Computer Application

PAPER-I

C fundamentals, I/O functions, Control statements, The C preprocessor

C Fundamentals: The C character set, identifiers and keywords, Data types, constants, variables and arrays, declarations, symbolic constants, Operators (Arithmetic, unary, relational, logical, bitwise, assignment), ekpressions, statements, C program structure, Need of header files, Process of compiling and running a C program

I/O functions: Header files (stdio.h, conio.h) getch(), getche(), getchar(), putch(), putchar(), scant(), printf(), gets(), puts(), cIrscr(), window(). Control statements: Decision making and branching (if.else, switch), Decision making and looping (while, do while, for), Jumping (break, continue, goto), Nested loops The C Preprocessor: Macro Expansions, Macro with arguments and Macro versus function, File Inclusion, Conditional Compilation, #if and #elif directives, Miscellaneous directives (#define and #undef)

Functions, Arrays and Pointer

Functions: Overview (definition, declaration), defining a function, accessing a function, function prototypes, call by value, call by reference, recursion, iteration, Advantages and disadvantages of recursion over iteration, Storage classes (Automatic, Register, External, Static), String functions (strcmp (), strlen (), strrev (), strcat (), toupper (), tolower ()), Math functions (sqrt (), abs (), sin (), cos (), Standard function- exit (), Memory allocation functions (malloc (), free (), realloc(), canoe())

Arrays and Pointers: Defining an array, array initialization, processing an array, passing array to a function, multidimensional arrays, arrays and strings, pointer declarations, passing pointer to a function, pointer and one dimensional arrays, Operation on pointers, pointers and multidimensional arrays, arrays of pointers, passing functions to other functions, pointer to function, functions returning pointers.

Structure and Union, Data files

Structures and Unions: Defining a structure, processing a structure, user defined data types, structures and arrays, structures and pointers, passing structures to a function, self referential structures, bit fields in structures, Union, Union of structures, Enumerated, typedef.

Data files: File opening modes, character1/0(getc(), putt()), String I/O (fgets(), fputs()), FoAmatted console I/0(fscanf(), fprintf()), text mode versus binary mode, Unformatted console I/O functions - record I/0(fread(), fWrite(), ftell(), fseek(), rewind(), rename()), Record operations (append, delete, update, search, display, sorting of records) checking file opening error, closing data files; Command line parameters, low level disk I/O (setting buffer, read buff5,- file opening modes).

Simple data structures, VDU Basics, Keyboard Basics

Section (a): Simple Data structures: Stack(push, pop, isempty, pop and display, display top operations), Queue using array (insert, delete, isempty , isfull operations), Creation of linked list, insertion, deletion, searching, of nodes for linked lists(singly, doubly Circular), Binary tree (creation, recursive tree traversals - inorder, preorder, postorder)

Section (b): VDU Basics: Screen memory accessing, memory segments, far pointers, writing to VDU memory, text mode, color attribute, Interrupts, interrupt vector table, WORD register, BYTE register, DOS interrupts, BIOS interrupts, int86() functions(controlling cursor size, position of cursor, visibility) and intdos() functions(make, remove, change directory and delete file)

Keyboard basics: operation on keyboard, Shift and Toggle keys

Graphics and Mouse programming

Graphics Programming: Introduction, Input devices (keyboard and mouse), Graphic output devices (VDU, LCD), plotter, printer, Video Graphics Adapter (VGA, CGA, SVGA), VRAM, Resolution, Library file- graphics.h, 2-D Coordinate system, Simple Graphics Functions(initgraph(), circle(), arc(), rectangle(), ellipse(), drawpoly(), closegraph(), restorecrtmode(), setfillstyle(), putpixel(), getmaxx(), getmaxy(),

outtextxy(), setcolor(), fillcolor(), settextstyle(), moveto(), lineto(), moverel(), linerel() Pallete and color, Animation functions(imagesize(), getimageO, putimage() and arguments)

Brehsenham's Line drawing algorithms, Brehsenham's Circle generation. Introduction to Curves (B-Spline and Bezier)

Mouse Programming: GUI and mouse, dos.h, mouse initialization, show and hide mouse pointer, restricts mouse movement, Cursor Position and button status, menus using mouse.

Data Representation and Algorithm Design Arrays

Data Type, Abstract Data Type, Data Structure, Fundamental and Derived Data Types.

Design and analysis of algorithm: Algorithm definition, Structured Programming, Top down and Bottom up approaches, Comparison of algorithms, Frequency count, Complexity measures in terms of time and space; Big O notation

Recursion (Towers of Hanoi, Fibonacci Numbers, Binary search), Comparison of Recursive and Non-Recursive algorithms

Array as a data structure (characteristics, advantages, disadvantages), Representation of arrays: single and multidimensional, Address calculation using column and row major ordering; insertion and deletion in arrays; use of arrays for matrix representation and manipulation (addition, multiplication, transpose), complexity analysis for matrix multiplication; use of arrays for sparsepOlynomial representation and manipulation (addition and multiplication, evaluation); use of arrays for large integer representation and their addition

Linked Lists; Stacks and Queues

Linked List as a data structure (characteristics, advantages, disadvantages); operations on lists (creation, insertion, deletion, traversal, merging, splitting); singly linked list (with one or two external pointers), doubly linked list, circular fist; use of linked lists for polynomial representation and manipulation (addition and multiplication), and sparse matrix representation and manipulation (inputting, adding, and displaying in matrix form) Stacks and Queues as data structures; implementation of stacks and queues using

arrays and linked lists; Circular Queue, Priority Queue, D-Queue; Application of stacks : Conversion of infix(containing arithmetic operators including exponential operator, and parenthesis) to postfix and prefix expressions; evaluation of postfix expression

Trees and Graphs

Definition of tree as a data structure (Binary Trees and General Trees), Basic Terms (father, son, descendant, ancestor, height, depth, leaf, node, forest, ordered trees, strictly binary tree, complete binary tree, almost complete binary tree, internal nodes, external nodes); Representation of trees using arrays and linked lists, Binary tree traversal methods (pre-order, in-order, post-order), recursive and non-recursive algorithms for traversal methods, Binary search trees (creation, insertion and deletion of a node), threaded binary trees (construct and traverse a right in-threaded binary tree); Height balanced (AVL) binary trees (construct and traverse an AVL tree), multi-way search trees (construction and traversal); B-tree (construction and traversal of a B-tree of given order)

Definition of a graph, Basic Terms (vertex, arc, directed, undirected,' cardinality, finite and infinite graph, incidence, adjacency, indegree, outdegree, path length, weighted graph, connected graph, cyclic and acyclic graph, symmetric graph, complete graph, sub-graph); Graph representation : Adjacency matrix, adjacency lists, incidence matrix, adjacency multi-lists; Traversal schemes : Depth first search, Breadth first search (Recursive and non-recursive algorithms); Shortest Path algorithms (Dijkstra's), Spanning tree, Minimal spanning tree algorithms (Kruskal's algorithm)

Searching and Sorting, and their complexity analysis

Linear and binary search, Indexed search, and their complexity analysis; Hashing, Hash Functions (division method, mid square method, folding), Analysis of ideal hash function; Conflict resolution (linear and quadratic probe, double hashing, separate chaining, coalesced chaining); Analysis of collision resolution techniques; Sorting algorithms(Insertion, Selection, Bubble, Quick, Merge, Radix, Heap) and comparison of their time complexity.

Visual Programming Using Visual Basic

Overview, Environment and Programming

Overview: Visual Basic Application Types, Visual Basic Application Components-(Projects, Forms, Controls, Code modules, Class modules, User controls, Property pages)

VB Environment: Menu Bar, Toolbar, Toolbox, Form, Project explorer, Property window, Immediate window, Form layout window. Creating a project, Forms, Naming a project, Saving a project.

Controls: Label control, TextBox control, Command Button, Frames, Option Buttons, Check Boxes, Picture control, Image Control, Shape control, Line control, Timer control, HscrollBar control, VscrollBar control, FileListBox control, DirListBox, DriveListBox control.

List and Menus: List Box control, Combo Box Control. Menu System(Menu Standards, Menu editor, Common menu properties)

Events: Code window, Breakdown of an Event procedure, Form Events, Label events, TextBox events, Command Button events, Frame Events, Option button events, CheckBox events, Picture control events, Image control events, ListBox events, ListBox events, ComboBox events, Menu Events

Variables: Data types, Declaring variables, Scope and lifetime of a variable, Examples of variables, Variant data types.

Arrays Types and Constants: Arrays(Fixed size, Dynamic, Preserving array contents), Setting array boundaries, Array() functions, isArray() functions, Bounds checking, Clearing an array. Multidimensional arrays, User-defined types, Constants(Local constants, Public constants, Module-level, Built-in), Mathematical and Relational operators, Control Arrays

More on Programming and Error Handling

Conditional Logic and Looping: If... Then, Select... Case, Do...While, While...Wend, Loop...While, Do...Until, Loop...Until, For... Next, Nested constructs, Exit For/Exit Do, Exit Sub/Exit Function.

Procedures and Functions: Procedures, Functions, Parameters and Arguments, Call by Value and Call by Reference, Optional Arguments, Named Arguments

Built-in Functions: String Functions, Date Functions, Conversion Functions, Functions to test Data Types, Methods

DialogBoxes: MsgBox, InputBox, Common Dialog Control

Multiple Document Interface: What is MDI, Creating an MD form, Child menus in MDI applications, Arranging child forms, Tracking Child Windows, Unloading an MDI application

Error Handling: Error handling techniques, On Error GoTo, Err object (Err.Number, Err.Description), On error Resume Next, Errors in Call Stack, Turning Error handling Off, Creating a Global ,error handler

Database Programming with Visual Basic

The ADO data control: Getting at Data(The Jet Engine, ActiveX Data Object), Universal Data Access(OLEDB, ActiveX -Data Object, ADO Features, ADO object hierarchy, Referencing ADO), Service Provider for ADC. The ADO Data Control, ADO control properties, Using the ADO Data Control.

Data Control Programming: Recordset Properties, Order of events, Modifying Data Programmatically, Adding records, Detecting changes in data, Data Control Error Handling

Additional Data Control Topics: Other Data-aware controls Topics (Data-bound combo box, Data bound List Box, Synchronizing the List Box, Data bound Grid Control)

ActiveX Data Object: The Connection object (Properties, Methods, Creating), Recordset object (Properties, Methods, Types, Forward-only recordset), Command objects

Data Entry with ADO: Creating a new ADO project, Adding data, Editing data, Deleting data

Visual Database Tools: Data environment designer, Data view window, Query designer window, The database diagram window, Visual data manager Creating Report with Crystal Report Pro: The Bands, Fields, Using Crystal Report Pro Writer, Calling The Report from within Visual Basic.

Advanced Visual Basic

ActiveX Controls: Toolbar control, Coolbar control, Status Bar, Image Combo, DateTimePicker control, MonthView control, Progress Bar Control, Slider Control , UpDown Control, TabStrip Control

Using the Windows API: Uses of API, Declaring API functions to VB, Calling API functions, API functions (SendMessageQ, GetDriveTypeQ, GetDiskFreeSpaceQ, GetFileAttributesO, GetComputerName(), GetUserName())

Building ActiveX Controls: On designing ActiveX controls, Interacting with a' container(Extender and Ambient object), Designing property pages, Building a generic control (Creating a generic control, Adding property, The life of a control, Initializing a control and its properties, Key properties, Designing a alarm control) , Enhancing the existing controls - an enhanced TextBox control

Web Programming with Visual Basic

Introduction to Web: Internet and Web protocols (HTML pages, Client-Server interactions, Scripting, DHTML).HTML Primer (URLs and hyperlinks, Structure of HTML documents, Basic HTML tags, Hyperlinks, Inserting graphics, Tables, Frames) Activating Client with VBScript (Forms and Controls, Embedding a script, Scripting an HTML page)

Visual Basic and Web: Web Browsing Objects (WebBrowser control, InternetExplorer control), Properties, Events and Methods of WebBrowser control. The Document Object (Properties and Methods), The History object, The Navigation object, Location object, The Link object

Active Server Pages: Client Server Interactions (Building a parameter string, Contacting a server, Connecting to Web Server), Creating an ASP page (Included files, Mixing server side and client side script), The Active Server Objects(Intrinsic objects, Basic objects, Response object, Request object, Server objects, Session Objects and Application Objects, Start and End events, Storing and recalling cookies), Using ActiveX Data Objects(Setting up an ODBC data structure, Opening a database, Building a recordset, Using the recordset)

Visual Programming Using VB.NET

Language Fundamentals, Forms & Controls

Language Fundamentals

Comments, Data Storage - Variables, Variable Type, Variable Names, Variable Declarations - explicit and implicit; Scope and lifetime of variables - Namespaces and Shadowing, Binding, Constants, Symbolic Constants; Arrays - one and multi dimensional, Changing size of an array; Structures, Enumerations; Arithmetic and string operators, operator precedence, Expressions, Logical operators

.NET framework, common language runtime, Value types and reference types

Forms and Controls

Control Class, ScroilableControl Class, ContainerControl Class, Form Class, UserControl Class.

Forms - Behaviour, Appearance, Layout and Design, Methods and Events, Adding controls, locking controls, startup form.

Controls - Common Properties and Methods,' Label, LinkLabel, TextBox, MainMenu, CheckBox, RadioButton, ListBox, ComboBox, GroupBox, Panel, TabContol, Timer, StatusBar, ImageList, ContextMenu; Outline of other controls - CheckedListBox, PictureBox, DataGrid, HScrollBar and VScrollBar, ListView, TreeView, DateTimePicker, MonthCalendar, PrintDialog, PrintPreviewDialog, PrintPreviewControl, PrintDocument, PageSetupDialog, OpenFileDialog ,IaveFileDialog, Toolbar, Splitter, DomainUpDown, NumericUpDown, TrackBar, ProgressBar, RichTextBox, HelpProvider, ToolTip, Notifylcon, FontDialog, ColorDialog, ErrorProvrder, CrystalReportViewer; Mouse related events, Keyboard related events.

Decision, Loops, Procedures & Exception Handling

Decision and Loop Structure: Decision Structures - If ... Then ... Else, Select Case; Loop Structures - For ... Next, Do ... Loop, While ... End While, With ... End With, For Each ... Next, Exit

Procedures

Sub Procedures and Function Procedures, Passing arguments, Parameter Array Arguments

Exception Handling

Structured Exception handling, Catch Expressions, Exception class and its derived classes, Throw statement. Unstructiired Exception Handling, On Error statement, Resume statement, Err object.

Object Oriented Programming & Custom Controls

Object Oriented Programming

OOP Fundamentals - Class and objects, Creating Classes, Namespaces and Classes, Class Properties, Class Methods, Class Constructors, Shared Methods, Shared Variables, Class Events, Class Access Options, Structures, Interfaces, Inheritance, Subclassing, Base Class Design Considerations, Me Keyword, MyBase Keyword, MyClass Keyword.

Creating Custom Controls

Using Windows Control Library- Subclassing Existing Control, Custom Properties, Custom Methods, Custom Event Handlers, Using Custom Control.

Creating UserControl Control-Design Considerations, UserControl Events.

Console Applications, MDI Applications, Library Functions & Files

Console Applications

Console Fundamentals, Console Class, Command Line Arguments, Redirecting Input and Output, Errors in Console Applications

MDI Applications

MDI Basics, Creating MDI Forms, Child Window List, Child Forms

Library Functions String Class – Chars() Length(), CompareTo(), EndsWith0, StartsWithQ, Equals(), IndexOfQ, LastIndexOfQ, Insert(), PadLeft(), PadRight(), Remove(), Replace(), SubString(), ToLower(), ToUpperQ, Trim(), TrimEndO, TrimStart() Math Class - Abs(), Acos(), Asin(), Atan(), Ceiling(), Cos(), Exp(), Floor(), IEEERemainder(), Log(), Log100, Max(), Min(), Pow(), Round(), Signs, Sin(), Sqrt(), Tan(), Math:E, Math:Pi; Generating Random Numbers

DateTime - DateTime Structure, DateTime Constructors, Date(), Day(), DayOfWeek(), Day0fYear(), DaysInMonth(), Hour(), IsLeapYear(), Minute(), Month(), Now(), Second(), Ticks(), Time0fDay(), Today(), Year(), Compare(), Equals(), Add(), AddDaysQ, AddHoursQ, AddMinutes(), AddMonths(), AddSeconds(), AddYearsQ, Subtract(), Parse(), ToLongDateStringQ, ToLongTimeString(), ToShortDateString(), ToShortTimeString(), ToString°, TimeSpan Constructors, Calendar Class

File Management

File Fundamentals, Exceptions in File Access, File Access, File Class, FileStream Class, BinaryReader Class, Closing Streiins, BinaryWriter Class, StreamReader Class, StreamWriter Class, FileInfo Class, Working with Directories and Drives.

Database and Web Programming

ADO.NET

SqlConnection Class, OleDbConnection Class, Sq1Adapter Class, OleDbAdapter Class, DataSet Class, DateView Class, Binding Controls

ASP.NET

Designing Visual Interface, Writing Code, Controls for Web Applications, PageLoad() Event, Session Object, Application Object, Events in Web Application

Web Form Controls

Label, TextBox, Button, HyperLink, ListBox, Image, Panel, Literal, Validation. Properties, Methods and Events of Web Controls

Database Access in Web Applications

DataReader Class, Repeater Control, DataList Control, DataGrid Control

Introduction to Web Services: Creating Simple Web Services Using Windows API

Uses of API, Calling API Functions, GetDriveType(), GetDriveFreeSpace(), GetFileAttributes(), GetUserName(), GetComputerName() Practical Assignments (Questions need not be restricted to this list)

Computer Oriented Numerical Methods

Objective The objective of this paper is to familiarise the students with algorithms to solve numerical problems arising in scientific, engineering and statistical work. The

emphasis should be on algorithms and their applications rather than on their theoretical derivation.

Computer arithmetic & Solutions to Single Polynomial

Computer Arithmetic: normalised floating point representation of real numbers and operations using it; normalisation and its consequences. Errors in Arithmetic Operations: types and measurement, absolute and relative error; approximation and significant figures. Solution of a Single Polynomial or Transcendental Equation: Method of bisection, false position, Newton-Raphson method, secant method; rate of convergence of iterative methods (definition only), comparison of the methods.

Solutions of Sets of Linear Equations & Polynomial Interpolation

Solution of Sets of Linear Equations: Gauss elimination method, pivotal condensation, ill-conditioned equations and iterative refinement; Gauss-Seidel iterative method. Polynomial Interpolation : Lagrange's interpolating polynomial; difference tables and Newton's divided difference interpolating polynomial; Newton-Gregory forward and backward difference inter.. olating polynomials.

Approximation of Fn, Differentiation/Integration & Differential

Approximation of Functions using Taylor's series. Numerical Differentiation and Integration: numerical differentiation; quadrature formulae: trapezoidal rule, Simpson's one-third rule, Simpson's one-eight rule. Solution of Differential Equations: Euler's method, second and fourth order Runga-Kutta methods, predictor- corrector method for solving first order, first degree differential equations.

PAPER- II

Computer Organization and Architecture

Digital Logic, Circuits, Digital Components

Combinational Circuits (Half -Adder, Full-Adder, Binary Parallel Adder, BCD Adder, Universal Property of NAND and NOR gates, Combinational Circuits using NAND and NOR gates); Flip flops (SR, I), .11<, T, Master Slave, Edge-Triggered, Excitation Tables); Sequential Circuits (Latches, Flip-Flop Input Equations, State Table, State

Diagram, Design Example, Design Procedure) Integrated Circuits (Digital Logic Families and Integrated Circuits); Decoders (NAND Gate Decoder, Decoder Expansion, Encoders); Multiplexes (4 to I Line Multiplexer, Data Selector); Demultiplexer; Code Converter; Registers (Register with Parallel Load); Shift Registers (Bidirectional Shift Registers with Parallel Load, Serial Register); Binary Counters (Binary Counter with Parallel Load, Ripple Counter); Memory Unit (Random-Access Memory, Read-Only Memory, Types of ROMs)

Register Transfers, Microoperations, Basic Computer Organization & Design

Register Transfer; Control Function; Bus and Memory Transfers (Three-State Bus Buffers, Memory Transfer); Arithmetic Microoperations (Binary Adder, Binary Adder-Subtractor, Binary Incrementer, Arithmetic Circuit); Logic Microoperations (List of Logic Microoperations, Hardware Implementation, Some Applications (viz. Selective-Set, Selective-Complement, Selective-Clear, Mask, Insert, Clear Operations); Shift Microoperations (Hardware Implementation); Arithmetic Logic Shift Unit (Function Table for Arithmetic Logic Shift Unit)

Instruction Codes (Stored Program Organization, Indirect Address); Computer Registers; Common Bus Systems; Computer Instructions (Instruction itt Complements); Timing and Control (Clock Pulses, Hardwired Control, Microprogrammed Control, Control Unit, Timing Signals); Instruction Cycle (Fetch and Decode, Determine the Type of Instruction, Register-Reference Instructions); Memory-Reference Instructions (AND to AC, ADD to AC, LDA:

Load to AC, STA: Store AC, BUN: Branch Unconditionally, 1.3SA: Branch and Save Return Address, ISZ: Increment and Skip If Zero, Control Flowchart); Input-Output and interrupt(Input-Output Configuration, Input-Output Instructions, Program Interrupt, Interrupt Cycle); Computer Description(Flowchart for Basic Computer); Design of Basic Computer(Control of Logic Gates, Control of Registers and Memory, Control of Single Flip-Flops, Control of Common Bus); Design of Accumulator Logic(Control of AC Register, Adder and Logic Circuit)

Programming the Basic Computer, Computer Arithmetic

Introduction (Instruction Set); Machine Language (Example ofa Binary Program to Add Two Numbers); Assembly Language (Rules of the Language, An Example-To Subtract two numbers, Translation to Binary); The Assembler (Representation of Symbolic Program in Memory, First Pass, Second Pass); Program Loops (Using an example of a Fortran Program to find the Sum of 100 Integer Numbers); Programming Arithmetic and Logic Operations (Multiplication Program, Double-Precision Addition, Logic Operations, Shift Operations; Subroutines(Subroutines Parameters and Data Linkage); Input Output Programming (Character Manipulation, Program Interrupt)

Introduction (Definition of Algorithm); Addition and Subtraction (Addition and Subtraction with Signed-Magnitude Data, Hardware Implementation, Hardware Algorithm, Addition and Subtraction with Signed-2's Complement Data); Multiplication Algorithms (Hardware Implementation for Signed-Magnitude Data, Hardware Algorithm, Booth's Multiplication Algorithm, Array Multiplier); Division Algorithms (Hardware implementation for Signed-Magnitude Data, Divide Overflow, Hardware Algorithm viz. Restoring Method, Other Algorithms viz. Comparison and Non-Restoring Method); Floating-Point Arithmetic Operations (Basic Considerations, Register Configuration, Addition and Subtraction, Multiplication, Division)

Central Processing Unit, Microprogrammed Control

Introduction to Major Components of a CPU; General Register Organization (Control Word, Examples of Microoperations); Stack Organization (Register Stack, Memory Stack, Reverse Polish Notation, Evaluation of Arithmetic Expressions); Instruction Formats (Three-Address Instructions, Two-Address Instructions, Zero-Address Instructions, RISC Instructions); Addressing Modes (Numerical Example with a Tabular List that shows the values of the Effective Address and Operand loaded into AC for the Nine Addressing Modes); Data Transfer and Manipulation(Data Transfer Instructions, Data Manipulation Instructions, Arithmetic Instructions, Logical and Bit Manipulation Instructions, Shift Instructions); Program Control(Status Bit Conditions, Conditional Branch Instructions, Subroutine Call and Return, Program Interrupt, Types of

Interrupts); Reduced Instruction Set Computer(CISC Characteristics, RISC Characteristics, Overlapped Register Windows, Berkeley RISC 1)

Control Memory (Control Word, Microinstruction, Microprogram, Control Memory, Control Address Register, Sequencer, Pipeline Register, Hardwired Control); Address Sequencing (Conditional Branching, Mapping of Instruction, Subroutines); Microprogram Example (Computer Configuration, Microinstruction Format, Symbolic Microinstructions, The Fetch Routine, Symbolic Microprogram, Binary Microprogram); Design of Control Unit (Microprogram Sequencer)

Multiprocessors, Pipeline and Vector Processing

Characteristics of Multiprocessors (MIMD, Microprocessor, VLSI, Tightly Coupled, Loosely Coupled); Flynn 's Classification; Interconnection Structures (Time-Shared Common Bus, Multiport Memory, Crossbar Switch, Mifltistage Switching Network, Hypercube Interconnection); Interprocessor Arbitration (System Bus, Serial Arbitration Procedure, Parallel Arbitration Logic, Dynamic Arbitration Algorithms); Interprocessor Communication, Synchronization and Mutual Exclusion with a Semaphore; Cache Coherence (Conditions for Incoherence, Solution to the Cache Coherence Problem)

Parallel Processing (Throughput, Multiple Functional Units, SIMD, MIMD); Pipelining (Example of Addition and Multiplication of a stream of numbers, General Considerations -viz. Task, SpaceTime Diagram, Speedup); Arithmetic Pipeline (Example of Floating-Point Addition and Subtraction); Instruction Pipeline (Example- Four Segment Instruction Pipeline, Data Dependency, Handling of Branch Instructions); RISC Pipeline (Example- Three Segment Instruction Pipeline, Delayed Load, Delayed Branch); Vector Processing(Vector Operations, Matrix Multiplication, Memory Interleaving and Supercomputers); Array Processors(Attached Array Processor, SIMD Array Processor)

Input-Output Organization and Memory Organization: Peripheral Devices; ASCII Alphanumeric Characters; Byte; Input Output Interface (I/O Bus and Interface Modules, I/O versus Memory Bus, Isolated versus Memory-Mapped I/0, Example of I/O Interface-I/O port); Asynchronous Data Transfer (Strobe Control, Handshaking, Asynchronous Serial Transfer, Asynchronous Communication Interface, First-In, First-Out Buffer);

Modes of Transfer (Example of Programmed I/O, Interrupt-Initiated I/O, Software Considerations); Priority Interrupt (Daisy-Chain Priority, Parallel Priority Interrupt, Priority Encoder, Interrupt Cycle, Software,Routines, Initial and Final Operations); Direct Memory Access (DMA Controller, DMA Transfer); Input-Output Processor(CPU-IOP Communication, IBM 370 I/O Channel, Intel 8089 IOP); Serial Communication (Character-Oriented Protocol, Transmission Example -viz. Typical Transmission from Terminal to Processor and Transmission from Processor to Terminal, Data Transparency, Bit-Oriented Protocol)

Memory Hierarchy (Auxiliary and Cache Memory, Multiprogramming); Main Memory (RAM and ROM Chips, Memory Address Map, Memory Connection to CPU); Auxiliary Memory (Magnetic Disks, Magnetic Tape); Associative Memory (Hardware Organization, Match Logic, Read Operation, Write Operation); Cache Memory (Associative Mapping, Direct Mapping, Set-Associative Mapping, Writing into Cache, Cache Initialization); Virtual Memory (Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table, Page Replacement); Memory Management(Segmented-Page Mapping, Numerical Example-Logical and Physical Address, Logical and Physical Address Memory Assignment, Logical to Physical Memory Mapping, Memory Protection)

Software Engineering

Introduction to Software Engineering

Preview to Software Engineering: - The Role of Software Engineering in System Design, The Role of the Software Engineer, The Software Life Cycle, The Relationship of Software Engineering to Other Areas of Computer Science (Programming Languages, Operating Systems, Databases, Artificial Intelligence, Theoretical Models)

Software: Its Nature and Qualities: - Classification of Softw,are Qualities (External Versus Internal qualities, Product and Process Qualities), Representative Qualities (Correctness, Reliability and Robustness, Performance, Usability. Verifiability, Maintainability, Reusability, Portability, Understandability, Interoperability, Productivity, Timeliness, Visibility), Quality Requirements in Different Application Areas (Information

Systems, Real-Time Systems, Distributive Systems, Embedded Systems), Measurement of Quality

Software Engineering Principles: - Rigor and Formality, Separation of Concerns, Modularity, Abstraction, Anticipation of Change, Generality, Incrementality, Case Study (Application of Software Engineering Principles to Compiler Construction)

Design and Specification

Design and Software Architecture: - The Software Design Activity and its Objective (Design for Change, Product Families), Modularization Techniques (The Module Structure and its Representation, Interface Implementation and Information Hiding, Design Notations, Categories of Modules, Some specific techniques for Design for Change, Stepwise Refinement, Top Down Versus Bottom Up Design), Handling Anomalies, Object Oriented Design (Generalization and Specialization, Associations, Aggregation), Architecture and Components (Standard Architectures)

Specification: - The Uses of Specifications, Specification Qualities, Classification of Specification Styles, Verification of Specification, Operational Specifications (Data Flow Diagrams, UML Diagrams for Specifying Behaviors), Descriptive Specifications (Entity Relationship Diagrams, Logic Specifications), Decision Tables, Decision Trees, Data Dictionary.

Verification and Testing

Goals and Requirements of Verification, Testing, Goals for Testing, White - Box testing, Black - Box testing, Testing and modularity, Bottom -up and Top-down integration, testing object oriented' programs, system testing, Separate Concerns in The Testing Activity (overload testing, testing for robustness, regression testing, testing concurrent and real time system), Analysis (Informal Analysis Techniques), Debugging.

Software Production, Tools and Management of ,Softtware Engineering

The Software Production Process - Software Process Model, Importance of Software Process Models, The Main Activities of Software Production (Feasibility Study, Eliciting, Understanding and Specifying Requirements, Definition of the Software Architecture and Detailed Design, Coding And Module Testing, Integration and System Testing,

Delivery, Deployment and Maintenance, Other Activities), An Overview of Software Process Models (Waterfall Models, Evolutionary Models), Organizing The Process (Structured Analysis/Structured Design, The Unified Software Development Process)

Management of Software Engineering: - Management Functions, Project Planning (Software Productivity, People and Productivity, Cost estimation (Predictive Models of Software cost, COCOMO, COCOMO II)), Project Control (Work breakdown Structures, Gantt Charts, PERT Charts, Dealing with Deviations from the Plan), Organization (Centralized-Control Team Organization, Decentralized-Control Team organization, Mixed-Control Team Organizations), Risk Management (Typical Management Risks in Software Engineering)

Software Engineering Tools and Environments: - Historical Evolution of Tools and Environments, representative Tools (Editors, Linkers, Interpreters, Code Generators, Debuggers, Tools Used in Software Testing, Graphical User Interface Tools)

Database Management System

Introduction and Conceptual Data modeling

Introduction: Introduction to databases, characteristics of the database approach, database users and designers, role of a DBA, advantages of using a DBMS, dat? models, schemas, instances, DI3MS architecture (Three-Schema Architecture), Database systems- Network, Hierarchical, Relational, Data Independence Conceptual Data Modeling: Phals of database design, entity type, entity set, attributes, keys, value sets, relationships, relationship types, relationship sets, relationship instances, relationship degree, role names, recursive relationships, constraints on relationship types, attributes of relationship types, weak entity types, ER Diagram, naming conventions and design issues, EER concepts-specialization, generalization, aggregation, Case study

Relational Data Model and Structured Query Language

Relational model concepts: Domain, attribute, tuple, relation, characteristics of relations, relational databases, relational database schemas, relational constraints (Domain

constraint, constraints on null), entity integrity, referential integrity, foreign keys. ER to Relational mapping algorithm, Case study.

Relational Algebra: basic relational algebra operations-SELECT, PROJECT, UNION, INTERSECTION, SET DIFFERENCE, Cartesian PRODUCT, JOIN, Aggregate functions

Relational Calculus: Tuple Relational Calculus, Domain Relational Calculus

SQL: Characteristics of SQL, Data types in SQL, Types of SQL commands

Data Definition Commands: CREATE SCHEMA, CREATE TABLE, DROP TABLE, ALTER TABLE

Single table query commands: SELECT, SELECT with WHERE, SELECT with ORDER BY, SELECT with GROUP BY, SELECT with GROUP BY and HAVING, SQL built-in functions - SUM, MIN, MAX, COUNT, AVG

Multi-table query commands: Retrieval using sub-query, JOIN,' EXIST and NOT EXIST

Special operators: IS NULL, IS NOT NULL, BETWEEN..AND, IN, LIKE, ANY, ALL *Data changing commands*: INSERT, DELETE, UPDATE

Functional Dependencies and Normalization

Functional Dependencies, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Multivalued Dependencies, Join Dependencies, Fourth Normal Form, Fifth Normal Form, Denormalization

File Organization

Introduction to storage hierarchies, hardware descriptions of disk devices, Magnetic Tape Storage Devices, RAID technology, Organization of file records on disk (record and record types, Fixed-length records, variable-length records, record blocking, spanned and unspanned records, allocating file blocks on disk, file headers), Operations on Files (Open, Reset, Find, Read, Delete, Modify, Insert, Close), primary methods of file organization -Heap Files, Sorted Files, Hashed Files.Types of Single-level Ordered Indexes (Primary Indexes, Clustering Indexes, Secondary Indexes), Multilevel Indexes: Basic technique, Multilevel indexing using B tree. and B+ tree, Indexing on multiple keys

Query Processing, Transaction Processing, Concurrency Control and Security

Query Processing: Overview of query processing, translation of SQL queries into relational algebra Transaction Processing: Transaction, ACID properties of transaction, transaction states, schedules, serializability, tests for serializability, recoverability, transaction definition in SQL.

Concurrency Control: Concurrent execution of transaction, Lock-, based techniques for concurrency control-Two-Phase locking protocol and its variations, Graph-based protocol, Time stamppased protocol, Deadlock, Deadlock prevention methods, Deadlock detection Deadlock recovery Security: Risks to data security, role of the DBA in maintaining database security access protection, encryption, database audits

Advanced Database Concepts and Emerging Applications

Introduction to Object-Oriented Databases, Distributed databases, Client-Server Architecture, Data Mining, Data Warehousing, Deductive databases, Databases on the World Wide Web, Multimedia Databases, Geographical Information Systems

Data Communication and Networks

Introduction To Computer Networks and Physical Layer

Introduction to Computer Networks

Uses of Computer Networks; Wired and wireless Networks; Types of networks - LAN, MAN, WAN; Network Topology; OSI Reference Model - Outline, Protocol hierarchies,. Design considerations; TCP-IP Reference Model; Comparison between the two reference models; ATM Reference Model; Examples-Internet, X.25, Frame Relay, ATM, Ethernet, Wireless LANs, ISDN

Physical Layer

Fourier Analysis (Qualitative), Maximum data rate of a Channel, Bit rate and Baud; Baseband and Broadband; Guided Transmission Media- Magnetic, Twisted pair, Coaxial cable, Fibre Optics; Wireless transmission - Electromagnetic Spectrum, Radio transmission, Microwave Transmission, Infrared transmission; Communication Satellite, Frequency Division and Time Division Multiplexing; Circuit, Message and Packet

Switching; Hybrid Switching; Outline of PSTN, Mobile Telephone System, Cable Television; Transmission in ATM Networks, ATM Switches.

Data Link Layer

Design Issues - Services provided to the higher layer, Framing, Error Control, Flow Control; Error Detection and Correction -Error Correcting Codes, Error-Detecting Codes; Elementary Data Link Protocols - Unrestricted simplex protocol, Simplex stop-and-wait protocol, Protocol for Noisy Channel; Sliding Window protocols - One bit sliding window, Go Back n protocol, Protocol using Selective Repeat; Examples - HDLC, Data Link Layer in the Internet, PPP

Medium Access Control Sub layer

Channel Allocation Problem - Static and Dynamic channel allocation; Multiple access - Aloha, Slotted Aloha, CSMA; Collision free protocols; Wireless LAN protocols - MACA, MACAW; IEEE Standard 802.3 Ethernet, Cabling, Encoding, MAC Sublayer, Switched Ethernet, Fast Ethernet Gigabit Ethernet; IEEE, Standard 802.4 - Physical Layer, MAC Protocol, MAC Sublayer; IEEE Standard 802.5 - Physical layer, MAC Protocol, MAC Sublayer; FDDI - Physical Layer, MAC Sublayer, MAC Frame; IEEE Standard 802.11 - Protocol Stack, Physical Layer, MAC Sublayer, Frame Structure; IEEE Standard 802.16 - Protocol Stack, Physical Layer, MAC Sublayer, Frame Structure; Bluetooth-Architecture, Application, Protocol Stack, Radio Layer, Baseband layer, Frame Structure; Bridges -Spanning tree bridges, Remote bridges

Network Layer

Design Issues - Store and forward packet switching, Services provided to higher layer, Connection Oriented and Connectionless services, Virtual Circuits and Datagram subnets; Routing Algorithms - Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Adhoc networks; Congestion Control Algorithms - General Principles, Load shedding, Jitter control, QoS, Leaky Bucket Algorithm, Token Bucket Algorithm, RSVP; Internetworking -Tunneling, Fragmentation;

Internet Protocol - IP addresses, Subnets, CIDR, Network address translation,; Internet Control Protocol - ARP, RARP, BOOTP, DHCP; Mobile IP - Routing

Transport Layer

Design Issues, Services presented to higher layers; Transport protocols - Addressing, Connection Establishment and Release, Flow Control and Buffering, Multiplexing, Crash Recovery, Simple Transport Protocol Internet Transport Protocols: UDP - Remote Procedure Call, Real-time transport Protocol; TCP - Service Model, Protocol, Header, Connection Establishment and Release, Connection Management, „Transmission Policy, Congestion Control; Wireless TCP and UDP; Performance Issues re

Application Layer, World Wide Web and Network Security

Application Layer Domain Name System - name space, resource records, name servers; Electronic Mail- architecture and services, user agent, Message formats - MIME,,Message Transfer SMTP, Message Delivery - POP3 and IMAP, Webmail, Telnet, Ftp

World Wide Web

Architectural Overview, Client Side, Server Side, Uniform Resource Locators, Statelessness and Cookies; HyperText Transfer Protocol; Wireless Web - Wireless Application Protocol, I-Mode.

Network Security - Cryptography, Substitution Ciphers, Transposition Ciphers, One time pads, Quantum Cryptography, Cryptographic principles; Symmetric Key Algorithms - Data Encryption Standard, Advanced Encryption Standard, Cipher Modes; Public Key Algorithms -RSA; Digital Signatures - Symmetric Key, Public Key, Message Digest, Birthday Attack; Communication Security - IPSec, Firewalls, Virtual Private Networks; Wireless Security - 802.11 Security, Bluetooth Security, WAP Security; Authentication Protocols - Based on shared secret,key, Deffie-Hellman Key Exchange, Key Distribution Center, Kerberos, Public Key.

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Syllabus

Electrical Engineering

Paper-I

Electrical Circuits – Theory and Applications

Circuit components; network graphs; KCL, KVL; circuit analysis methods : nodal analysis, mesh analysis; basic network theorems and applications; transient analysis : RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits and applications; coupled circuits and applications; balanced 3-phase circuits. Two-port networks, driving point and transfer functions; poles and zeros of network functions. Elements of networks synthesis. Filter-theory : design and applications. Active filters. Circuit simulation : Input formats; methods of education formulation; solution of equations; output formats; SPICE.

Signals & Systems

Representation of continuous-time and discrete-time signals & systems; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform. Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals DFT, FFT Processing of analog signals through discrete-time systems.

E.M. Theory

Maxwell's equations, wave propagation in bounded media. Boundary conditions, reflection and refraction of plane waves. Transmission line : Distributed parameter circuits, travelling and standing waves, impedance matching, Smith chart. Waveguides : parallel plane guide, TE, TM and TEM waves, rectangular and cylindrical wave guides, resonators. Planar transmission lines: stripline, microstripline.

Analog Electronics

Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET. Diode circuits : clipping, clamping, rectifier. Biasing and bias stability. FET amplifiers. Current mirror; Amplifiers : single and multi-stage, differential, operational, feedback and power. Analysis of amplifiers; frequency response of amplifiers. OPAMP

circuits. Filters; sinusoidal oscillators : criterion for oscillation; single transistor and OPAMP configurations. Function generators and wave-shaping circuits. Power supplies.

Digital Electronics.

Boolean algebra; minimisation of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits : arithmetic circuits, code converters, multiplexers and decoders.Sequential circuits : latches and flip-flops, counters and shift-registers. Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories. Logic implementation using programmable devices (ROM, PLA, FPGA).

Energy Conversion

Principles of electromechanical energy conversion : Torque and emf in rotating machines. DC machines : characteristics and performance analysis; starting and speed control of motors.

Transformers : principles of operation and analysis; regulation, efficiency; 3-phase transformers. 3-phase induction machines and synchronous machines : characteristics and performance analysis; speed control. Special machines : Stepper motors, brushless dc motors, permanent magnet motors single-phase motors; FHP.

Power Electronics and Electric Drives :

Semiconductor power devices : diode, transistor, thyristor, triac, GTO and MOSFET-static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters : fully-controlled and half-controlled; principles of thyristor choppers and inverters; basic concepts of speed control of dc and ac motor drives applications of variable-speed drives.

Analog Communication

Random variables : continuous, discrete; probability, probability functions. Statistical averages;

probability models; Random signals and noise : white noise, noise equivalent bandwidth; signal

transmission with noise; signal to noise ratio. Linear CW modulation : Amplitude modulation : DSB, DSBSC and SSB. Modulators and Demodulators; Phase and Frequency modulation : PM & FM signals; narrowband FM; generation and detection of FM and PM, Deemphasis, Preemphasis. CW modulation system : Superhetrodyne receivers, AM receivers, communication receivers, FM receivers, phase locked loop, SSB receiver Signal to noise ratio calculation for AM and FM receivers.

Microwaves and Antenna

Electromagnetic radiation, Propagation of waves : ground waves, sky wave, space wave, tropospheric scatter propagation. Extraterrestrial communications. Antenna : Various types, gain, resistance, bandwidth, bcamwidth and polarization, effect of ground. Antenna coupling; high frequency antennas; microwave antennas; special purpose antennas. Microwave Services : Klystron, magnetron, TWT, gun diodes, Impatt, Bipolar and FETSs, Microwave integrated circuits. Microwave measurements.

Paper-II

Control Systems

Elements of control systems; block-diagram representation; open-loop & closed-loop systems; principles and applications of feed-back. LTI systems : time-domain and transform-domain analysis. Stability : Routh Hurwitz criterion, root-loci, Nyquist's criterion, Bode-plots , Design of lead-lad compensators. Proportional, PI, PID controllers. State-variable representation and analysis of control systems. Principles of discrete-control systems.

Electrical Engineering Materials

Electrical/electronic behaviour of materials : conductivity: free-electrons and band-theory; intrinsic and extrinsic semiconductor, p-n junction; solar cells, super-conductivity. Dielectric behaviour of materials; polarization phenomena; piezo-electric phenomena. Magnetic materials : behaviour and application. Photonic materials : refractive index, absorption and emission of light, optical fibres, lasers and optoelectronic materials.

Microprocessors and microcomputers.

8-bit microprocessor : architecture, CPU, module design, memory interfacing, I/O, Peripheral controllers, Multiprocessing, IBM PC architecture : overview, introduction to DOS, Advanced microprocessors.

Measurement and Instrumentation

Error analysis; measurement of current voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurement. Electronic measuring instruments : multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyser, distortion-meter. Transducers : thermocouple, thermistor, LVDT, strain-gauge, piezo-electric crystal. Use of transducers in measurements of non-electrical quantities. Data-acquisition systems.

IC Technology

Overview of IC Technology. Unit-steps used in IC fabrication : wafer cleaning, photo-lithography, wet and dry etching, oxidation, diffusion, ion-implantation, CVD and LPCVD techniques for deposition of polysilicon, silicon, silicon-nitride and silicon di-oxide; metallisation and passivation.

Power Systems : Analysis and Control

Steady-state performance of overhead transmission lines and cables; principles of active and reactive power transfer and distribution; per-unit quantities; bus admittance and impedance matrices; load flow;

voltage control and power factor correction; economic operation; symmetrical components, analysis of symmetrical and unsymmetrical faults. Concept of system stability : swing curves and equal area criterion. Static VAR system. Basic concepts of HVDC transmission; FACTS. Computer control and Automation :

Introduction to energy control centres; various states of a power system; SCADA systems and RTUs. Active power control : Speed control of generators, tie-line control, frequency control. Economic dispatch.

Power system protection

Principle of overcurrent, differential and distance protection. Concept of solid state relays. Circuit brakers. Computer aided protection : Introduction; line bus, generator, transformer protection; numeric relays and application of DSP to protection.

Non-conventional Energy Sources and Energy Management.

Introduction to the energy problem; difficulties with conventional energy sources. Wind-Energy : Basics of Wind turbine aerodynamics; wind-energy conversion systems and their integration into electrical grid. Solar-Energy : Thermal conversion : photo-voltaic conversion. Wave-energy. Importance of Energy Management : Energy audit; energy economics : discount rate, payback period, internal rate ofreturn, life cycle costing.

Digital Communication

Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM), Digital modulation and demodulation schemes : amplitude, phase and frequency keying schemes (ASK, PSK,

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Syllabus

Horticulture

Paper-I

Section - A

1) Basic Horticulture:

1) Horticulture : Defination, branches, importance and scope. Nutritive values of fruits and vegetables.

2) Classification of horticultural crops.

3) Climatic parameters affecting the growth and development of horticultural crops. Horticultural zones of Maharashtra and India.

4) Site selection for establishment of orchards.

5) Soil considerations. Formation of soil. Classification of soils on the basis of texture. Physical and chemical properties of soil in relation to horticultural crops.

6) Systems of planting and layout of orchard.

7) Nutrition, manuring and foliar feeding of plant nutrients. Symptoms of nutrient deficiencies and excesses.

8) Water management of horticultural crops. Determination of water requirement of horticultural crops.

9) Weed management by mechanical, cultural, biological, chemical methods. Use of herbicides in the control of seasonal and perennial weeds.

10) Orchard soil management practices. Inter cropping, sod culture, clean culture, cover cropping and green manuring.

11) Control of important diseases and pests of horticultural crops. Integrated pest management in horticultural crops and its importance. Formulations of fungicides and pesticides solutions.

12) Training and pruning of fruit trees, their principles, objectives and methods.

13) Flower bud formation, fruit bud differentiation, fruit set, fruit development and fruit drop, causes and control measures for fruit drops.

14) Unfruitfulness factors responsible and measures to overcome the same.

15) Parthenocarpy and seedless ness in fruits.

16) Special horticultural practices like pinching, girdling, notching, ringing, bending, smudging, bahar treatment.

17) Classes of growth regulators and uses of plant growth regulators in Horticulture.

18) Mendal's work and its impact on plant breeding. Mendal's laws of inheritance. Methods of breeding of horticultural crops. Achievements of breeding.

19) Photoperiodism, photosynthesis, C3 and C4 plants. Mechanism of uptake of nutrients by plants. Short day, long day and day neutral plants.

20) Farming system - definition, objectives, types - mono, multiple, mixed (apiculture, sericulture, dairy, sheep and goat, poultry, fish culture)

21) Use of Windbreaks and Shelter Belts.

22) Organic farming concept.

Section - B

2) Plant Propagation and Nursery Management :

1) Plant propagation: definition, basic concepts, sexual and asexual propagation, their advantages and disadvantages.

2) Viability and vitality of seed. Types of dormancy and measures to overcome the same.

3) Apomixis, Polyembryony and use of Polyembryonic root stocks.

4) Methods of asexual propagation-cuttage, layering, budding and grafting Rootstocks. Factors affecting rooting in cutting and layering. Factors affecting union of grafts

5) Stock-Scion relationship. Graft incompability and its causes and remedies to overcome the same.

6) Establishment of commercial nurseries. Nursery Act.

7) Propagation by specialised structures like suckers, rhizomes, corm, bulb, runner, stolon.

8) Mist propagation, micropropagation, Role of Biotechnology. Tissue culture.

9) Rejuvenation of fruit crops.

10) Use of growth regulators in plant propagation.

11) Propagation media and containers.

Section - C

3) Fruit Production:

1) Importance, scope and present status of fruit production in Maharashtra and India.

2) Fruit Crops: Present status, area and production, geographical distribution, important varieties, propagation methods, soil and climatic requirements. Use of wind breaks and shelter

belts, Layout & planting, manuring, irrigation, training and pruning, intercropping, weed control. Harvesting, grading, packaging, marketing and storage of mango, banana, citrus, guava, pineapple, grape, papaya, sapota, fig, pomegranate, aonla tamarind, ber, litchi, kokum, jackfruit, karonda, apple, pear, peach, cherries, almond, walnut, plum, apricot.

3) Control of important pests and diseases of above fruit crops.

4) Methods of breeding in fruit crops & significant achievements made through various breeding methods.

5) Flowering and fruiting : problems and measures to overcome the same.

6) Role of plant growth regulators in maximization of fruit production.

7) Special problems in fruit culture like alternate bearing, malformation, spongy tissue, black tip of mango, bitter pit in apple, granulation in citrus, bronzing in guava, shot berries, water berries and mummification in grape, fruit cracking in fig, pomegranate, etc.

8) High density planting in fruit crops.

9) Suitability of fruit crops for soil salinity and alkalinity.

Section - D

4) Vegetable Production :

1) Definition of Olericulture. Importance of vegetables from nutritional and economic security. Present status of vegetables in India and Maharashtra. Export of vegetables.

2) Classification of vegetable crops. Types of vegetable farming. Kitchen and nutrition garden.

3) Climatic factors affecting vegetable and tuber crops production.

4) Climate, soil, improved varieties, nursery raising, planting, manuring, irrigation, weed control, intercultural operations, use of growth regulators, special intercultural practices in vegetables and tuber crops production like tomato, brinjal, chillies, bell pepper, okra, cucurbits, cluster bean, sweet potato, cole crops, root crops, garden peas, fenugreek, lettuce, beet-root, potato, tapioca, colocasia, yam and perennial vegetable crops.

5) Harvesting, yield, grading, packing, storage and marketing of vegetable and tuber crops.

6) INM (Integrated Nutrient Management) and use of starter solutions in vegetable production.

7) Rotation, inter, relay, mixed and companion cropping in vegetable cropping system.

8) Importance of mushrooms in nutritional and economic security, types of mushrooms, culture of mushrooms. Materials and equipments required for mushroom cultivation. Problems

in mushroom cultivation.

9) Standards for export of vegetable crops, organic vegetables production and certification agencies.

10) Poly house cultivation of bell pepper, cucumber and tomato.

Paper - II

Section - A

1) Ornamental Horticulture, Aromatic and medicinal crops :

1) Importance and scope of ornamental gardening and floriculture.

2) Principles of garden designing, types of garden, garden features and adornments.

3) Types of lawn grasses, annual flowers, shrubs, trees, climbers and creepers, herbaceous plants, palms and their use in gardening.

4) Lawn making, rockery, flower arrangement, bonsai, ikebana, topiary work.

5) Open cultivation of rose, chrysanthemum, gladiolus, jasmine, tuberose, aster, marigold, gaillardia, crossandra, daisy. Use of growth regulators and special horticultural practices in cultivation of flower crops.

6) Protected cultivation and its scope and problems in India.

7) Types of greenhouses.

8) Greenhouse ventilation, cooling system, green house heating system, CO_2 enrichment, light control.

9) Irrigation, nutrient management and fertigation system in greenhouses.

10) Protected cultivation of rose, gerbera, carnation anthurium, orchid, chrysanthemum.

11) Harvesting, grading, precooling, storage and transport and export of cut flowers.

12) Use of computers in green house production of cut flowers.

13) Cultivation of lemon grass, shatavari, mehandi, rose, geranium, mentha, eucalyptus, kewada, davana, vetivera, citronella, sandalwood, jasmines, opium, vinca, Solanum khasianum, isabgol, cinchona, belladonna, rauvolfia, dioscorea, ashwagandha and patchouli on following aspects - importance, scope, species, varieties, propagation and cultural practices, nutrition and water requirements, harvesting, yield, processing and marketing.

14) Chemical constituents of important medicinal and aromatic crops.

15) Therapeutic and pharmaceutical uses of important species of medicinal and aromatic crops.

16) Methods of extraction of essential oils from aromatic crops.

Section – B

2) Post harvest technology of Horticultural Produce :

1) Maturity indices and harvesting of fruits and vegetables.

2) Ripening of fruit and changes associated with fruit ripening, methods of hastening and delaying the ripening.

3) Post harvest losses, their causes and prevention.

4) Precooling, grading, packing, storage and transport, storage structures, types of storage. Controlled atmosphere storage, modified storage, freezing preservation.

5) Importance and scope of fruit and vegetables preservation.

6) Principles and methods of fruit and vegetable preservation.

7) Preparation and preservation of fruit juices, squash, syrup, cordial, jam, jelly marmalade, fruit preserve, candy, pickle and ketchup.

8) Canning of fruits, fruit juices and vegetables.

9) Causes of spoilage of fruits and preserved products.

10) Dehydration and drying of fruits and vegetables.

11) Waste and by- product utilization of major fruits and vegetables.

12) Scope and development of processing as cottage industries in rural areas.

13) Food Products Order (F.P.O.) regulations.

Section – C

3) Agricultural Business Management and Agricultural Extension :

1) Importance of Horticulture in national economy.

2) Concept of national income.

3) Horticulture development strategies. Role of Horticulture in five year plan.

4) Horticultural marketing, marketing channels and price spread, market functions, functionaries, market cost, margining. Role of STC, NAFED, APEDA, National Horticulture Board, Maharashtra Agricultural Produce and Marketing Board in financing and marketing of horticultural produce.

5) Present status and future scope for export of horticultural produce. Role of ATMA, APEDA, Spice Board, Coffee Board and other agencies in Horticulture development.

6) Horticultural Finance : Definition of credit, type of credits, role of village agricultural co-operative societies, District Central Co-operative Banks, Apex Banks, NABARD, Rural Banks, Commercial Banks

in Development of Horticulture. Role of Horticultural Development Scheme under EGS and its impact on economy of farmers and the State.

7) Extension agencies - Agencies responsible for dissemination of Horticultural technology.

8) Role of rural social institutions in Horticultural Development Programme, Transfer of Technology programme. Impact of GATT and WTO in horticultural sector, Export and import potential for horticultural sector. Role of information technology in Horticulture development.

Section - D

4) Plantation Crops, Spices and Condiments :

1) Definition- Importance, present status and future scope of plantation/ spices and condiment crops in India and Maharashtra.

2) Problems in growing of plantation crops and spices.

3) Complete cultivation aspect of various plantation crops and spices on the points -Soil and climatic requirements, varieties, propagation, planting, after cares including shade regulation, training and pruning, pest and disease control, harvesting, processing and yield of

(i) Plantation crops: coconut, arecanut, tea, coffee, cocoa, cashewnut, oil palm and rubber.

(ii) Spices and Condiments: black pepper, clove, cinnamon, ginger, curry leaf, turmeric, betelvine, cardamom, chilli, nutmeg, vanilla, cumin and coriander.

5) Forestry and Agroforestry:

1) Importance of forests, causes and effects of deforestation. Afforestation. Branches of forestry.

2) Agroforestry- definition, scope, benefits and limitations. Interactions of trees with crops.

3) Agroforestry Systems- Agri-siliviculture, Silvi-pasture, Horti-pasture, Horti- silvi pasture.

4) Horti-Silvi pastoral system- Introduction, land use planning with special reference to Indian Agriculture and Forestry, Trees with plantation crops, Trees with fodder grasses and legumes.

5) Compatibility of grazing-free V/S controlled grazing combination based on systems of grazing.

6) Regeneration methods of forest tree species.

7) Site preparation, management of Horti-pastoral systems and its economics.

MPSC- Forest Ranger
Syllabus
Agriculture

Paper - I

- Ecology and its relevance to man, natural resources, their sustainable management and conservation.
- Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth, impact of changing environment on cropping pattern as indicators of environments.
- Environmental pollution and associated hazards to crops, animals, and humans.

Cropping Pattern Topics:

- Cropping pattern in different agro-climatic zones of the country.
- Impact of high-yielding and short-duration varieties on shifts in cropping pattern.
- Concepts of multiple cropping, multistorey, relay and inter-cropping, and their importance in relation to food production.
- Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops grown during Kharif and Rabi seasons in different regions of the country.

Propagation of Plants:

- Important features, scope and propagation of various types of forestry plantations such as extension, social forestry, agro-forestry, and natural forests.
- Weeds, their characteristics, dissemination and association with various crops; their multiplication; cultural, biological and chemical control of weeds.
- Soil-physical, chemical and biological properties. Processes and factors of soil formation.
- Modern classification of Indian soils, Mineral and organic constituents of soils and their role in maintaining soil productivity.
- Essential plant nutrients and other beneficial elements in soils and plants. Principles of soil fertility and its evaluation for judicious fertiliser use, integrated nutrient management.
- Losses of nitrogen in soil, nitrogen-use efficiency in submerged rice soils, nitrogen fixation in soils.
- Fixation of phosphorus and potassium in soils and the scope for their efficient use. Problem soils and their reclamation methods.

Soil conservation:

- Soil conservation planning on watershed basis. Erosion and run-off management in hilly, foot hills, and valley lands; processes and factors affecting them.
- Dryland agriculture and its problems.
- Technology of stabilising agriculture production in rainfed agriculture area.

Water-use:

- Water-use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water.
- Drip and sprinkler irrigation.

- Drainage of water-logged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.

Farm Planning & Management:

- Farm management, scope, important and characteristics, farm planning.
- Optimum resources use and budgeting.
- Economics of different types of farming systems.
- Marketing and pricing of agricultural inputs and outputs, price fluctuations and their cost; role of co-operatives in agricultural economy; types and systems of farming and factors affecting them.
- Agricultural extension, its importance and role, methods of evaluation of extension programmes, socio-economic survey and status of big, small, and marginal farmers and landless agricultural labourers; farm mechanization and its role in agricultural productioin and rural employment.
- Training programmes for extension workers; lab-to-land programmes.

Paper – II

- Cell Theory, cell structure, cell organelles and their function, cell division, nucleic acids-structure and function, gene structure and function.
- Laws of heredity, their significance in plant breeding. Chromosome structure, chromosomal aberrations, linkage and cross-over, and their significance in recombination breeding.
- Polyploidy, euploid and an euploids.
- Mutation-micro and macro-and their role in crop improvement.
- Variation, components of variation.
- Heritability, sterility and incompatibility, classification and their application in crop improvement.
- Cytoplasmic inheritance, sex-linked, sex-influenced and sex-limited characters.

History of Plant Breeding:

- History of plant breeding.
- Modes of reproduction, selfing and crossing techniques.
- Origin and evolution of crop plants, centre of origin, law of homologous series, crop genetic resources-conservation and utilization.
- Application of principles of plant breeding to the improvement of major field crops.
- Pure-line selection, pedigree, mass and recurrent selections, combining ability, its significance in plant breeding.
- Hybrid vigour and its exploitation, backcross method of breeding, breeding for disease and pest resistance, role of interspecific and intergeneric hybridization.
- Role of biotechnology in plant breeding.
- Improved varieties, hybrids, composites of various crop plants.
- Seed technology, its importance. Different kinds of seeds and their seed production and processing techniques.
- Role of public and private sectors in seed production, processing and marketing in India.

Physiology:

- Physiology and its significance in agriculture.
- Imbibition, surface tension, diffusion and osmosis.
- Absorption and translocation of water, transpiration and water economy.
- Enzymes and plant pigments; photosynthesis-modern concepts and factors affecting the process, aerobic and nonaerobic respiration; C, C and CAM mechanisms.

- Carbohydrate, protein and fat metabolism.

Growth & Development:

- Growth and development; photoperiodism and vernalization.
- Auxins, hormones, and other plant regulators and their mechanism of action and importance in agriculture.
- Physiology of seed development and germination; dormancy
- Climatic requirements and cultivation of major fruits, plants, vegetable crops and flower plants; the package of practices and their scientific basis.
- Handling and marketing problems of fruit and vegetables.
- Principal methods of preservation of important fruits and vegetable products, processing techniques and equipment.
- Role of fruits and vegetables in human nutriton.
- Raising of ornamental plants, and design and layout of lawns and gardens.

Diseases of plant pests & diseases:

- Diseases and pests of field vegetables, orchard and plantation crops of India.
- Causes and classification of plant pests and diseases.
- Principles of control of plant pests and diseases Biological control of pests and diseases.
- Integrated pest and disease management.
- Epidemiology and forecasting.

Pesticides:

- Pesticides, their formulations and modes of action.
- Compatibility with rhizobial inoculants.
- Microbial toxins.

Storage pests and diseases of cereals and pulses, and their control.

Food Production:

- Food production and consumption trends in India.
- National and international food policies.
- Production, procurement, distribution and processing constraints.
- Relation of food production to national dietary pattern, major deficiencies of calorie and protein.

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Syllabus

Veterinary Science

Paper – I

1. **Animal Nutrition:**

- Energy sources, energy, metabolism and requirements for maintenance and production of milk, meat, eggs and wool. Evaluation of feeds as sources of energy.

1.1 Trends in protein nutriton:

- sources of protein metabolism and synthesis, protein quantity and quality in relation to requirements. Energy protein ratios in ration.

1.2. Minerals in animal diet :

- Sources, functions, requirements and their relationship of the basic minerals nutrients including trace elements.

1.3. Vitamins, Hormones and Growth Stimulating, substances :

- Sources, functions, requirements and inter-relationship with minerlas.

1.4. Advances in Ruminant Nutrition-Dairy Cattle:

- Nutrients and their metabolism with reference to milk production and its composition.
- Nutrient requirements for calves, heifers, dry and milking cows and buffaloes.
- Limitations of various feeding systems.

1.5 Advances in Non-Rumiant Nutrition-Poultry-Nutrients and their metabolism with reference to poultry, meat and egg production, Nutrients requirements and feed formulation and broilers at different ages.

1.6 Advances in Non-Ruminant Nutrition-Swine-Nutrients and their metabolism with special reference to growth and quality of meat production, Nutrient requirement and feed formulation for baby-growing and finishing pigs.

1.7. Advances in Applied Animal Nutrition-A critical review and evalaution of feeding experiments, digestibility and balance studies. Feeding standards and measures of food energy. Nutrition requirements for growth, maintenance and production. Balanced rations.

2. **Animal Physiology :**

2.1 Growth and Animal Production :

- Prenatal and postnatal growth, maturation, growth curves, measures of growth, factors affecting growth, conformation, body composition, meat quality.

2.2 Milk Production and Reproduction and Digestion :

- Current status of hormonal control of mammary development, milk secretion and milk ejection.
- Male and Female reproduction organ, their components and function.
- Digestive organs and their functions.

2.3 Environmental Physiology :

- Physiological relations and their regulation; mechanisms of adaption, environmental factors and regulatory mechanism involved in animal behaviour, methods of controlling climatic stress.

2.4 Semen quality :

- Preservation and Artificial Insemination-Components of semen, composition of spermatozoe, chemical and physical properties of ejaculated semen, factors affecting semen in vivo and in vitro.
- Factors affecting semen production and quality preservation, composition of diluents, sperm concentration, transport of diluted semen.
- Deep Freezing techniques in cows, sheep and goats, swine and poultry.
- Detection of oestrus and time of insemination for better conception.

3. Livestock Production and Management :

- Commercial Dairy Farming-Comparison of dairy farming in India with advanced countries.
- Dairying under fixed farming and as a specialised farming, economic dairy farming, Starting of a dairy farm.
- Capital and land requirement, organisation of the dairy farm. Procurement of goods; opportunities in dairy farming, factors determining the efficiency of dairy animal, Herd recording, budgeting, cost of milk production; pricing policy; Personnel Management.
- Developing Practical and Economic ration for dairy cattle; supply of greens throughout the year, field and fodder requirements of Dairy Farm, Feeding regimes for day and young stock and bulls, heifers and breeding animals, new trends in feeding young and adult stock; Feeding records.

3.2. Commercial meat, egg and wool production:

- Development of practical and economic rations for sheep, goats, pigs, rabbits and poultry. Supply of greens, fodder, feeding regimens for young and mature stock.
- New trends in enhancing production and management.
- Capital and land requirements and socio-economic concept.

3.3. Feeding and management of animals under drought, flood and other natural calamities.

4. Genetics and Animal Breeding :

- Mitosis and Meiosis; Mendelian inheritance; deviations to Mendelian genetics; Expression of genes; Linkage and crossing over; Sex determination, sex influenced and sex limited characters; Blood groups and polymorphism;

Chromosome abberations; Gene and its structure; DNA as a genetic material; Genetic code and protein synthesis; Recombinant DNA technology, Mutations, types of mutations, methods for detecting mutations and mutation rate.

4.1 Population Genetics Applied to Animal Breeding:

- Quantitative Vs.
- Qualitative traits; Hardy Weinberg Law; Population Vs.
- Individual; Gene and genotypic frequency; Forces changing gene frequency; Random drift and small populations; Theory of path coefficient; Inbreeding, methods of estimating inbreeding coefficient, systems of inbreeding; Effective population size; Breeding value, estimation of breeding value, dominance and epistatic deviation; partitioning of variation; Genotype X environment correlation and genotype X environment interaction; Role of multiple measurements; Resemblance between relatives.

4.2 Breeding Systems :

- Heritability, repeatability and genetic and phenotypic correlations, their methods of estimation and precision of estimates; Aids to selection and their relative merits; Individual, pedigree, family and within family selection; Progeny testing; Methods of selection; Construction of selection indices and their uses; Comparative evaluation of genetic gains through various selection methods; Indirect selection and Correlated response; Inbreeding, upgrading, cross-breeding and synthesis of brees; Crossing of inbred lines for commercial production; Selection for general and specific combining ability; Breeding for threshold character.

Paper – II

1. **Health and Hygiene:**

1.1. Histology and Histological Techniques :

- Stains-Chemical classification of stains used in biological work-principles of staining tissues-mordants-progressive & regressive stains-differential staining of cytoplasmic and connective tissue elements-Methods of preparation and processing of tissues-celloidin embedding-Freezing microtomy-Microscopy-Bright field microscope and electron microscope.
- Cytology-structure of cell, organells & inclusions; cell divison-cell types-Tissues and their classification-embryonic and adult tissues-Comparative histology of organs:-vascular, Nervous, digestive, respiratory, musculo-skeletal and urogenital systems-Endocrine glands-Integuments-sense organs.

1.2 Embryology:

Embryology of vertebrates with special reference to aves and domestic mammals-gametogenesis-fertilization-germ layers-foetal membranes & placentation-types of placenta in domestic mammals-Teratology-twin & twinning-organogenesis-germ layer derivatives-endodermal, mesodermal and ectodermal derivatives.

1.3 Bovine Anatomy-Regional Anatomy :

Paranasal sinuses of OX-surface anatomy of salivary glands. Regional anatomy of infraorbital, maxillary, mandibuloalveolar, mental & coronal nerve block-Regional anatomy of paravertebral nerves, pudental nerve, median, ulnar & radial nerves-tibial, fibular and digital nerves-Cranial nerves-structures involved in epidural anaesthesia-superficial lymph nodes-surface anatomy of visceral organs of thoracic, abdominal and pelvic cavities-comparative features of locomotor apparatus & their application in the biomechanics of mammalian body.

1.4 Anatomy of Fowl : Musculo-skeletal system-functional anatomy in relation to respiration and flying, digestion and egg production.

1.5 Physiology of blood and its circulation, respiration; excretion, Endocrine glands in health and disease.

1.5.1 Blood constituents : Properties and functions-blood cell formation-Haemoglobin synthesis and chemistry-plasma proteins production, classification and properties; coagulation of blood; Haemorrhagic disorders-anticoagulants-blood groups-Blood volume-Plasma expanders-Buffer systems in blood. Biochemical tests and their significance in disease diagnosis.

1.5.2. Circulation: Physiology of heart, cardiac cycle-heart sounds, heart beat, electrocardiograms, Work and efficiency of heart-effect of ions on heart function-metabolism of cardiac muscle, nervous and chemical regulation of heart, effect of temperature and stress on heart, blood pressure and hypertension, Osmotic regulation, arterial pulse, vasomotor regulation of circulation, shock. Coronary & pulmonary circulation, Blood-Brain barrier-Cerebrospinal fluid-circulation in birds.
1.5.3 Respiration : Mechanism of respiration, Transport and exchange of gases-neural control of respiration-chemoreceptors-hypoxia-respiration in birds.

1.5.4 Excretion: Structure and function of kidney-formation of urinemethods of studying renal function-renal regulation of acid-base balance; physiological constituents of urine-renal failure-passive venous congestion-Urinary recreation in chicken-Sweat glands and their function. Biochemical tests for urinary dysfunction.

1.5.5 Endocrine glands : Functional disorders, their symptoms and diagnosis. Synthesis of hormones, mechanism and control of secretion-hormonal receptors-classification and function.

1.6. General knowledge of pharmacology and therapeutics of drugs : Celluar level of pharmacodynamics and pharmaco-kinetics-Drugs acting on fluids and electrolyte balance-drugs acting on Autonomic nervous system-Modern concepts of anaesthesia and dissociative anaesthetics-Autocoids-Antimicrobials and principles of chemotherapy in microbial injections-use of hormones in therapeutics-chemotherapy of parasitic infections-Drug and economic persons in the Edible tissues of animals-chemotherapy of Neoplastic diseases.

1.7. Veterinary Hygiene with reference to water, air and habitation : Assessment of pollution of water, air and soil-Importance of climate in animal health-effect of environment on animal function and performance-relationship between industri-alisation and animal agriculture-animal housing requirements for specific categories of domestic animals viz. pregnant cows & sows, milking cows, broiler birds-stress, strain & productivity in relation to animal habitation.

2. Animal Diseases :

2.1 Pathogenesis, symptoms, postmortum lesions, diagnosis, and control of infection diseases of cattle, pigs and poultry, horses, sheep and goats.

2.2 Etiology, symptoms, diagnosis, treatment of production diseases of cattle, pig and poultry.

2.3 Deficiency diseases of domestic animals and birds.

2.4 Diagnosis and treatment of nonspecific condition like impaction, Bloat, Diarrhoea, Indigestion, dehydration, stroke, poisioning.

2.5 Diagnosis and treatment of neurological disorders.

2.6 Principles and methods of immunisation of animals against specific disseases-hard immunity-disease free zones-'zero' disease concept-chemoprophylaxis.

2.7 Anaesthesia-local, regional and general-preanaesthetic medication, Symptoms and surgical interference in fractures and dislocation, Hernia, choking, abomassal displacement-Caesarian operations, Rumenotomy-Castrations.

2.8 Disease investigation techniques-Materials for laboratory investigation-Establishment Animal Health Centres-Disease free zone.

3. Veterinary Public Health:

3.1 Zoonoses : Classification, definition; role of animals and birds in prevalence and transmission of zoonotic diseases-occupational zoonotic diseases.

3.2. Epidemiology : Principles, definition of epidemiological terms, application of epidemiological measures in the study of diseases and disease control, Epidemiological features of air, water and food borne infections.

3.3 Veterinary Jurisprudence : Rules and Regulations for improvement of animal quality and prevention of animal diseases-state and control Rules for prevention of animal and animal product borne diseases-S.P. C.A.-veterolegal cases-certificates-Materials and Methods of collection of samples for veterolegal investigation.

4. Milk and Milk Products Technology :

4.1 Milk Technology :

- Organization of rural milk procurement, collection and transport of raw milk. Quality, testing and grading raw milk, Quality storage grades of whole milk, Skimmed milk and cream.
- Processing, packaging, storing, distributing, marketing defects and their control and nutritive properties of the following milks : Pasteurized, standardized, toned, double toned, sterilized, homogenized, reconstituted, recombined and flavoured milks.
- Preparation of cultured milks, cultures and their management, youghurt, Dahi, Lassi and Srikhand. Preparation of flavoured and sterlized milks. Legal standards, Sanitation requirement for clean and safe milk and for the milk plant equipment.

4.2 Milk Products Technology :

- Selection of raw materials, assembling, production, processing, storing, distributing and marketing milk products such as Butter, Ghee, Khoa, Channa, Cheese; Condensed, evaporated, dried milk and baby food; Ice cream and Kulfi; by products; whey products, butter milk, lactose and casein.
- Testing Grading, judging milk products-BIS and Agmark specifications, legal standards, quality control nutritive properties. Packaging, processing and operational control Costs.

5. Meat Hygiene and Technology : 5.1 Meat Hygiene :

5.1.1 Ante mortem care and management of food animals, stunning, slaughter and dressing operations; abattoir requirements and designs; Meat inspection procedures and judgement of carcass meat cuts-drading of carcass meat cuts-duties and functions of Veterinarians in Wholesome meat production.

5.1.2 Hygienic methods of handling production of meat-spoilage of meat and control measures-Post slaughter physicochemical changes in meat and factors that influence them-quality improvement methods-Adulteration of meat and defection-Regulatory provisions in Meat trade and Industry.

5.2. Meat Technology

5.2.1 Physical and chemical characteristics of meat-meat emulsions-methods of preservation of meat-curing, canning, irradiation, packaging of meat and meat products; meat products and formulations.

5.3. Byproducts : Slaughter house by products and their utilisation-Edible and inedible byproducts-social and economic implications of proper utilisation of slaughter house byproducts-Organ products for food and pharmaceuticals.

5.4. Poultry Products Technology : Chemical composition and nutritive value of poultry meat, pre slaughter care and management. Slaughtering techniques, inspection, preservation of poultry meat, and products. Legal and BIS standards. Structure, composition and nutritive value of eggs. Microbial spoilage. Preservation and mainteancne. Marketing of poultry meat, eggs and products.

5.5. Rabbit/Fur Animal farming : Care and management of rabbit meat production. Disposal and utilization of fur and wool and recycling of waste byproducts. Grading of wool.

5. Extension :

- Basic philosophy, objectives, concept and principles of extension. Different Methods adopted to educate farmers under rural conditions. Generation of technology, its transfer and feedback. Problems of constraints in transfer of technology. Animal husbandry programmes for rural development.

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Syllabus

Botany

1. Microbiology and Plant Pathology:

- Viruses, bacteria, and plasmids-structure and reproduction. General account of infection, Phytoimmunology.
- Applications of microbiology in agriculture, industry, medicine and pollution control in air, soil and water.
- Important plant diseases caused by viruses, bacteria, mycoplasma, fungi and nematodes.
- Mode of infection and dissemination.
- Molecular basis of infection and disease resistance/defence. Physiology of parasitism and control measures. Fungal toxins.

2. Cryptogams:

- Algae, Fungi, Bryophytes, Pteridophytes-structure and reproduction from evolutonary viewpoint.
- Distribution of Cryptogams in India and their economic potential.

3. Phanerogams:

- **Gymnosperms:** Concept of Progymonosperms. Classification and distribution of Gymnosperms. Salient features of Cycadales, Coniferrals and Gnetales, their structures and reproduction. General account of Cycadofilicales, Bennettitales and Cordaitales.
- **Angiosperms:** Systematics, anatomy, embryology, palynology and phylogeny. Comparative account of various systems of Angiosperm Classiification. Study of angiospermic familiesâ€"Magnoliaceae, Ranunculaceae, Brassicaceae (Cruci-ferae), Rosaceae, Leguminosae, Euphorbiaceae, Malvaceaie, Dipterocar-paceae, Apiaceae (Umbelliferae), Asclepiadaceae, Verbenaceae, Solana-ceae, Rubiaceae, Cucurbitaceae, Asteraceae (Composite), Poaceae (Gramineae), Arecaceae (Palmae), Liliaceae, Musaceae, Orchidaceae. Stomata and their types. Anomalous secondary growth, Anatomy of C 3 and C 4 plants. Development of male and female gametophytes, pollination, fertilization. Endospermâ€"its development and function. Patterns of embryo development. Polyembryony, apoxmix, Applications of palynology.

4. Plant Utility and Exploitation:

- Origin of cultivated plants, Vavilov's centres of origin. Plants as sources for food, fodder, fibres, spices, beverages, drugs, narcotics, insecticides, timber, gums, resins and dyes. Latex, cellulose Starch and their products. Perfumery. Importance of Ethnobotany in Indian context. Energy plantation. Botanical Gardens and Herbaria.

5. Morphogenesis:

- Totipotency, polarity, symmetry and differentiation. Cell, tissue, organ and protoplast culture. Somatic hybrids and Cybrids.

Paper - II

1. **Cell Biology:**

- Techniques of Cell Biology. Prokaryotic and eukaryotic cells -structural and ultrastructural details. Structure and function of extracellular matrix or ECM (cell wall) and membranes-cell adhesion, membrane transport and vesicular transport. Structure and function of cell organelles (chloroplasts, mitochondria, ER, ribosomes, endosomes, lysosomes, peroxisomes, hydrogenosome). Nucleus, nucleolus, nuclear pore complex. Chromatin and nucleosome. Cell signalling and cell receptors. Signal transduction (G-1 proteins, etc.). Mitosis and meisdosis; molecular basis of cell cycle. Numerical and structural variations in chromosomes and their significance. Study of polytene, lampbrush and B-chromosomes structure, behaviour and significance.

2. **Genetics, Molecular Biology and Evolution:**

- Development of genetics, and gene versus allele concepts (Pseudoalleles). Quantitative genetics and multiple factors. Linkage and crossing overâ€"methods of gene mapping including molecular maps (idea of mapping function). Sex chromosomes and sexlinked inheritance, sex determination and molecular basis of sex differentiation. Mutation (biochemical and molecular basis). Cytoplasmic inheritance and cytoplasmic genes (including genetics of male sterility). Prions and prion hypothesis. Structure and synthesis of nucleic acids and protines. Genetic code and regulation of gene expression. Multigene families. Organic evolution-evidences, mechanism and theories. Role of RNA in origin and evolution.

3. **Plant Breeding, Biotechnology and Biostatistics:**

- Methods of plant breeding -- introduction, selection and hybridization (pedigree, backcross, mass selection, bulk method). Male sterility and heterosis breeding. Use of apomixis in plant breeding. Micropropagation and genetic engineeringâ€"methods of transfer of genes and transgenic crops; development and use of molecular markers in plant breeding.

- Standard deviation and coefficient of variation (CV). Tests of significance (Z-test, t-test and chi-square tests). Probability and distributions (normal, binomial and Poisson distributions). Correlation and regression.

4. **Physiology and Biochemistry:**

    - Water relations, Mineral nutrition and ion transport, mineral deficiencies. Photosynthesisâ€"photochemical reactions, photophosphorylation and carbon pathways including C pathway (photorespiration), C, C and CAM pathways. Respiraion (anaerobic and aerobic, including fermentation-electron transport chain and oxidative phosphorylation. Chemiosmotic theory and ATP synthesis. Nitrogen fixation and nitrogen metabolism. Enzymes, coenzymes, energy transfer and energy conservation. Importance of secondary metabolites. Pigments as photoreceptors (plastidial pigments and phytochrome). Photoperiodism and flowering, vernalization, senescence. Growth substances-their chemical nature, role and applications in agri-horticulture, growth indices, growth movements. Stress physiology (heat, water, salinity, metal). Fruit and seed physiology. Dormancy, storage and germination of seed. Fruit ripening -- its molecular basis and manipulation.
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5. Ecology and Plant Geography:

- Ecological factors. Concepts and dynamics of community. Plant succession. Concepts of biosphere. Ecosystems and their conservation. Pollution and its control (including phytoremediation).
- Forest types of India -- afforestation, deforestation and social forestry. Endangered plants, endemism and Red Data Books. Biodiversity. Convention of Biological Diversity, Sovereign Rights and Intellectual Property Rights. Biogeochemical cyeles. Global warming.

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Syllabus

Chemistry

Paper – I

1. **Atomic structure**

Quantum theory, Heisenberg's uncertainity principle, Schrodinger wave equation (time independent). Interpretation of wave function, particle in one-dimensional box, quantum numbers, hydrogen atom wave functions. Shapes of s, p and d orbitals.

2. Chemical bonding

Ionic bond, characteristics of ionic compounds, factors affecting stability of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and its general characteristics, polarities of bonds in molecules and their dipole moments. Valence bond theory, concept of resonance and resonance energy. Molecular orbital theory (LCAO method); bonding in homonuclear molecules: H+2, H2 to Ne2, NO, CO, HF, CN, CN-, BeH2 and CO2. Comparision of valence bond and molecular oribtal theories, bond order, bond strength and bond length.

3. Solid state

Forms of solids, law of constancy of interfacial angles, crystal systems and crystal classes (crystallographic groups). Designation of crystal faces, lattice structures and unit cell. Laws of rational indices. Bragg's law. X-ray diffraction by crystals. Close packing, radious ratio rules, calculation of some limiting radius ratio values. Structures of NaCl, ZnS, CsCl, CaF2, CdI2 and rutile. Imperfections in crystals, stoichiometric and nonstoichiometric defects, impurity defects, semi-conductors. Elementary study of liquid crystals.

4. The gaseous state

Equation of state for real gases, intermolecular interactions, liquifictaion of gases and critical phenomena, Maxwell's distribution of speeds, intermolecular collisions, collisions on the wall and effusion.

5. Thermodynamics and statistical thermodynamics

Thermodynamic systems, states and processes, work, heat and internal energy; first law of thermodynamics, work done on the systems and heat absorbed in different types of processes; calorimetry, energy and enthalpy changes in various processes and their temperature dependence. Second law of thermodynamics; entropy as a state function, entropy changes in various process, entropy reversibility and irreversibility, Free energy functions; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Nernst heat theorem and third law of thermodynamics. Micro and macro states; canonical ensemble and canonical partition function; electronic, rotational and vibrational partition functions and thermodynamic quantities; chemical equilibrium in ideal gas reactions.

6. Phase equilibria and solutions

Phase equilibria in pure substances; Clausius-Clapeyron equation; phase diagram for a pure substance; phase equilibria in binary systems, partially miscible liquids upper and lower critical solution temperatures; partial molar quantities, their significance and determination; excess thermodynamic functions and their determination.

7. Electrochemistry

Debye-Huckel theory of strong electrolytes and Debye-Huckel limiting Law for various equilibrium and transport properties. Galvanic cells, concentration cells; electrochemical series, measurement of e.m.f. of cells and its applications fuel cells and batteries. Processes at electrodes; double layer at the interface; rate of charge transfer, current density; overpotential; electroanalytical techniques voltametry, polarography, amperometry, cyclic-voltametry, ion selective electrodes and their use.

8. Chemical kinetics

Concentration dependence of rate of reaction; defferential and integral rate equations for zeroth, first, second and fractional order reactions. Rate equations involving reverse, parallel, consecutive and chain reactions; effect of temperature and pressure on rate constant. Study of fast reactions by stop-flow and relaxation methods. Collisions and transition state theories.

9. Photochemistry

Absorption of light; decay of excited state by different routes; photochemical reactions between hydrogen and halogens and their quantum yields.

10. Surface phenomena and catalysis

Adsorption from gages and solutions on solid adsorbents, adsorption isothermsâ€"Langmuir and B.E.T. isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.

11. Bio-inorganic chemistry

Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), ionophores, photosynthesisâ€"PSI, PSII; nitrogen fixation, oxygen-uptake proteins, cytochromes and ferredoxins.

12. Coordination chemistry

(a) Electronic configurations; introduction to theories of bonding in transition metal complexes. Valence bond theory, crystal field theory and its modifications; applications of theories in the explanation of magnetism and electronic spactra of metal complexes.
(b) Isomerism in coordination compounds. IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans effect and its theories; kinetics of substitution reactions in square-planer complexes; thermodynamic and kinetic stability of complexes.
(c) Synthesis and structures of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.

(d) Complexes with aromatic systems, synthesis, structure and bonding in metal olefin complexes, alkyne complexes and cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization. Compounds with metal-metal bonds and metal atom clusters.

13. General chemistry of block elements

Lanthanides and actinides; separation, oxidation states, magnetic and spectral properties; lanthanide contraction.

14. Non-Aqueous Solvents

Reactions in liquid NH3, HF, SO2 and H2 SO4. Failure of solvent system concept, coordination model of non-aqueous solvents. Some highly acidic media, fluorosulphuric acid and super acids.

Paper – II

1. **Delocalised covalent bonding :**

- Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, kekulene, fulvenes, sydnones.

2. (a) Reaction mechanisms :

General methods (both kinetic and non-kinetic) of study of mechanism or organic reactions illustrated by examplesâ€"use of isotopes, cross-over experiment, intermediate trapping, stereochemistry; energy diagrams of simple organic reactionsâ€"transition states and intermediates; energy of activation; thermodynamic control and kinetic control of reactions.

(b) Reactive intermediates :

- Generation, geometry, stability and reactions of carbonium and carbanium ions, carbanions, free radicals, carbenes, benzynes and niternes.

(c) Substitution reactions :

- SN1, SN2, SNi, SN1â€™, SN2â€™, SNiâ€™ and SRN1 mechanisms; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compound including simple heterocyclic compoundsâ€"pyrrole, thiophene, indole.

(d) Elimination reactions :

- E1, E2 and E1cb mechanisms; orientation in E2 reactionsâ€"Saytzeff and Hoffmann; pyrolytic syn eliminationâ€"acetate pyrolysis, Chugaev and Cope eliminations.

(e) Addition reactions :

- Electrophilic addition to C=C and C=C; nucleophilic addition to C=O, C=N, conjugated olefins and carbonyls.

(f) Rearrangements :

- Pinacol-pinacolune, Hoffmann, Beckmann, Baeyer Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner-Meerwein rearrangements.

3. Pericyclic reactions :

- Classification and examples; Woodward-Hoffmann rulesâ€"clectrocyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5] FMO approach.

4. Chemistry and mechanism of reactions :

- Aldol condensation (including directed aldol condensation), Claisen condensation, Dieckmann, Perkin, Knoevenagel, Witting, Clemmensen, Wolff-Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski, Sandmeyer, Reimer-Tiemann and Reformatsky reactions.

5. Polymeric Systems
(a) Physical chemistry of polymers : Polymer solutions and their thermodynamic properties; number and weight average molecular weights of polymers. Determination of molecular weights by sedimentation, light scattering, osmotic pressure, viscosity, end group analysis methods.
(b) Preparation and properties of polymers : Organic polymers polyethylene, polystyrene, polyvinyl chloride, Teflon, nylon, terylene, synthetic and natural rubber. Inorganic polymersâ€"phosphonitrilic halides, borazines, silicones and silicates.
(c) Biopolymers : Basic bonding in proteins, DNA and RNA.

6. Synthetic uses of reagents : OsO_4, HIO_4, CrO_3, $Pb(OAc)_4$, SeO_2, NBS, B_2H_6, Na-Liquid NH_3, $LiAlH_4$, $NaBH_4$ n-BuLi, MCPBA.

7. Photochemistry : Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Type II reactions.

8. Principles of spectroscopy and applications in structure elucidation :

(a) Rotational spectra diatomic molecules; isotopic substitution and rotational constants.

(b) Vibrational spectra diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(c) Electronic spectra : Singlet and triplet states; application to conjugated double bonds and conjugated carbonyls Woodward-Fieser rules.

(d) Nuclear magnetic resonance : Isochronous and anisochronous protons; chemical shift and coupling constants; Application of 1H NMR to simple organic molecules.

(e) Mass spectra : Parent peak, base peak, daugther peak, metastable peak, fragmentation of simple organic molecules; cleavage, McLafferty rearrangement.

(f) Electron spin resonance : Inorganic complexes and free radicals.

MPSC-Forest Ranger

Syllabus

Civil Engineering

Paper - I

Part-A

ENGINEERING MECHANICS, STRENGTH OF MATERIALS AND STRUCTURAL ANALYSIS.

ENGINEERING MECHANICS :

Units and Dimensions, SI Units, Vectors, Concept of Force, Concept of particle and rigid body. Concurrent, Non-Concurrent and parallel forces in a plane, moment of force and Varignon's theorem, free body diagram, conditions of equilibrium, Principle of virtual work, equivalent force system.

First and Second Moment of area, Mass moment of Inertia.

Static Friction, Inclined Plane and bearings. Kinematics and Kinetics.

Kinematics in Cartesian and Polar Coordinates, motion under uniform and nonuniform acceleration, motion under gravity. Kinetics of particle: Momentum and Energy principles, D'Alembert's Principle, Collision of elastic bodies, rotation of rigid bodies, simple harmonic motion, Flywheel.

STRENGTH OF MATERIALS:

Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength, Leaf Spring. Strain Energy in direct stress, bending & shear.

Deflection of beams: Mecaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method, Torsion of Shafts, Transmission of power, close coiled helical springs, Elastic stability of columns, Euler's Rankine's and Secant formulae. Principal Stresses and Strains in two dimensions, Mohr's Circle, Theories of Elastic Failure, Thin and Thick cylinder; Stresses due to internal and external pressure- Lame's equations.

STRUCTURAL ANALYSIS:

Castiglianio's theroems I and II, Unit load method of consistent deformation applied to beams and pin jointed trusses. Slopedeflection, moment distribution, Kani's method of analysis and column Analogy method applied to indeterminate beams and rigid frames.

Rolling loads and influences lines: Influences lines for Shear Force and Bending moment at a section of beam. Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses.

Arches:

Three hinged, two hinged and fixed arches, rib shortening and temperature effects, influence lines in arches.

Matrix methods of analysis:

Force method and displacement method of analysis of indeterminate beams and rigid frames.

Plastic Analysis of beams and frames:

Theory of plastic bending, plastic analysis, statical method, Mechanism method.

Unsymmetrical bending:

Moment of inertia, product of inertia, position of Neutral Axis and Principle axes, calculation of bending stresses.

Part-B

DESIGN OF STRUCTURES: STEEL, CONCRETE AND MASONRY STRUCTURES.
STRUCTURAL STEEL DESIGN :

Structural Steel: Factors of safety and load factors, Rivetted, bolted and welded joints and connections. Design of tension and compression member, beams of built up section, rivetted and welded plate girders, gantry girders, stancheons with battens and lacings, slab and gussetted column bases. Design of highway and railway bridges: Through and deck type plate girder, Warren girder, Pratt truss.

DESIGN OF CONCRETE AND MASONRY STRUCTURES:

Concept of mix design, Reinforces Concrete: Working Stress and Limit State method of design-recommendations of I.S. codes, design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, Isolated and combined footings.

Cantilever and counterfort type retaining walls. Water tanks:

Design requirements for rectangular and circular tanks resting on ground. Prestressed concrete: Methods and systems of prestressing, anchorages, analysis and disign of sections for flexure based on working stress, loss of prestress.Design of brick masonry as per I.S. Codes Design of masonry retaining walls.

Part-C

FLUID MECHANICS, OPEN CHANNEL FLOW AND HYDRAULIC MACHINES

Fluid Mechanics:

Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curve surfaces. Kinematics and Dynamics of Fluid flow: Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flownet, methods of drawing flownet, sources and sinks, flow separation, free and forced vortices.Control volume equation, continuity, momentum, energy and moment of momentum equations from control volume equation, Navier-Strokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes, sluice gates, weirs, orifice meters and Venturi meters.

Dimensional Analysis and Similitude:

Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models. Laminar Flow: Laminar flow between parallel, stationary and moving plates, flow through tube.

Boundary Layer:

Laminar and turbulent boundary layer on a flat plate, laminar sublayer, smooth and rough boundaries, drag and lift.

Turbulent flow through pipes:

Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line, siphons, expansion and contractions in pipes, pipe networks, water hammer in pipes and surge tanks.

Open Channel Flow:

Uniform and nonuniform flows, momentum and energy correction factors. Specific energy and specific force, critical depth, resistance equations and variation of roughness coefficient, rapidly varied flow, flow in contractions, flow at sudden drop, hydraulic jump and its applications surges and waves, gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation, moving surges and hydraulic bore.

HYDRAULIC MACHINES AND HYDROPOWER:

Centrifugal pumps:

Types, characteristics, Net positive Suction Height (NPSH), specific speed, Pumps in parallel. Reciprocating pumps, Air vessels,Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps. Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed. Principles of hydropower development. Type, layouts and Component works, surge tanks, types and choice. Flow duration curves and dependable flow. Storage an pondage, Pumped storage plants. Special features of mini, micro-hydel plants.

Part-D

GEO TECHNICAL ENGINEERING :

Types of soil, phase relationships, consistency limits particles size distribution, classifications of soil, structure and clay mineralogy. Capillary water and structural water, effectives trees and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits. Seepage pressure, quick sand condition, compressibility and consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test. Compaction of soil, field control of compaction. Total stress and effective stress parameters, pore pressure coefficients. Shear strength of soils, Mohr Coulomb failure theory, Shear tests.

Earth pressure at rest, active and passive pressure, Rankin's theory, Coulomb's wedge theory, earth pressure on retaining wall, sheetpile walls, Braced excavation. Bearing capacity, Terzaghi and other important theories, net and gross bearing pressure. Immediate and consolidation settlement. Stability of slope, Total Stress and Effective Stress methods, Conventional methods of slices, stability number. Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests.

Essential features of foundation, types of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinessq's theory, Newmarks' chart, pressure bulb, contact pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from field tests, allowable bearing capacity, Settlement analysis, allowable settlement. Proportioning of footing, isolated and combined footings, rafts, buoyancy rafts, Pile foundation, types of piles, piles capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles, lateral capacity. Foundation for Bridges. Ground improvement techniques-preloading, sand drains, stone column, grouting, soil stabilisation.

Paper - II

Part-A

CONSTRUCTION TECHNOLOGY,EQUIPMENT, PLANNING AND MANAGEMENT :

1. Construction Technology:

Engineering Materials: Physical properties of construction materials: Stones, Bricks and Tiles; Lime, Cement and Surkhi Mortars; Lime concrete and Cement concrete, Properties of freshly mixed and hardened concrete, flooring Tiles, use of ferro-cement, fibre-reinforced and polymer concrete, high strength concrete and light weight concrete. Timber: Properties and uses; defects in timber; seasoning and preservation of timber, Plastics, rubber and damp-proofing materials, termite proofing, Materials for Low cost housing.

Construction:

Building components and their functions; Brick masonry: Bonds, jointing, Stone masonry, Design of Brick masonry walls as per I.S. codes, factors of safety, serviceability and strength requirements; plastering, pointing. Types of Floors & Roofs, Ventilators, Repairs in buildings. Functional planning of building: Building orientation, circulation, grouping of areas, privacy concept and design of energy efficient building; provisions of National Building Code.

Building estimates and specifications; Cost of works; valuation

2. Construction Equipment :

Standard and special types of equipment, Preventive maintenance and repair, factors affecting the selection of equipment, economical life, time and motion study, capital and maintenance cost.

Concreting equipments :

Weigh batcher, mixer, vibration, batching plant, Concrete pump.Earth-work equipment : Power shovel hoe, bulldozer, dumper, trailors, and tractors, rollers, sheep foot roller.

3. Construction Planning and Management :

Construction activity, schedules, job layout, bar charts, organization of contracting firms, project control and supervision. Cost reduction measures.

New-work analysis:

CPM and PERT analysis, Float times, cashing of activities, contraction of network for cost optimization, up dating, cost analysis and resource allocation.

Elements of Engineering Economics, methods of appraisal, present worth, annual cost, benefit-cost, incremental analysis. Economy of scale and size. Choosing between alternatives including levels of investments. Project profitability.

Part-B

SURVEY AND TRANSPORTATION ENGINEERING :

Survey :

Common methods of distance and angle measurements, plane table survey, levelling traverse survey, triangulation survey, corrections, and adjustments, contouring, topographical map. Surveying instruments for above purposes Techeometry. Circular and transition curves, Principles of photogrammetry.

Railways:

Permanent way, sleepers, rail fastenings, ballast, points and crossings, design of turn outs, stations and yards, turn-tables, signals, and interlocking, levelcrossing.Construction and maintenance of permanent ways: Superelevlation, creep of rail, ruling gradient, track resistance, tractive effort, relaying of track.

Highway Engineering:

Principles of highway planning, Highway alignments, Geometrical design: Cross section, camber, superelevation, horizontal and vertical curves. Classification of roads: low cost roads, flexible pavements, rigid pavements. Design of payments and their construction, evaluation of pavement failure and strengthening. Drainage of roads: Surface and subsurface drainage.

Traffic Engineering : Forecasting techniques, origin and destination survey, highway capacity, Channelised and unchannelised intersections, rotary design elements, markings, sign, signals, street lighting; Traffic surveys, Principle of highway financing.

Part-C

HYDROLOGY, WATER RESOURCES AND ENGINEERING:

Hydrology:

Hydrological cycle, precipitation, evaporation, transpiration, depression storage, infiltration, overland flow, hydrograph, flood frequency analysis, flood estimation, flood routing through a reservoir, channel flow routing-Muskingam method.

Ground water flow:

Specific yield, storage coefficient of permeability, confined and unconfined aquifers,aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential.

WATER RESOURCES ENGINEERING:

Ground and surface water resource, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation, economics of water resources projects.

IRRIGATION ENGINEERING:

Water requirements of crops: consumptive use, quality of water for irrigation duty and delta, irrigation methods and their efficiencies.

Canals:

Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlied canals, drain-age behind lining. Water logging: causes and control, drainage system design, salinity.Canal structures: Design of cross regulators, head regulators, canal falls, aqueducts, metering flumes and canal outlets.

Diversion head work:

Principles and design of weirs of permeable and impermeable foundation, Khosla's theory, energy dissipation, stilling basin, sediment excluders. Storage Works: Types of dams, design, principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage.

Spillways:

Spillway types, crest gates, energy dissipation.

River training:

Objectives of river training, methods of river training.

Part-D

ENVIRONMENTAL ENGINEERING :

Water Supply :

Estimation of surface and subsurface water resources, predicting demand for water, impurities of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.

Intake of water:

Pumping and gravity schemes. Water treatment: Princi-ples of coagulation, flocculation and sedimentation; slow-, rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

Water storage and distribution:

Storage and balancing reservoirs: types, location and capacity. Distribution system: layout, hydraulics of pipe lines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, leak detection, maintenance of distribution systems, pumping stations and their operations.

Sewerage systems:

Domestic and industrial wastes, storm sewage-separate and combined systems, flow through sewers, design of sewers, sewer appurtenances, manholes, inlets, junctions, siphon, Plumbing in Public buildings.

Sewage characterisation:

BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

Sewage treatment:

Working principles, units, chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge process, septic tank; disposal of sludge, recycling of waste water.

Solid waste :

Collection and disposal in rural and urban contexts, management of long-term ill-effects.

Environmental pollution:

Sustainable development. Radioactive wastes and disposal, Environmental impact assessment for thermal power plants, mines, river valley projects, Air pollution, Pollution control acts.

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Syllabus

COMPUTER ENGINEERING

PAPER-I
Engineering Mathematics
Mathematical Logic: Propositional Logic; First Order Logic. **Probability:** Conditional Probability; Mean, Median, Mode and Standard Deviation; Random Variables; Distributions; uniform, normal, exponential, Poisson, Binomial. **Set Theory & Algebra:** Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra. **Combinatorics:** Permutations; Combinations; Counting; Summation; generating functions; recurrence relations; asymptotics. **Graph Theory:** Connectivity; spanning trees; Cut vertices & edges; covering; matching; independent sets; Colouring; Planarity; Isomorphism. **Linear Algebra:** Algebra of matrices, determinants, systems of linear equations, Eigen values and Eigen vectors. **Numerical Methods:** LU decomposition for systems of linear equations; numerical solutions of non-linear algebraic equations by Secant, Bisection and Newton-Raphson Methods; Numerical integration by trapezoidal and Simpson's rules. **Calculus:** Limit, Continuity & differentiability, Mean value Theorems, Theorems of integral calculus, evaluation of definite & improper integrals, Partial derivatives, Total derivatives, maxima & minima.
PAPER-II
Computer Science and Information Technology
Digital Logic: Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point). **Computer Organization and Architecture:** Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage. **Programming and Data Structures:** Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees,

Binary heaps.

Algorithms: Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes P, NP, NP-hard, NP-complete.

Theory of Computation: Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

Compiler Design: Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Operating System: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Information Systems and Software Engineering: information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security basic concepts of public key and private key cryptography, digital signature, firewalls.

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Syllabus

Electronic Engineering

Paper-I.
Engineering Mathematics
Linear Algebra: Matrix Algebra, 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' series, Residue theorem, solution integrals. **Probability and Statistics:** Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, 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. **Transform Theory:** Fourier transform, Laplace transform, Z-transform.
Paper-II
Electronics and Communication Engineering
Networks: Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. 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. Linear constant coefficient differential equations; time domain analysis of simple RLC 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. **Electronic Devices:** Energy bands in silicon, 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, p-I-n and avalanche photo diode, Basics of LASERs. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Analog Circuits: Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multi-stage, differential and operational, feedback, and power. Frequency response of 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.

Digital circuits: Boolean algebra, minimization of Boolean functions; logic GATEs; digital IC families (DTL, TTL, ECL, MOS, CMOS). 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. Microprocessor(8085): architecture, programming, memory and I/O interfacing.

Signals and Systems: Definitions and properties of Laplace transform, 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. Signal transmission through LTI systems.

Control Systems: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Communications: Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Electromagnetics: Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms. Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.

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SYLLABUS

ENVIRONMENTAL SCIENCE

PAPER-I

Environment, Ecology and Ecosystem Dynamics

Unit I: Concept of environment, scope of Environmental Science, environmental components, scope
and subdivisions of ecology, ecological principles pertaining to population, community, ecosystem and biome.

Unit II: Population dynamics and population regulations, concept of carrying capacity, population fluctuations, population dispersion, r and k selection, ecotypes and ecophene, habitats and niches.

Unit III: Energy in ecosystem, Primary and secondary production, Biomass, Methods of measuring productivity, Pattern of primary production in the major ecosystems of the world, Energy flow in ecosystems, Feedback and control mechanism, Pathways of energy transfer- grazing and detritus food chain, Ecological efficiency and ecological pyramids.

Unit IV: Biogeochemical cycles: nutrient cycling in the ecosystems, Gaseous cycles (Carbon and Nitrogen) and sedimentary cycles (Phosphorus and Sulphur), Impact of man on nutrient cycles; Major ecosystems of the world: A general idea of forest, grassland, desert, wetland, freshwater and marine ecosystems.

Forestry and Water Resources

Unit I: Forest: definition, growth stages, crown differentiation, forest types of India, measurement of
height and girth of trees, form factor, estimation of volume of logs, Role of plantation forestry in environmental conservation.

Unit II: Social Forestry: Origin, definitions, objectives, scope, place of social forestry in National Forest Policies., Multipurpose tree species (MPTs), Nitrogen fixing tree species (NFTs), characteristics of MPTs, NFTs. Community participation in social forestry programme, Pattern of planting, calculation of number of plants (line, square, triangular and quincunx), Ecorestoration of eroded hill slopes and degraded *Jhum* land. Tree species suitable for different edaphic conditions

Unit III: Agroforestry: Origin and definition, type, gains of agro forestry system, Tree and crop management, Production potential of alley cropping, Agroforestry models developed for hill farming system- Three tier system, Tree-green hedge-crop Farming system and Contour- Tree-

Greenhedge-Crop Farming system, Acidic, Saline and alkaline soils and their reclamation techniques.

Unit IV: Water resources: Hydrologic cycle, distribution and extent, water availability and uses, freshwater shortages, impact of climate change on freshwater resources, Management and conservation of water resources, Role of forestry in watershed management.

Environmental Pollution

Unit I: Types and sources of air, water and soil pollution, monitoring of air and water pollution, noise pollution, impact of pollution on human health, environment and assets; Water Pollution control technologies: Waste water treatment, primary treatment, secondary treatment and Advance treatment.

Unit II: Air pollution control technologies and devices: Limestone injection and fluidized bed combustion, Desulfurization; Catalytic converter and control of vehicular emission, Gravity settling chamber, Centrifugal collectors- cyclone collector and dynamic precipitators; Electrostatic precipitators; Fabric filters.

Unit III: Solid, Toxic, and Hazardous waste management; solid waste disposal methods – open dumps, ocean dumping, Landfills, Incineration; Recycling and reuse, Organic pollutants; pesticides- organochlorine insecticides, organophosphates and carbamates; fertilizers, Hazardous waste disposal and management corporate social Responsibility.

Unit IV: Electronic waste (E-waste): Sources and types, constituents of E-wastes, recycling of e- waste and its environmental consequences, Transboundary movement and management of e-wastes, Basel convention, Radioactive wastes: Types, hazards, storage and management.

Environmental Microbiology, Biotechnology and Toxicology

Unit I: Scope and importance of microorganisms; Microorganism in different environments-soil,
water, air and extreme environments, Reproduction and growth, methods for determining bacterial numbers, Role of microorganisms in waste treatment, Anaerobic (methanogenesis) and aerobic (trickling filter, activated sludge, oxidation pond) treatment of wastewater, production of enzymes and alcohol.

Unit II: Basic techniques in genetic engineering: Nucleic acid hybridization and polymerase chain reaction as sensitive detection methods, Gene cloning, Introduction of cloned genes into new hosts using plasmids and phage vector systems, expression of genes in new host, Genetically Modified Organisms (GMOs) and their possible environmental implications.

Unit III: Principles in toxicology; Toxicants and toxicity, Factors affecting concentration of toxicants in environment, Toxicity tests and concepts of LD_{50} and $LC_{50,}$ Sources and types of toxicants and their health hazards, Dose-effect and Dose response relationship, Absorption, translocation and excretion of toxicants.

Unit IV: Global dispersion of toxic substance, Dispersion and circulating mechanisms of pollutant, degradable and non-degradable toxic substances in food chain, Ecosystem influence on fate and transport of toxicants, Bio-absorption of heavy metals and Bio-accumulation, Bio magnification.

Environmental Impact Assessment, Environmental Policies and Ethics

Unit I: Introduction to environmental impact assessment (EIA), origin and development of EIA,
Environmental impact statement and environmental management plan. EIA Notifications & Guidelines 1994, 2006, and 2009, Stages of granting Environmental Clearance: Screening, Scoping, Public consultation, Appraisal & recommendations and grant of environmental clearance and its validity.

Unit II: Components of an EIA report; Generation of baseline data & preparation of EIA report, procedure for reviewing EIA report, Authorities/ Institutions involved in granting environmental clearance at Central & State Government levels.

Unit III: Environmental policy 2006, Environmental policy resolution, Legislation, Public policy strategies in pollution control, International and National Conservation agencies, policies and strategies, Convention on biodiversity, Convention on Climate change, Kyoto protocol, Carbon credit and Carbon trading.

Unit IV: Concept of environmental ethics, philosophies of biocentrism and ecocentrism, application of ethics to environmental issues, eastern and western philosophical traditions/religious treatises on the relationships between humans, animals, and the natural environment, value of wilderness.

Remote Sensing and Geographical Information System

Unit I: Remote sensing: definition and scope; Electro-magnetic radiation: characteristics, interaction
with matter and spectral regions. Aerial photos: Types, Scale, Resolution; Stereoscopy; Geometric properties of aerial photos; Stereoscopic parallax; Relief displacement.

Unit II: Types of remote sensing; Remote sensing regions and bands. Indian and foreign Remote Sensing Satellites: LANDSAT, IRS, IKONOS, QUICK BIRD, CARTOSAT; Platforms and sensors- principles and geometry.

Unit III: Image classification procedures; supervised and unsupervised classifications; Elements of aerial photo-interpretation, Elements of Visual Interpretation. Satellite Imageries and its application in Environmental Monitoring, Landuse Mapping, Habitat Analysis, Drought Monitoring and Flood Studies, Soil Conservation and Watershed Management, Urban sprawl, Landslide hazard zonation and geosciences.

Unit IV: GIS: Introduction, components and software modules. Geographic data: spatial and

non- spatial. Data structure. Application of GIS in Land use Mapping, Habitat Analysis, Urban sprawl and Landslide hazard zonation. GIS as a decision support system; Global positioning system: Basic principles, instruments, components and applications of Global Positioning System (GPS) Measurement of coordinates using GPS, Demonstration of GIS Software module.

Environmental Law

Unit I: Basics of Law: Rights and Privileges ,Article 21 of the Constitution of India, Acquisition of Rights Indian Penal code; Laws of Criminal procedure ,Cognizable and non –cognizable offences, Search warrant; Indian Forests Act 1927: Application of Indian Penal code (Act XLV of 1860 to forest offences, Land Acquisition Act ,1894 Forest Act :Salient features and amendments.; Classification of forests as per IFA, 1927:Reserved forests (Sections 3, 4, 6, 7, 9, 10, 11, 13, 20, 23,
25, 26 and 27); Village forests (Section 28) and Protected forests (Sections 29, 30, 32), Biological Diversity Act (2002) Forest (Conservation) Act, 1980.with explanations (amendments made on the basis of verdict of the High Court and Apex court) Sixth schedule and Article 371A of the Constitution of India: Vis-a Vis Forest Conservation Act,1980: A critical appraisal.

Unit II: Environment (Protection) Act, (1986) and Rules (1986); Water Prevention and control of Pollution Act, 1974; Air Prevention and control of Pollution Act, 1981, Disaster management act 2005; Disaster management and administrative reforms. Salient features of Wildlife (Protection) Act, 1972: Protection of specified plants (Sections 17A to 17H). Sanctuaries, National parks and Closed areas (Sections 18 to 38). Trade in wild animals, animal articles and trophies (Sections 39 to 41). Major amendments of Wildlife (Protection) Act, 1972.

Radiation Biology

UNIT I: Types of radiation, natural and man-made radiations; Radiation interaction with water/matter, units of radiation; Radiation interaction with biological materials:Nucleic acids (DNA & RNA), proteins, carbohydrates, lipids and membranes; Radiation as a mutagen.

UNIT II: Target theories, acute and delayed cellular effects by radiation, radiation syndromes, chromosomal aberrations; Applied aspects of radiation: cancer therapy, food preservation, alternative energy sources.

Natural Resource Management

Unit I: Natural resources: Concept and major types of natural resources, Land Resources: Land use and land cover, land use change, drivers of land use change, impact of land use change on environment; Soil resource: soil types, profile and composition, degradation of land and soil; environmental effects of mining.

Unit II: Mineral Resources and Energy**:** Types, distribution and reserves of mineral resources, environmental effects of mining; Definition of Energy; Sources of energy; Energy units; Energy

Resources: Oil and natural gas, coal, solar and wind energy, biomass energy, geothermal energy, hydropower; Environmental implication of energy use.

UNIT III: Water Resources: Introduction of water resources, distribution and supply: Global, national and regional; hydrological cycle, Water resource type: surface water, ground water; Causes of water resource depletion: Use and over use of water resources, Methods for managing water resources: Ground water recharging, rain water harvesting; Watershed management: Concept, and objectives, land use planning, flood control; Wetlands: definition, importance and classification.

Unit IV: Forest and Biodiversity: Forest as natural resource: importance, classification and extent of forests in India; deforestation and conservation strategies; Role of forests in carbon management; forest fragmentation, national forest policy; Biodiversity: introduction, levels, importance, threats to biodiversity, modern and traditional biodiversity conservation strategies, global biodiversity hotspots; threatened and endemic species.

PAPER-II

Environmental Geoscience and Energy

Unit I: Primary differentiation and formation of core, mantle, crust, atmosphere and hydrosphere;
Geomagnetism: remnant magnetization, paleomagnetism. Gravity and figure of the Earth: mass inhomogeneties and associated gravity anomalies; Stress and Strain: Definition, classification and types. Behavior of rocks under of stress and strain.

Unit II: Seismology: causes and space distribution of earthquakes; seismic waves; (body and surface waves), Precursors to the earthquakes. Sea floor spreading; Plate tectonics theory: types of plate boundaries, processes and corresponding geophysical and geological signatures; Himalayan tectonics.

Unit III: Energy resources and their exploitation. Energy: Conventional and non-conventional energy sources. Renewable sources of energy- hydroelectric power, solar, tidal, wind, geothermal energy, biomass and biofuels. Environmental impacts of conventional and renewable energy. Sun as source of energy, nature of solar radiation, heat budget of the earth, earth's temperature and atmosphere, Photovoltaics and Solar collectors. Energy use pattern in India and the world.

Unit IV: Concept of Minerals and Rocks. Atomic minerals as a source of energy. Atomic fuel, radioactive wastes and their management, Fossil fuels- physico-chemical characteristics and energy content of coal, petroleum and natural gases, Petroleum and coal deposits of Northeast India.

Research Methods, Techniques and Statistical Analyses

Unit I: Definition of applied science and research. Classification of research. Critical appraisal of
research studies, Planning research projects, Advance planning and its value, Methods of data collection and analysis, interpretation and presentation.

Unit II: Sampling techniques: Sampling of air, water and soil, sampling of plant and animal populations, concept of species area curve, concept of random and stratified sampling, Methods of Social Science research, PRA.

Unit III: Population and sample, frequency table, mean, mode, median, measure of dispersion, standard deviation, variance, correlation, regression and prediction, multivariate analysis. Test of significance- (Z & T test) variance in one and two sample cases. Test of equality of K–variance (Bartlett's test).

Unit IV: Basic principles of field experimentation: Randomization, Replication and Local Control. Lay out and analysis of data of completely Randomized block design, Latin square designs, Factorial design, Split plot and Strip plot designs.

Disaster Management

Unit I: Introduction and Concept of disasters and hazards related to Earthquakes, Tsunami, Volcanic
eruption, Cyclones, Floods, Drought, Landslides, Forest fires, Avalanches and Pest infestation. Prediction and perception of hazards and adjustments to hazardous activities; Rates of natural cycles and residence time.

Unit II: Landslide: causes, prevention and correction. Landslide hazard mitigation. Earthquakes: intensity and magnitude of earthquakes; geographic distribution of earthquake zones; precursors to the earthquakes, seismic waves, travel-time and location of epicentre; nature of destruction; ground subsidence; protection from earthquake hazards; do's and don'ts during earthquake; Tsunamis- causes and consequences.

Unit III: Floods: Causes, nature and frequency of flooding: nature and extent of flood hazard; urban floods, environmental effects of flooding; flood mitigation methods. Tropical cyclone-formation and consequences. Coastal erosion; sea level changes and its impact on coastal areas. Drought: Nature and effect on plant and animal systems. Study of pattern and mitigation of forest fires.

Unit IV: Geological and environmental investigations for the construction of dams, bridges, highways and tunnels. Impact of major geotechnical projects on the environment. Disaster Management: Capability-Vulnerability- risk- preparedness and mitigation- Disaster management cycle; Disaster Risk Reduction and Resilience; Disaster Management Act and Policy.

Environmental Issues and Problems of North East India

Unit I: Population growth, urbanization, growth of vehicles and its impact on air quality. Changes in forest cover, biodiversity loss and conservation measures, issues and concerns related to sacred forests and sacred groves. Impact of introduction of high yielding varieties, use of fertilizers and pesticides, issues and problems associated with shifting agriculture; Industrialization: environmental impacts of oil refineries, cement plants, paper mills, wood based industries and tea industry.

Unit II: Environmental impacts of coal and lime stone mining, quarrying of sand from hills and rivers, Extraction of petroleum and natural gas; Environmental and socio-economic implications of mega hydro electric projects; Issues relating to conservation of Ramsar sites of north-east India: Loktak lake, Deepor beel, Impact of tourism, social conflicts and environment.

Environmental Economics and Sociology

Unit I: Introduction to Environmental Economics and Natural Resource Accounting; Natural Goods and Services; Valuation methods of Natural Resources; Valuation of tangibles and intangibles; Accounting of Forest, Land and Water resources; Natural Resource Accounting and sustainable development; System of Environmental and Economic Accounting, and Green Accounting.

Unit II: Population growth of humans; Malthusian theory of population; factors affecting human population growth and distribution; Impact of human population growth on natural resources and environment, city and village ecosystem.

Unit III: Environmental sociology: concept of culture, inequality, gender and equity, interaction between society and environment, environmental problems in historical perspective, individual interaction with environment and impact thereof, social movements influencing environmental protection, society and resources management, decision making.

Unit IV: Communication: definition, models, characteristics, process and approach, learning experience, principles and types, learning in groups, group defined, group size and characteristics, task and techniques: Snowball groups and Buzz group. Motivation: definition, models; Training- concept, type and steps required to be followed to train different level of functionaries.

Forest Management and Biodiversity Conservation

Unit I: Management: definition, principles of forest management, objectives of forest management,
Rotation: kinds of rotation, Land expectation value, Normal forest, Estimation of normal growing stock. Silviculture systems: definition, characteristics, scope and classification; Clear felling systems, Clear strip system. Alternate strip system: (methods of obtaining regeneration, advantages and disadvantages.

Unit II: Uniform system: definition, pattern of felling- seeding felling, secondary and final fellings, Regeneration period, Periodic block,: allotment of area to fixed/ permanent of floating periodic blocks, preparatory fellings, (examples , advantages and disadvantages). Indian Irregular Shelterwood system and Selection system: definition, methods of obtaining regeneration, conditions of application, pattern of felling, advantages and disadvantages. Management of clump and non clump forming bamboo species), traditional forest management systems in northeast India.

Unit III: Biodiversity: Major categories, ecosystem diversity, species diversity, genetic diversity, natural biodiversity vs agricultural biodiversity, determinants of species diversity. Definitions: endemic, extinct, endangered, vulnerable, rare. Status of species diversity in India, distribution of biodiversity, hotspots. Biodiversity loss and strategies for conservation: Factors affecting biodiversity, ex-situ and in-situ conservation at the species and ecosystem levels. Protected areas: National parks, wildlife Sanctuaries and Biosphere Reserves. Traditional biodiversity conservation practices.

Unit IV: Value and significance of biodiversity: Tangible benefits- food, fiber, fodder, medicines, construction material. Intangibles- pollination, pest control, soil development and maintenance of soil fertility, soil and water conservation, nutrient cycling. Human-animal conflicts, existing conservation projects: Tiger, Rhino, Elephant, Turtles, Crocodiles, Birds; Coral reefs and Mangroves.

MPSC-Forest Ranger

Syllabus

Forestry

Paper - I

Section-A

1. Silviculture – General:

General Silvicultural Principles: Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests; methods of propagation, grafting techniques; site factors; nursery and planting techniquesnursery beds, poly-bags and maintenance, water budgeting, grading and hardening of seedlings; special approaches; establishment and tending.

2. Silviculture-Systems:

Clear felling, uniform shelter wood selection, coppice and conversion systems, Management of silviculture systems of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of standards, enrichment methods, technical constraints, intensive mechanized methods, aerial seeding, thinning.

3. Silviculture – Mangrove and Cold desert:

Mangrove: Habitat and characteristics, mangrove, plantation-establishment and rehabilitation of degraded mangrove formations; silvicultural systems for mangrove; protection of habitats against natural disasters. Cold desert- Characteristics, identification and management of species.

4. Silviculture of trees:

Traditional and recent advances in tropical silvicultural research and practices. Silviculture of some of the economically important species in India such as Acacia catechu, Acacia nilotica, Acacia auriculiformis, Albizzia lebbeck, Albizzia procera, Anthocephalus Cadamba, Anogeissus latifokia, Azadirachta indica, Bamboo spp, Butea monosperma, Cassia siamea, Casuarina equisetifolia, Cedrus deodara, Chukrasia tabularis, Dalbergia sisoo, Dipterocarpus spp, Emblica officindils, Eucalyptus spp, Gmelina Arborea, Hardwickia binata, Largerstroemia Lanceolata, Pinus roxburghi, Populus spp, Pterocarpus marsupium, Prosopis juliflora, Santalum album, Semecarpus anacrdium,. Shorea robusta, Salmalia malabaricum, Tectona grandis, Terminalis tomemtosa,Tamarindus indica.

Section- B

1.Agroforestry, Social Forestry, Joint Forest Management and Tribology:

Agroforestry – Scope and necessity; role in the life of people and domestic animals and in integrated land use, planning especially related to (i) soil and water conservation; (ii) water recharge; (iii) nutrient availability to crops; (iv) nature and eco-system preservation including ecological balances through pest-predator relationships and (v) Providing opportunities for enhancing biodiversity, medicinal and other flora and fauna. Agro forestry systems under different agroecological zones; selection of species and role of multipurpose trees and NTFPs, techniques, food, fodder and fuel security. Research and Extension needs. Social/Urban Forestry : Objectives, scope and necessity; peoples participation. JFM - Principles, objectives, methodology, scope, benefits and role of NGOs. Tribology: Tribal scene in India; tribes, concept of races, Principles of social grouping, stages of tribal economy,education, cultural tradition, customs, ethos and participation in forestry programmes.

2. Forest Soils, soil Conservation and Watershed Management:

Forests Soils: Classification, factors affecting soil formation; physical, chemical and biological properties.

Soil conservation – definition, causes for erosion; types–wind and water erosion; conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. Role of forests in conserving soils. Maintenance and build up of soil organic matter, provision of loppings for green leaf manuring; forest leaf litter and composting; Role of micro-organisms in ameliorating soils; N and C cycles, VAM. Watershed Management – Concepts of watershed; role of mini-forests and forest trees in overall resource management, forest hydrology, watershed development in respect of torrent control, river channel stabilization, avalanche and landslide controls, rehabilitation of degraded areas; hilly and mountain areas; watershed management and environmental functions of forests; water-harvesting and conservation; ground water recharge and watershed management; role of integrating forest trees, horticultural crops, field crops, grass and fodders.

3.Environmental Conservation and Biodiversity:

Environment : Components and importance, principles of conservation, impact of deforestation; forest fires and various human activities like mining, construction and developmental projects, population growth on environment.

Pollution: Types, Global warming, green house effects, ozone layer depletion, acid rain, impact and control measures, environmental monitoring; concept of sustainable development. Role of trees and forests in environmental conservation; control and prevention of air, water and noise pollution.

Environmental policy and legislation in India. Environmental impact Assessment, Economics assessment of watershed development vis-a-vis ecological and environmental protection.

4. Tree Improvement and Seed Technology :

General concept of tree improvement, methods and techniques, variation and its use, provenance, seed source, exotics; quantitative aspects of forest tree improvement, seed production and seed orchards, progeny tests, use of tree improvement in natural forest and stand improvement, genetic testing programming, selection and breeding for resistance to diseases, insects, and adverse environment; the genetic base, forest genetic resources and gene conservation in situ and ex-situ. Cost benefit ratio, economic evaluation.

Paper - II

Section-A

1. **Forest Management and Management Systems:**
   Objective and principles; techniques; stand structure and dynamics, sustained yield relation; rotation, normal forest, growing stock; regulation of yield; management of forest plantations, commercial forests, forest cover monitoring. Approaches viz., (i) site-specific planning, (ii) strategic planning, (iii) Approval, sanction and expenditure. (iv) Monitoring (v) Reporting and governance. Details of steps involved such as formation of Village Forest Committees, Joint Forest Participatory Management.

2. **Forest Working Plan:**
   Forest planning, evaluation and monitoring tools and approaches for integrated planning; multipurpose development of forest resources and forest industries development; working plans and working schemes, their role in nature conservation, bio-diversity and other dimensions; preparation and control. Divisional Working Plans, Annual Plan of Operations.

3. **Forest Mensuration and Remote Sensing:**
   Methods of measuring- diameter, girth, height and volume of trees; form-factor; volume estimation of stand, current annual increment; mean annual increment, Sampling methods and sample plots. Yield calculation; yield and stand tables, forest cover monitoring through remote sensing; Geographic Information Systems for management and modelling.

4. **Surveying and Forest Engineering:**

   Forest surveying – different methods of surveying, maps and map reading. Basic principles of forest engineering. Building materials and construction. Roads and Bridges, General principles, objects, types, simple design and construction of timber bridges.

Section- B

1. **Forest Ecology and Ethnobotany:**

Forest Ecology: Biotic and aboitic components, forest eco-systems; forest community concepts; vegetation concepts, ecological succession and climax, primary productivity, nutrient cycling and water relations; physiology in stress environments (drought, water logging salinity and alkalinity). Forest types in India, identification of species, composition and associations; dendrology, taxonomic classification, principles and establishment of herbaria and arboreta. Conservation of forest ecosystems. Clonal parks. Role of Ethnobotany in Indian Systems of Medicine; Ayurveda and Unani – Introduction, nomenclature, habitat, distribution and botanical features of medicinal and aromatic plants. Factors affecting action and toxicity of drug plants and their chemical constituents.

2. **Forest Resources and Utilization:**

   Environmentally sound forest harvesting practices; logging and extraction techniques and principles, transportation systems, storage and sale; Non-Timber Forest Products (NTFPs) - definition and scope; gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac, katha and Bidi leaves, collection; processing and disposal, need and importance of wood seasoning and preservation; general principles of seasoning, air and kiln seasoning, solar dehumidification, steam heated and electrical kilns. Composite wood; adhesives-manufacture, properties, uses, plywood manufacture-properties, uses, fibre boards-manufacture properties, uses; particle boards-manufacture; properties, uses. Present status of composite wood industry in India and future expansion plans. Pulp-paper and rayon; present position of supply of raw material to industry, wood substitution, utilization of plantation wood; problems and possibilities. Anatomical structure of wood, defects and abnormalities of wood, timber identification-general principles.

3. **Forest Protection & wildlife Biology:**

   Injuries to forest – abiotic and biotic, destructive agencies, insect-pests and disease, effects of air pollution on forests and forest die back. Susceptibility of forests to damage, nature of damage, cause, prevention, protective measures and benefits due to chemical and biological control. General forest protection against fire, equipment and methods, controlled use of fire, economic

and environmental costs; timber salvage operations after natural disasters. Role of afforestation and forest regeneration in absorption of CO_2. Rotational and controlled grazing, different methods of control against grazing and browsing animals; effect of wild animals on forest regeneration, human impacts; encroachment, poaching, grazing, live fencing, theft, shifting cultivation and control.

4. **Forest Economics and Legislation:**

Forest economics: Fundamental principles, cost-benefit analyses;estimation of demand and supply; analysis of trends in the national and international market and changes in production and consumption patterns; assessment and projection of market structures; role of private sector and co-operatives; role of corporate financing. Socio-economic analysis of forest productivity and attitudes; valuation of forest goods and service.

Legislation-History of forest development; Indian Forest Policy of 1894, 1952 and 1990. National Forest Policy, 1988 of People's involvement, Joint Forest Management, Involvement of women; Forestry policies and issues related to land use, timber and non-timber products, sustainable forest management; industrialisation policies; institutional and structural changes. Decentralization and Forestry Public Administration. Forest laws, necessity; general principles, Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments; Application of Indian Penal Code to Forestry. Scope and objectives of Forest Inventory.

MPSC-Forest Ranger

Syllabus

Geology

Paper - I

Section-A

(i) General Geology:

The Solar System, meteorities, origin and interior of the earth. Radioactivity and age of earth; Volcanoes-causes and products, volcanic belts.Earthquakes-causes, effects, earthquake belts, seismicity of India, intensity and magnitude,seismongraphs. Island arcs, deep sea trenches and mid-ocean ridges. Continental drift-evidences and mechanics; sea-floor spreading, plate tectonics. Isostasy, orogeny and epeirogeny. Continents and oceans.

(ii) Geomorphology and Remote Sensing:

Basic concepts of geomorphology.Weathering and mass wasting. Landforms, slopes and drainage. Geomorphic cycles and their interpretation, Morphology and its relation to structures and lithology. Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. Geomorphology of Indian sub-continent.
Aerial photographs and their interpretationmerits and limitations.The Electromagnetic Spectrum. Orbiting satellites and sensor systems.Indian Remote Sensing Satellites. Satellites data products. Applications of remote sensing in geology.The Geographic Information System and its applications. Global Positioning System.

(iii) Structural geology:

Principles of geologic mapping and map reading, projection diagrams, stress andstrain ellipsoid and stress-strain relationships of elastic, plastic and viscous materials. Strain markers in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Folds and faults classification and mechanics.Structural analysis of folds, foliations, lineations, joints and faults, unconformities. Superposed deformation. Time – relationship between crystallization and deformation. Introduction to petrofabrics.

Section- B

(iv) Paleontology:

Species definition and nomenclature.Megafossils and Microfossils. Modes of preservation of fossils. Different kinds of micro fossils. Application of microfossils in correlation, petroleum

exploration, paleo-climatic and pale oceanographic studies, Morphology, geological history and evolutionary trend in Cephalopoda, Trilobita, Brachiopoda, Echi-noidea and Anthozoa, Stratigraphic utility of Ammonoidea, Trilobita and Graptoloidea, Evolutionary trend in Hominidae, Equidae and Probo-scidae. Siwalik fauna, Gondwana flora and its importance.

(v) **Stratigraphy and Geology of India:**

Classification of stratigraphic sequences: lithostratigraphic, biostratigraphic, chronostratigraphic and magnetostratigraphic and their interrelationships. Distribution and classification of Precambrian rocks of India. Study of stratigraphic distribution and lithology of Phanerozoic rocks of India with reference to fauna, flora and economic importance. Major boundary problems -Cambrian/Precambrian, Permian/ Triassic, Cretaceous/Tertiary and Pliocene/ Pleistocene. Study of climatic conditions, paleogeography and igneous activity in the Indian subcontinent in the geological past. Tectonic framework of India. Evolution of the Himalayas.

(vi) **Hydrogeology and Engineering Geology:**

Hydrologic cycle and genetic classification of water. Movement of subsurface water, Springs. Porosity, permeability, hydraulic conductivity, transmissivity and storage coefficient, classification of aquifers.Water-bearingcharacteristics of rocks. Ground-water chemistry. Salt water intrusion.Types of wells.Drainage basin morphometry. Exploration for groundwater. Groundwater recharge. Problems and management of groundwater, Rainwater harvesting. Engineering properties of rocks. Geological investigations for dams, tunnels and bridges. Rock as construction material. Alkali-aggregate reaction. Landslides causes, prevention and rehabilitation. Earthquake-resistant structures.

Paper - II

Section-A

(i) **Mineralogy:**

Classification of crystals into systems and classes of symmetry. International system of crystallographic notation. Use of projection diagrams to represent crystal symmetry. Crystal defects. Elements of xray crystallography. Petrological microscope and accessories. Optical properties of common rock forming minerals. Pleochroism, extinction angle, double refraction, birefringence, twinning and dispersion in minerals. Physical and chemical characters of rock forming silicate mineral groups. Structural classification of silicates. Common minerals of

igneous and metamorphic rocks. Minerals of the caronate, phosphate, sulphide and halide groups.

(ii) **Igneous and Metamorphic Petrology:**

Generation and crystallisation of magma. Crystallisation of albite-anorthite, diopside-anorthite and diopsidewollastonite- silica systems. Reaction principle. Magmatic differentiation and assimilation. Petrogenetic significance of the textures and structures of igneous rocks. Petrography and petrogenesis of granite, syenite, diorite, basic and ultrabasic groups, charnockite, anorthosite and alkaline rocks. Carbonatites. Deccan volcanic province. Types and agents of metamorphism. Metamorphic grades and zones. Phase rule. Facies of regional and contact metamorphism. ACF and AKF diagrams. Textures and structures of metamorphic rocks. Metamorphism of arenaceous, argillaceous and basic rocks. Minerals assemblages, Retrograde metamorphism. Metasomatism and granitisation, migmatities, granulite terrains of India.

(iii) **Sedimentology: Sedimentary rocks:**

Processes of formation, diagenesis and lithification, Properties of sediments. Clastic and nonclastic rocks-their classification, petrography and depositional environment, Sedimentary facies and provenance. Sedimentary structures and their significance. Heavy minerals and their significance. Sedimentary basins of India.

Section-B

(iv) **Economic Geology:**

Ore, ore minerals and gangue, tenor of ore, classification of ore deposits. Process of formation of minerals deposits. Controls of ore locallisation. Ore textures and structures, Metallogenic epochs and provinces, Geology of the important Indian deposits of aluminium, chromium, copper, gold, iron, lead, zinc, manganese, titanium, uranium and thorium and industrial minerals. Deposits of coal and petroleum in India. National Mineral Policy. Conservation and utilization of mineral resources. Marine mineral resources and Law of Sea.

(v) **Mining Geology:**

Methods of prospecting-geological, geophysical, geo-chemical and geo-botanical, Techniques of sampling. Estimation of reserves of ore, Methods of exploration and mining metalic ores, industrial minerals and marine mineral resources. Mineral beneficiation and ore dressing.

(vi) **Geochemistry and Environmental Geology:**

Cosmic abundance of elements, Composition of the planets and meteorites, Structure and composition of earth and distribution of elements, Trace elements, Elements of crystal chemistry – types of chemical bonds, coordination number, Isomorphism and polymorphism, Elementary thermodynamics. Natural hazards-floods, landslides, coastal erosion, earthquakes and volcanic activity and mitigation, Environmental impact of urbanization, open cast mining, industrial and radioactive waste disposal, use of fertilizers, dumping of mine waste and fly-ash. Pollution of ground and surface water, marine pollution,environment protection-legislative measures in India.

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Syllabus

Mathematics

Paper - I

Section-A

Linear Algebra :

Vector, space, linear dependence and independence, subspaces, bases, dimensions. Finite dimensional vector spaces. Matrices, Cayley-Hamilition theorem, eigen-values and eigenvectors, matrix of linear transformation, row and column reduction, Echelon form, equivalences, congruences and similarity, reduction to cannonical form, rank, orthogonal, symmetrical, skew symmetrical, unitary, hermitian, skewhermitian forms- their eigenvalues. Orthogonal and unitary reduction of quadratic and hermitian forms, positive definite quardratic forms.

Calculus :

Real numbers, limits, continuity ,differentiability, mean-value theorems, Taylor's theorem with remainders, indeterminate forms, maxima and minima, asymptotes. Functions of several variables: continuity, differentiability, partial derivatives, maxima and minima, Lagrange's method of multipliers, Jacobian. Riemann's definition of definite integrals, indefinite integrals, infinite and improper integrals, beta and gamma functions. Double and triple integrals (evaluation techniques only). Areas, surface and volumes, centre of gravity.

Analytical Geometry :

Cartesian and polar coordinates in two and three dimensions, second degree equations in two and three dimensions, reduction to cannonical forms, straight lines, shortest distance between two skew lines, plane, sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

Section-B

Ordinary Differential Equations:

Formulation of differential equations, order and degree, equations of first order and first degree, integrating factor, equations of first order but not of first degree, Clariaut's equation, singular solution. Higher order linear equations with constant coefficients, complementary function and particular integral, general solution, Euler-Cauchy equation.

Second order linear equations with variable coefficients, determination of complete solution when one solution is known, method of variation of parameters.

Dynamics, Statics and Hydrostatics:

Degree of freedom and constraints, rectilinear motion, simple harmonic motion, motion in a plane, projectiles, constrained motion, work and energy, conservation of energy, motion under impulsive forces, Kepler's laws, orbits under central forces, motion of varying mass, motion under resistance.

Equilibrium of a system of particles, work and potential energy, friction, common catenary, principle of virtual work, stability of equilibrium, equilibrium of forces in three dimensions.

Pressure of heavy fluids, equilibrium of fluids under given system of forces, Bernoulli's equation, centre of pressure, thrust on curved surfaces, equilibrium of floating bodies, stability of equilibrium, meta-centre, pressure of gases.

Vector Analysis:

Scalar and vector fields, triple products, differentiation of vector function of a scalar variable, gradient, divergence and curl in Cartesian, cylindrical and spherical coordinates and their physical interpretations. Higher order derivatives, vector identities and vector equations.

Application to Geometry:

Curves in space curvature and torision. Serret-Frenet's formulae, Gauss and Stokes' theorems, Green's identities.

Paper - II

Section-A

Algebra:

Groups, sub-groups, normal subgroups, homomorphism of groups, quotient groups, basic isomorphism theorems, Sylow's group, permutation groups, Cayley theorem, rings and ideals, principal ideal domains, unique factorization domains and Euclidean domains. Field extensions, finite fields.

Real Analysis:

Real number system, ordered sets, bounds, ordered field, real number system as an ordered field with least upper bound property, Cauchy sequence, completeness, Continuity and uniform continuity of functions, properties of continuous functions on compact sets. Riemann integral, improper integrals, absolute and conditional convergence of series of real and complex terms, rearrangement of series, Uniform convergence, continuity, differentiability and integrability for sequences and series of functions.

Differentiation of functions of several variables, change in the order of partial derivatives, implicit function theorem, maxima and minima, Multiple integrals.

Complex Analysis:

Analytic function Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formula, power series, Taylor's series, Laurent's Series, Singularities, Cauchy's residue theorem, contour integration, Conformal mapping, bilinear transformations.

Linear Programming:

Linear programming problems, basic solution, basic feasible solution and optimal solution, graphical method and Simplex method of solutions, Duality. Transportation and assignment problems, Travelling salesman problems.

Section-B

Partial differential equations:

Curves and surfaces in three dimensions, formulation of partial differentiation equations, solutions of equations of type dx/p=dy/q=dz/r; orthogonal trajectories, Pfaffian differential equations; partial differential equation of the first order, solution by Cauchy's method of characteristics; Charpit's method of solutions, linear partial differential equations of the second order with constant coefficients, equations of vibrating string, heat equation, Laplace equation.

Numerical analysis and Computer programming:

Numerical methods: solution of algebraic and transcendental equations of one variable by bisection, Regula-Falsi and Newton-Raphson methods, solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct) methods, Gauss-Seidel (iterative) method. Newton's (Forward and backward) and Lagrange's method of interpolation.

Numerical integration:

Simpson's onethird rule, tranpezodial rule, Gaussian quardrature formula.

Numerical solution of ordinary differential equations:

Euler and Runge Kuttamethods. Computer Programming: Storage of numbers in computers, bits, bytes and words, binary system, arithmetic and logical operations on numbers, Bitwise operations. AND, OR, SOR, NOT, and shift/rotate operators, Octal and Hexadecimal Systems. Conversion to and form decimal

Systems. Representation of unsigned integers, signed integers and reals, double precision reals and long integrers.

Algorithms and flow charts for solving numerical analysis problems. Developing simple programs in Basic for problems involving techniques covered in the numerical analysis.

Mechanics and Fluid Dynamics:

Generalised coordinates, constraints, holonomic and non-holonomic, systems, D' Alembert's principle and Lagrange's equations, Hamilton equations, moment of inertia, motion of rigid bodies in two dimensions. Equation of continuity, Euler's equation of motion for inviscid flow, stream-lines, path of a particle, potential flow,two-dimensional and axisymetric motion, sources and sinks, vortex motion, flow past a cylinder and a sphere, method of images. Navier- Stokes equation for a viscous fluid.

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Syllabus

Mechanical Engineering

Paper - I

1. **Theory of Machines :**
   Kinematic and dynamic analysis of planar mechanisms, Cams, Gears and gear trains, Flywheels, Governors, Balancing of rigid rotors, Balancing of single and multicylinder engines, Linear vibration analysis of mechanical systems (single degree and two degrees of freedom), Critical speeds and whirling of shafts, Automatic Controls, Belts and chain drives. Hydrodynamic bearings.

2. **Mechanics of Solids :**
   Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, Stress-strain relations, unilaxial loading, thermal stresses, Beams: Banding moment and shear force diagrams, bending stresses and deflection of beams, Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Thick and thin walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure. Rotating discs. Shrink fits.

3. **Engineering Materials :**
   Basic concepts on structure of solids, crystalline materials, Defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials. Heat treatment of steels, plastics, Ceramics and composite Materials, common applications of various materials.

4. **Manufacturing Science:**
   Merchant's force analysis, Taylor's tool life equation, machinability and machining economics, Rigid, small and flexible automation, NC, CNC. Recent machining methods-EDM, ECM and ultrasonic. Application of lasers and plasmas, analysis of forming processes. High energy rate forming Jigs, fixtures, tools and gauges, Inspection of length, position, profile and surface finish.

5. **MANUFACTURING MANAGEMENT :**

Production Planning and Control, Forecasting-moving average, exponential smoothing, Operations sheduling; assembly line balancing. Product development, Breakeven analysis, Capacity planning. PERT and CPM. Control Operations: Inventory control-ABC analysis, EOQmodel, Materials requirement planning, Job design, Job standards, work measurement, Quality management-Quality control Operations Research: Linear programming-Graphical and Simplex methods, Transportation and assignment models, Single server queuing model.

Value Engineering:
Value analysis, for cost/ value, Total quality management and forecasting techniques. Project management.

6. **ELEMENTS OF COMPUTATION :**
   Computer Organisation, Flow charting, Features of Common Computer Languages FORTRAN, d Base-III, Lotus 1-2-3, C and elementary programming.

Paper - II

1. **THERMODYNAMICS:**
   Basic concept, Open and closed systems, Applications of Thermo-dynamic Laws, Gas equations, Clapeyron equation, Availability, Irreversibility and T ds relations.

2. **I.C. Engines, Fuels and Combustion:**
   Spark Ignition and compression ignition engines, four stroke engine and two stroke engines, mechanical, thermal and volumetric efficiency, Heat balance. Combustion process in S.I. and C.I. engines, pre-ignition detonation in S.I. engine Diesel knock in C.I. engine. Choice of engine fuels, Octane and Cetane retings. Alternate fuels Carburration and Fuel injection, Engine emissions and control, Solid, liquid and gaseous fuels, stoichometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

3. **HEAT TRANSFER, REFRIGERATION AND AIR CONDITIONING :**
   One and two dimensional heat conduction. Heat transfer from extended surfaces, heat transfer by forced and free convection. Heat exchangers, Fundamentals for diffusive and connective mass transfer, Radiation laws, heat exchange between black and non black surfaces, Network Analysis, Heat pump refrigeration cycles and systems, Condensers, evaporators and expansion devices and controls, Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling loading calculations, solar refrigeration.

4. **TURBO-MACHINES AND POWER PLANTS:**
   Continuity, momentum and Energy Equations. Adiabatic and Isentropic flow, fanno lines, Raylegh lines, Theory and design of axial flow turbines and compressors, Flow through turbo-machine balde, cascades, centrifugal compressor. Dimensional analysis and modelling. Selection of site for steam, hydro nuclear and stand-by power plants, Selection base and peak load power plants, Modern High Pressure, High duty boilers, Draft and dust removal equipment, Fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

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Syllabus

Physics

Paper - I

Section-A

1. Classical Mechanics

(a) Particle dynamics:

- Centre of mass and laboratory coordinates
- conservation of linear and angular momentum
- The rocket equation
- Rutherford scattering
- Galilean transformation
- inertial and non-inertial frames
- rotating frames
- centrifugal and Coriolls forces
- Foucault pendulum

(b) System of particles

- Constraints
- degrees of freedom
- generalised coordinates
- momenta.Lagrange’s equation
- applications to linear harmonic oscillator
- simple pendulum
- central force problems
- Cyclic coordinates
- Hamiltonian Lagrange’s equation from Hamilton’s principle.

(c) Rigid body dynamics

- Eulerian angles
- inertia tensor
- principal moments of inertia
- Euler’s equation of motion of a rigid body
- force-free motion of a rigid body
- Gyroscope.

2. Special Relativity, Waves & Geometrical Optics :

(a) Special Relativity

- Michelson-Morley experiment and its implications
- Lorentz transformations length contraction,
- time dilation
- addition of velocities
- aberration and Doppler effect
- mass energy relation
- simple application to a decay process
- Minkowski diagram
- four dimensional momentum vector
- Covariance of equations of physics.

(b) Waves

- Simple harmonic motion
- damped oscillation
- forced oscillation
- resonance
- Beats
- Stationary waves in a string
- Pulses and wave packets
- Phase and group velocities
- Reflection and Refraction from Huygens' principle.

(c) Geometrical Optics

- Laws of reflection and refraction from Format's principle
- Matrix method in paraxial optic-thin-lens formula
- nodal planes
- system of two thin lenses
- chromatic and spherical aberrations.

3. Physical Optics :

(a) Interference

- Interference of light-Young's experiment
- Newton's rings
- interference by thin films
- Michelson interferometer
- Multiple beam interference and Fabry-Perot interferometer
- Holography and simple applications.

(b) Diffraction

- Fraunhofer diffraction-single slit
- double slit
- diffraction grating
- resolving power
- Fresnel diffraction
- half-period zones and zones plates
- Fersnel integrals.
- Application of Cornu's spiral to the analysis of diffraction at a straight edge and by a long narrow slit. Deffraction by a circular aperture and the Airy pattern.

(c) Polarisation and Modern Optics

- Production and detection of linearly and circularly polarised light
- Double refraction
- quarter wave plate
- Optical activity
- Principles of fibre optics attenuation
- pulse dispersion in step index and parabolic index fibres
- material dispersion
- single mode fibres
- Lasers-Einstein A and B coefficients
- Ruby and He-Ne lasers
- Characteristics of laser light-spatial and temporal coherence
- Focussing of laser beams
- Three-level scheme for laser operation.

Section-B

4. Electricity and Magnetism:

(a) Electrostatics and Magneto-statics

- Laplace and Poisson equations in electrostatics and their applications
- Energy of a system of charges
- multiple expansion of scalar potential
- Method of images and its applications.
- Potential and field due to a dipole
- force and torque on a dipole in an external field
- Dielectrics
- Polarisation
- Solutions to boundary-value problems conducting and dielectric spheres in a uniform electric field Magnetic shell

- uniformly magnetised sphere
- Ferromagnetic materials
- Hysteresis
- energy loss

(b) Current Electricity:

Kirchhoff's laws and their applications, Biot- Savart law, Ampere's law, Faraday's law, Lenz' law. Self and mutual inductances. Mean and rms values in AC circuits, LR, CR and LCR circuits-series and parallel resonance, Quality factor, Principle of transformer.

5. Electromagnetic Theory & Black Body Radiation :

(a) **Electromagnetic Theory :** Displacement current and Maxwell's equations. Wave equations in vacuum, Poynting theorem, Vector and scalar potentials, Gauge invariance, Lorentz and Coulomb gauges, Electromagnetic field tensor, covariance of Maxwell's equations. Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics. Fresnel's relations, Normal and anomalous dispersion, Rayleigh scattering.

(b) Blackbody radiation:

Blackbody radiation ad Planck radiation law-Stefan-Boltzmann law, Wien displacement law and Rayleigh-Jeans law, Planck mass, Planck length, Planck time, Plank temperature and Planck energy.

6. Thermal and Statistical Physics :

(a) Thermodynamics

Laws of thermodynamics, reversible and irreversible processes, entropy, Isothermal, adiabatic, isobaric, isochoric processes and entropy change, Otto and Diesel engines, Gibbs' phase rule and chemical potential. Van der Waals equation of state of real gas, critical constants. Maxwell-Boltzman distribution of molecular velocities, transport phenomena, equipartition and virial theorems, Dulong-Petit, Einstein, and Debye's theories of specific heat of solids. Maxwell relations and applications. Clausius-Clapeyron equation. Adiabatic demagnetisation, Joule-Kelvin effect and liquefication of gases.

(b) Statistical Physics: Saha ionization formula, Bose-Einstein condensation, Thermodynamic behaviour of an ideal Fermi gas, Chandrasekhar limit, elementary ideas about neutron stars and pulsars, Brownian motion as a random walk, diffusion process. Concept of negative temperatures.

Paper - II

Section-A

1. Quantum Mechanics I:

Wave-particle duality. Schroedinger equation and expectation values. Uncertainty principle, Solutions of the onedimensional Schroedinger equation free particle (Gaussian wave-packet), particle in a box, particle in a finite well, linear, harmonic oscillator, Reflection and transmission by a potential step and by a rectangular barrier, use of WKB formula for the life-time calculation in the alphadecay problem.

2. Quantum Mechanics II & Atomic Physics :

(a) Quantum Mechanics II :

Particle in a three dimensional box, density of states, free electron theory of metals, The angular momentum problem, The hydrogen atom, The spin half problem and properties of Pauli spin matrices.

(b) Atomic Physics :

Stern-Gerlack experiment, electron spin, fine structure of hydrogen atom, L-S coupling, J-J coupling, Spectroscopic notation of atomic states, Zeeman effect, Frank-Condon principle and applications.

Molecular Physics : Elementary theory of rotational, vibrational and electronic spectra of diatomic molecules, Raman effect and molecular structure, Laser Raman spectroscopy importance of neutral hydrogen atom, molecular hydrogen and molecular hydrogen ion in astronomy Fluorescence and Phos-phorescence, Elementary theory and applications of NMR. Elementary ideas about Lamb shift and its significance.

Section-B

Nuclear Physics :

Basic nuclear properties-size, binding energy, angular momentum, parity,magnetic moment, Semi-empirical mass formula and applications, Mass parabolas, Ground state of deuteron magnetic moment and non-central forces, Meson theory of nuclear forces, Salient features of nuclear forces, Shell model of the nucleus-success and limitations, Violation of parity in beta decay, Gamma decay and internal

conversion, Elementary ideas about Mossbauer spectroscopy, Q-value of nuclear reactions, Nuclear fission and fusion, energy production in stars, Nuclear reactors.

Particle Physics & Solid State Physics:

(a) Particle Physics:

Classification of elementary particles and their interactions, Conservation laws, Quark structure of hadrons. Field quanta of electro-weak and strong interactions. Elementary ideas about Unification of Forces, Physics of neutrinos.

(b) Solid State Physics

Cubic crystal structure, Band theory of solids-conductors, insulators and semiconductors, Elements of superconductivity, Meissner effect, Joseph-son junctions and applications, Elementary ideas about high temperature superconductivity.

6. Electronics

Intrinsic and extrinsic semiconductors-pn- p and n-p-n transistors, Amplifiers and oscillators, Op-amps, FET, JFET and MOSFET, Digital electronics-Boolean identities, De-Morgan's laws, Logic gates and truth tables, Simple logic circuits, Thermistors, solar cells, Fundamentals of microprocessors and digital computers.

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Syllabus

Statistics

Paper - I

Probability :

- Sample space and events
- probability measure and probability space
- random variable as a measurable function
- distribution function of a random variable
- discrete and continuous-type random variable
- probability mass function, probability density function
- vector-valued random variable
- marginal and conditional distributions
- stochastic independence of events and of random variables
- expectation and moments of a random variable
- conditional expectation
- convergence of a sequence of random variable in distribution in probability
- pth mean and almost every where
- criteria and inter-relations
- Borel-Cantelli lemma
- Chebyshev's and Khinchine's weak laws of large numbers
- strong law of large numbers and Kolmogorov's theorems
- Glivenko-Cantelli theorem
- probability generating function
- characteristic function
- inversion theorem
- Laplace transform
- related uniqueness and continuity theorems
- determination of distribution by its moments
- Linderberg and Levy forms of central limit theorem
- standard discrete and continuous probability distributions
- their interrelations and limiting cases
- simple properties of finite Markov chains

Statistical Inference :

- Consistency
- Unbiasedness
- Efficiency
- Sufficiency
- minimal sufficiency
- completeness
- ancillary statistic
- factorization theorem
- exponential family of distribution and its properties
- uniformly minimum variance unbiased (UMVU) estimation
- Rao-Blackwell and Lehmann- Scheffe theorems
- Cramer-Rao inequality for single and several-parameter family of distributions
- minimum variance bound estimator and its properties

- modifications and extensions of Cramer-Rao inequality
- Chapman-Robbins inequality, Bhattacharya's bounds
- estimation by methods of moments, maximum likelihood
- least squares
- minimum chisquare
- modified minimum chi-square properties of maximum likelihood
- other estimators,
- idea of asymptotic efficiency
- idea of prior and posterior distributions
- Bayes
- estimators
- Non-randomised and randomised tests
- critical function
- MP tests
- Neyman- Pearson lemma
- UMP tests, monotone likelihood ratio
- generalised Neyman- Pearson lemma
- similar and unbiased tests
- UMPU tests for single and severalparameter families of distributions
- likelihood rotates and its large sample properties
- chi-square goodness of fit test and its asymptotic distribution.
- Confidence bounds and its relation with tests
- uniformly most accurate (UMA) and UMA unbiased confidence bounds.
- Kolmogorov's test for goodness of fit and its consistency
- sign test and its optimality
- Wilcoxon signed-ranks test and its consistency
- Kolmogorov-Smirnov twosample test
- run test
- Wilcoxon-Mann- Whitney test and median test
- their consistency and asymptotic normality
- Wald's SPRT and its properties
- OC and ASN functions
- Wald's fundamental identity
- sequential estimation

Linear Inference and Multivariate Analysis :

- Linear statistical models
- theory of least squares and analysis of variance
- Gauss- Markoff theory
- normal equations
- least squares estimates and their precision
- test of significance and interval estimates based on least squares theory in one-way,two-way and three-way classified data
- regression analysis
- linear regression
- curvilinear regression and orthogonal polynomials
- multiple regression
- multiple and partial correlations
- regression diagnostics and sensitivity analysis
- calibration problems
- estimation of variance and covariance components
- MINQUE theory

- multivariate normal distribution
- Mahalanobis
- D2 and Hotelling's T2 statistics and their applications and properties
- discriminant analysis
- canonical correlations
- one-way MANOVA
- principal component analysis
- elements of factor analysis

Sampling Theory and Design of Experiments :

- An outline of fixed-population and superpopulation approaches,
- distinctive features of finite population sampling
- probability sampling designs
- simple random sampling with and without replacement
- stratified random sampling
- systematic sampling and its efficacy for structural populations
- cluster sampling
- two-stage and multi-stage sampling
- ratio and regression
- methods of estimation involving one or more auxiliary variables
- two-phase sampling
- probability proportional to size sampling with and without replacement
- the Hansen-Hurwitz and the Horvitz-Thompson estimator
- nonnegative variance estimation with reference to the Horvitz-Thompson estimators non-sampling errors
- Warner's randomised response technique for sensitive characteristics.
- Fixed effects model (two-way classification) random and mixed effects models (two-way classification with equal number of observation per cell), CRD, RBD, LSD and their analysis, incomplete block designs, concepts of orthogonality and balance, BIBD, missing plot technique, factorial designs: 2n, 32 and 33, confounding in factorial experiments, splitplot and simple lattice designs.
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Paper – II

I. Industrial Statistics:

- Process and product control
- general theory of control charts
- different types of control charts for variables and attributes, X, R, s, p, np and c charts
- cumulative sum chart
- V-mask
- single, double, multiple and sequential sampling plans for attributes
- OC, ASN, AQQ and ATI curves
- concepts of producer's and consumer's risks
- AQL
- LTPD and AOQL
- sampling plans for variables
- use of Dodge-Roming and Military Standard tables
- Concepts of reliability
- maintainability and availability
- reliability of series and parallel systems and other simple configurations
- renewal density and renewal function

- survival models (exponential, Weibull, lognormal, Rayleigh, and bath-tub)
- different types of redundancy and use of redundancy in reliability improvement
- Problems in lifetesting censored and truncated experiments for exponential models.

II. Optimization Techniques:

- Different types of models in Operational Research
- their construction and general methods of solution
- simulation and Monte-Carlo methods
- the structure and formulation of linear programming (LP) problem
- simple LP model and its graphical solution
- the simplex procedure
- the two-phase method and the Mtechnique with artificial variables
- the duality theory of LP and its economic interpretation, sensitivity analysis, transportation and assignment problems
- rectangular games
- two-person zero- sum games
- method of solution (graphical and algebraic).
- Replacement of failing or deteriorating items
- group and individual replacement policies
- concept of scientific inventory management
- analytical structure of inventory problems
- simple models with deterministic and stochastic demand with and without lead time
- storage models with particular reference to dam type.
- Homogeneous discrete-time Markov chains
- transition probability matrix
- classification of states and ergodic theorems
- homogeneous continuoustime Markov chains
- Poisson process
- elements of queuing theory
- M/M/1, M/M/K, G/M/1 and M/G/1 queues
- Solution of statistical problems on computers using well-known statistical software packages like SPSS.

III. Quantitative Economics and Official Statistics :

- Determination of trend, seasonal and cyclical components,
- Box-Jenkins method
- tests for stationery of series
- ARIMA models and determination of orders of autoregressive and moving average components, forecasting.
- Commonly used index numbers
- Laspeyre’s, Paashe’s and Fisher’s ideal Index numbers
- chain-base index numbers
- uses and limitations of index number
- index number of wholesale prices
- consumer price index number
- index numbers of agricultural and industrial production
- test for index numbers like proportionality test
- timereversal test
- factor-reversal test

- circular test and dimensional invariance test
- General linear model
- ordinary least squares and generalised least squares methods of estimation
- problem of multicollinearity
- consequences and solutions of multi-collinearity
- autocorrelation and its consequences
- heteroscedasticity of disturbances and its testing
- test for independence of disturbances
- Zellner's seemingly unrelated regression equation model and its estimation
- concept ofstructure and model for simultaneousequations
- problem of identification-rank and order conditions of identifiability
- twostageleast squares method of estimation
- Present official statistical system in India relating to population
- Agriculture
- industrial production
- trade and prices
- methods of collection of official statistics
- their reliability and limitation and the principal publications containing such statistics various official agencies responsible for data collection and their main functions.

IV. Demography and Psychometry :

- Demographic data from census, registration
- NSS and other surveys, and their limitation and uses
- Definition
- construction and uses of vital rates and ratios
- measures of fertility
- reproduction rates, morbidity rate
- standardized death rate
- complete and abridged life tables
- construction of life tables from vital statistics and census returns
- uses of life tables
- logistic and other population growth curve
- fitting a logistic curve
- population projection
- stable population theory
- uses of stable population
- quasi-stable population techniques in estimation of demographic parameters
- morbidity and its measurement
- standard classification by cause of death
- health surveys and use of hospital statistics.
- Method of standardisation of scales and tests
- Z-scores, standard scores
- Tscores, percentile scores
- intelligence quotient and its measurement and uses
- validity of test scores and its determination
- use of factor analysis and path analysis in psychometry

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Syllabus

Zoology

Paper - 1

Section-A

1. Non-chordata and chordata: (a) Classification and relationship of various phyla up-to sub-classes; Acoelomata and Coelomata; Protostomes and Deuterostomes, Bilateralia and Radiata; Status of Protista, Parazoa, Onychophora and Hemichordata; Symmetry.

(b) Protozoa: Locomotion, nutrition, reproduction; evolution of sex; general features and life history of Paramaecium, Monocystis, Plasmodium and Leisismania.

(c) Porifera: Skeleton, canal system and reproduction.

(d) Coelenterata: Polymorphism, defensive structures and their mechanism; coral reefs and their formation; metagenesis; general features and life history of Obelia and Aurelia.

(e) Platyhelminthes: Parasitic adaptation; general features and life history of Fasciola and Taenia and their relation to man.

(f) Nemathelminthes: General features, life history and parasitic adaptation of Ascaris; nemathelminths in relation to man.

(g) Annelida: Coelom and metamerism; modes of life in polychaetes; general features and life history of nereis (Neanthes), earthworm (Pheretima) and leach (Hirundaria).

(h) Arthropoda: Larval forms and parasitism in Crustacea; vision and respiration in arthropods (prawn, cockroach and scorpion); modification of mouth parts in insects (cockroach, mosquito, housefly, honey bee and butterfly); metamorphosis in insects and its hormonal regulation; social organization in insects (termites and honey bees).

(i) Mollusca: Feeding, respiration, locomotion, shell diversity; general features and life history of Lamellidens, Pila and Sepia, torsion and detorsion in gastropods.

(j) Echinodermata: Feeding respiration, locomotion larval forms; general features and life history of Asterias.

(k) Protochordata: Origin of chordates; general features and life history of Branchiostoma and Herdamania.

(l) Pisces: Scales, respiration, locomotion, migration.

(m) Amphibia: Origin of tetrapods; parental care, paedomorphosis.

(n) Reptilia: Origin of reptiles; skull types; status of Sphenodon and crocodiles.

(o) Aves: Origin of birds; flight adaptation, migration.

(p) Mammalia: Origin of mammals; dentition; general features of egglaying mammals, pouchedmammals, aquatic mammals and primates; endocrine glands and other hormone producing structures (pituitary, thyroid, parathyroid, adrenal, pancreas, gonads) and their inter relationships.

(q) Comparative functional anatomy of various systems of vertebrates(integument and its derivatives, endoskeleton, locomotory organs digestive system, respiratory system,

circulatory system including heart and aortic arches; urino-genital system, brain and sense organs (eye and ear).

Section-B
I. Ecology:

(a) Biosphere: Biogeochemical cycles, green-houses effect, ozone layer and its impact; ecological succession, biomes and ecotones.

(b) Population, characteristics, population dynamics, population stabilization.

(c) Conservation of natural resources mineral mining, fisheries, acquaculture; forestry; grassland; wildlife (Project Tiger); sustainable production in agriculture-integrated pest management.

(d) Environmental biodegradation; pollution and its impact on biosphere and its prevention.

II. Ethology:

(a) Behaviour: Sensory filtering, responsiveness, sign stimuli, learning, instinct, habituation, conditioning, imprinting.

(b) Role of hormones in drive; role of pheromones in alarm spreading; crypsis, predator detection, predator tactics, social behaviour in insects and primates, courtship (Drosophila, 3-spine stickleback and birds).

(c) Orientation, navigation, homing; biological rhythms; biological clock, tidal, seasonal and circadian rhythms.

(d) Methods of studying animal behaviour.

III. Economic Zoology:

(a) Apiculture, sericulture, lac culture, carp culture, pearl culture, prawn culture.

(b) Major infectious and communicable diseases (small pox, plague, malaria, tuberculosis, cholera and AIDS) their vectors, pathogens and prevention.

(c) Cattle and livestock diseases, their pathogens (helminths) and vectors (ticks, mites, Tabanus, Stomoxys)

(d) Pests of sugar cane (Pyrilla perpusiella), oil seed (Achaea Janata) and rice (Sitophilus oryzae).

IV. Biostatistics: Designing of experiments; null hypothesis; correlation, regression, distribution and measure of central tendency, chi square, student t-test, F-test (one-way & two-way F-test)

V. Instrumental methods:

(a) Spectrophotometry, flame photometry, Geiger-Muller counter, scintillation counting.

(b) Electron microscopy (TEM, SEM).

Paper - II

Section-A
I. Cell Biology:

(a) Structure and function of cell and its organelles (nucleus, plasma membrane, mitochondria, Golgibodies, endoplasmic reticulum, ribosomes and lysosomes), cell division (mitosis and meiosis), mitotic spindle and mitotic apparatus, chromosome movement.

(b) Watson-Crick model of DNA, replication of DNA, protein synthesis, transcription and transcription factors.

II. Genetics:

(a) Gene structure and functions; genetic code.

(b) Sex chromosomes and sex determination in Drosophilla, nematodes and man.

(c) Mendel's laws of inheritance, recombination, linkage, linkage-maps, multiple alleles, cistron concept; genetics of blood groups.

(d) Mutations and mutagenesis: radiation and chemical.

(e) Cloning technology, plasmids and cosmids as vectors, transgenics, transposons, DNA sequence cloning and whole animal cloning (Principles and methodology).

(f) Regulation and gene expression inpro-and eukaryotes.

(g) Signal transduction; pedigreeanalysis; congenital diseases in man.

(h) Human genome mapping; DNA finger-printing.

III. Evolution:

(a) Origin of life.

(b) Natural selection, role of mutation in evolution, mimicry, variation, isolation, speciation.

(c) Fossils and fossilization; evolution of horse, elephant and man.

(d) Hardy-Weinberg law, causes of change in gene frequency.

(e) Continental drift and distribution of animals.

IV. Systematics:

(a) Zoological nomenclature; international code; cladistics.

Section-B
I. Biochemistry:

(a) Structure and role of carbohydrates, fats, lipids, proteins, aminoacids, nucleic acids; saturated and unsaturated fatty acids, cholesterol.

(b) Glycolysis and Krebs cycle, oxidation and reduction, oxidative phosphorylation; energy conservation and release, ATP, cyclic AMP – its structure and role.

(c) Hormone classification (steroid and peptide hormones), biosynthesis and function.

(d) Enzymes: types and mechanisms of action; immunoglobulin and immunity; vitamins and co-enzymes.

(e) Bioenergetics.

II Physiology (with special reference to mammals):

(a) Composition and constituents of blood; blood groups and Rh factor in man; coagulation, factors and mechanism of coagulation; acid-base balance, thermo regulation.

(b) Oxygen and carbon dioxide transport; haemoglobin: constituents and role in regulation.

(c) Nutritive requirements; role of salivary glands, liver, pancreas and intestinal glands in digestion and absorption.

(d) Excretory products; nephron and regulation of urine formation; osmoregulation.

(e) Types of muscles, mechanism of contraction of skeletal muscles.

(f) Neuron, nerve impulse-its conduction and synaptic transmission; neurotransmitters.

(g) Vision, hearing and olfaction in man.

(h) Mechanism of hormone action.

(i) Physiology of reproduction, role of hormones and phermones.

III. Developmental Biology:

(a) Differentiation from gamete to neurula stage; dedifferentiation; metaplasia, induction, morphogenesis and morphogen; fate maps of gastrulae in frog and chick; organogenesis of eye and heart, placentation in mammals.

(b) Role of cytoplasm in and genetic control of development; cell lineage; causation of metamorphosis in frog and insects; paedogenesis and neoteny; growth, degrowth and cell death; ageing; blastogenesis; regeneration; teratogenesis; neoplasia.

(c) Invasiveness of placenta; in vitro fertilization; embryo transfer, cloning.

(d) Baer’s law; evo-devo concept.