

VISVESVARAYA TECHNOLOGICAL UNIVERSITY,  
BELAGAVI

VTU Eligibility Test for  
Research (VTU-ETR)

Syllabii

For Ph.D/M.Sc.(Engg)  
Programmes

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY,  
BELAGAVI SCHEME OF (VTU-ETR) For  
Ph.D/M.Sc.(Engg)**

**For Faculty of Engineering & General Science**

**Common to:**

Civil Engineering Science / Mechanical Engineering Science' / Electrical Engineering Science / Computer Sciences / Textile / Silk Engineering / Chemical Engineering / Polymer Science /Bio-Tech/ Architecture / Physics / Chemistry /Mathematics/Computer Application/Geology/Nanotechnology

**Part I: Mathematics Section**

Questions carrying one mark - 30 questions  
(Objective/multiple choice, covering full syllabus)

**Part II: Discipline Oriented Section**

Questions carrying one marks - 50 questions  
(Objective/multiple choice, preferably involving numerical covering full syllabus)

**Part III : Aptitude section**

Reading Comprehension data Sufficiency & Data - 20 questions  
Interpretation, Logical Reasoning computer awareness

**TOTAL                    100 marks**

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

## Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT

### For Faculty of Engineering & General Science

#### Part I: **Mathematics Section**

Questions carrying one mark  
(Objective/multiple choice, covering full syllabus)

- 30 questions

#### Common to:

Civil Engineering Science / Mechanical Engineering Science / Electrical Engineering Science / Computer Sciences / Textile / Silk Engineering / Chemical Engineering / Polymer Science / Bio -Tech / Architecture / Physics / Chemistry / Mathematics & M.Sc (Engg)

#### **SYLLABUS IN MATHEMATICS**

1. **Matrices** : Definition, Rank of matrix Systems of m linear equations with n unknown, Eigen value and eigen vectors of a square matrix.
2. **Calculus**
  - a) **Differential Calculus** : Limits and Continuity , Differentiation and its applications, Partial Derivatives.(Basic)
  - b) **Integral Calculus** : Reduction formulae, Definite Integrals, Properties and Multiple Integrals,
3. **Vector Algebra; Complex numbers;** Definitions, Vector products , Properties; Amplitude & Modules of a complex number, De Moivre's theorem and examples.
4. **Applied Mathematics** - Laplace Transforms (Elementary transformation), Fourier series, (Basics definition and examples.) , half range Fourier series and harmonic analysis.
5. **Numerical Analysis** – Numerical Solutions of Algebraic and transcendental equations, Finite differences , Interpolation (For equal and unequal intervals) Numerical solutions of first order differential equations , Numerical Integration
6. **Statistics and Probability**

Measures of central tendency and dispersion curve fitting by least square methods .  
Correlation and regression. analysis

**Probability** : Axioms , conditional probability, probability distribution-Binomial poisson and normal distribution

#### **TEXTBOOKS:**

1. Higher Engineering Mathematics – Dr. B.S. Grewal (37<sup>th</sup> Edition)
2. Elementary Engineering Mathematics- Dr. B.S. Grewal
3. Advanced Engineering Mathematics –Erwin Kreyszig
4. Introduction to Numerical Analysis –S.S. Sastry

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# **VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**

## **Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT**

### **For Faculty of Engineering & General Science**

#### **Part III: Aptitude section**

Questions carrying one mark  
(Objective/multiple choice, covering full syllabus)

- 20 questions

#### **Common to:**

Civil Engineering Science / Mechanical Engineering Science / Electrical Engineering Science / Computer Sciences / Textile / Silk Engineering / Chemical Engineering / Polymer Science / Bio -Tech / Architecture / Physics / Chemistry / Mathematics & M.Sc (Engg)

#### **Syllabus in Aptitude section**

Reading Comprehension data Sufficiency & Data Interpretation, Logical Reasoning & Computer awareness

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI Topics of  
Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus  
for the VTU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**CIVIL ENGINEERING SCIENCE**

**Structural Analysis**

- Structural Systems
- Methods of Joints and Sections and Truss Analysis
- Strain Energy
- Arches and Cables

**Fluid Mechanics**

- Open Channel Flow
- Water Hammer
- Dimensional Analysis
- Impact of Jets on Vanes
- Turbines
- Centrifugal Pumps

**Concrete Technology**

- Fresh Concrete and Hardened Concrete
- Mix Design
- Special Concretes
- Non-destructive Testing of Concrete

**Design of Concrete Structures**

- Principles of Limit State Design
- Serviceability Limits
- Effective Lengths
- Design Loads
- Anchorage of Bars
- Lateral Stability of Beams

**Geotech**

- Index Properties of Soil
- Classification of Soils
- Soil Structures
- Compaction of Soil
- Consolidation of Soils
- Shear Strength of Soil

**Transportation**

- Highway Planning and Alignment

Design Principles  
Pavement Materials and Construction  
Wind Analysis and Site Selection for Airports

**Irrigation Engineering**

Water Requirements of Crops  
Canals, Diversion Works,  
Gravity and Earthen Dams

**Steel Structures**

Steel Structural Fasteners  
Tension – Compression – Flexure Members  
Connections

**Theory of Elasticity**

Plane Stresses and Plane Strain  
Principal Stresses and Principal Strains  
Strain Displacement Relationship  
Equilibrium and Boundary Condition  
Generalised Hook's Law

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VTU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Mechanical Engg. Science**  
**(IP/IEM/Auto/ME/ & Other Allied branches)**

I. Prime movers (I. C. Engine)

Classification of I. C Engines - 2 Stroke & 4 Stroke Petrol & Diesel Engines.

Concept of Mechanical efficiency BHP & IHP Laws of I<sup>st</sup> & II<sup>nd</sup> Thermodynamics, zeroth Law, applications.

II. Refrigeration & Air-conditioning – properties – COP unit of Refrigeration, Refrigeration effect, Tonne Refrigeration.

III. Manufacturing Process part of a lathe, operation in a lathe, Types of Drilling Machine, operation a Drilling machine.

Types of milling machines, operation on milling machines

Grinding machines, bonding materials, grinding terminology. Type of grinding machine,

Soldering,

brazing & welding classification & types. Lubrication & bearing types.

IV Power transmission & mechatronics

Belt drives, gear drives,

Introduction to mechatronics- open loop & closed loop control System

Advantages & Disadvantages.

V Heat treatment of Metals-Annealing, Normalizing hardening, tempering, carburizing, cyaniding, Nitriding

and flame hardening, Iron, Carbon equilibrium diagram.

Composite Materials – Types of matrix materials, FRP & MMC advantages & applications.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VRAT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Electrical Sciences**

**(ECE/EEE/IT/TC/BM/ML and other allied branches)**

1. Fundamentals & AC Circuits Network Theorems.
2. Electrical Machines AC & DC, Transformers
3. Diode Circuits – Amplifiers, op – Amp Applications.
4. Simplification of Boolean Expressions – karnaugh maps combinational logic Design.
5. Sequential logic circuits – Flip flops & counters, shift Registers
6. Time response of second order control systems nyquist criteria – Bode plots, phase & gain margins.
7. Thyrestors – Choppers & Inverters.
8. Field Theory – Electric & magnetic fields, max wells equations.
9. Microprocessors – Architecture, operation, programming and interfacing
10. Transducers.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Computer Sciences**  
**(CSE/ISE/MCA)**

1.	Discrete Mathematical Structures (Set Memory Fundamentals of Logic, Relations functions)
2.	Computer Organization (as per CSE 46 Syllabus)
3.	Data Structures using C (Stack, recursion, Queues and lists, Trees, sorting, searching)
4.	Operating systems (as per CS 52 Syllabus)
5.	OOP with C++ (as per CSE 36 Syllabus)
6.	DBMS (as per CS53 Syllabus)
7.	Analysis & Design of Algorithms (as per CSE 43 Syllabus)
8.	object oriented Analysis & design (as per CS 72 Syllabus)
9.	Software Engg. (Overview, Requirements Engg, Software Design, verification & Validation)

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**

**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme  
Draft Syllabus for the VTU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Textile / Silk Technology**

Introduction to monomers, polymers, history of polymers, classification of polymers. Introduction to various Fibre forming polymers. Application of polymers.

Study of various methods of polymerisation viz addition, chain, co-ordination polymerization. Study of various types of initiators. Techniques of polymerisation. Copolymerisation.

Nature of polymeric fluids. Flow of polymeric fluids, rheology of polymers – derivation of various laws to flow of polymeric fluids. Mechanical behavior of polymers- tensile behavior. Time dependent behaviour and temperature dependent mechanical behaviour.

Thermal analysis of polymers – glass transition temperature of polymers. Determination of glass transition temperature. Free volume concept. Time temperature Superposition in polymers. Study of thermal characterization by DSC, DTA and TGA ,

Introduction to Textiles. Brief introduction to Textile materials. Brief history on origin of textiles. Introduction to textile fibers, basic requirements of textile fibers. Geographical distribution, cultivation & grading of cotton, wool, silk, & jute fibers. Brief study of physical & chemical properties of cotton, wool, silk & blast fibers. India's position of natural fibers in global scenario.

Introduction to regenerated fibers, chemistry and physics of viscose rayon production. Production of modified viscose rayon, brief out line on production of acetate & cupramonium rayon. Manufacture of Tencel, 'Modal' and 'lyocell' fibre.

Modern developments in blowroom machineries, evaluation of blowroom performance, calculation regarding blowroom line.

Need of blending, Process modification required in blowroom for processing various blends like Polyester/cotton, Polyester/viscose, silk and its blends. Types of blending operation and blending procedure.

Various quality control studies in blowroom like alp rejection percentage, cleaning efficiency within and between lap variations.

**Carding:**

Objects of carding, detailed study of working of revolving flat card, card clothing, autolevellers, setting of different parts and effect of changing the setting on sliver quality, methods of grinding, stripping calculation of production, draft etc. in carding.

Developments in modern carding such as developments in preceding zone, speeds, efficiency etc. Developments in post carding zone.

Modern cards, their applications – tandem card, various quality control studies in carding.

Winding:

Objects and principles of winding, classification of winding machine. Derivation of expression to find winding speed and surface speed, cone angle, coil angle and angle of wind and their importance. Methods of increasing angle of packages. Controlling of ballooning tension, types of balloon breakers. Precision and drum winders. Yarn clearers, types and settings, Tensioning devices. User classimat and its usefulness in selecting optimum clearing. Study of automatic winders viz. Auto coner and Uniconer. Winding faults and remedies. Identification of cones, material handling, measurement handling, measurement of package density and their efficiency.

Warping:

Objects and systems of warping. Different types of modern creels. Study of modern, friction driven and spindle driven beam warping machines. Study of different types of sectional warping machines and their salient features. Special warpers for polyolefin filament yarns. Special requirements of yarn preparatory for shuttleless weaving machine. Production calculation of all machines.

Sizing:

Objects of sizing. Study of Ingredients used for size preparation. Size formulation, mixing vessels Viz. Pressure cookers, Injection cookers, homogenizers, agitators and storing becks. Techniques of sizing, Sizing of Natural, man made fibres and their blends. Size pickup, size add on, Salient features of modern sizing machines. Creels sow box, Drying principles – multicylinder drying, hot air drying, radiation drying. Concept of single end sizing.

Head stock – dry splitting comb, drag roll. After waxing, cut mark motion, beam pressing, PIV and friction clutch.

Controls in sow box – stretch and its control, moisture measurement and temperature control. Recent trends in sizing Viz. Foam sizing solvent sizing. Hot melt sizing, high pressure squeezing, migrating behaviour of warp ends, dead loss, hard waste. Production and efficiency calculations.

Sizing defects and remedies.

Post sizing operations – Drawing – in, leasing, knotting, automatic drawing in machine.

Chemicals and auxiliaries used for textile wet processing and their functions. Introduction to shearing and cropping. Objects of shearing and cropping.

Objects of singeing, methods of singeing by various singeing machines, precautions to be taken during singeing, latest developments in singeing.

Objects of desizing, methods of desizing, continuous desizing, desizing of cotton and other blend. latest developments in desizing.

Objects of scouring, mechanism of scouring, methods of scouring, scouring of natural cellulose fabrics, degumming of silk, scouring of wool and jute, scouring of synthetic, modifications required to scour knitted fabrics, latest developments in scouring.

Objects of Bleaching, mechanism of bleaching, methods of bleaching, bleaching of cellulose fibres, fibres, bleaching of natural protein fibres, bleaching of common manufactured fibres, bleaching of common whitening, optical whitening process for common fibres. Chemistry of optical whitening agents.

Objects of mercerization, history and developments of mercerization, physical and chemical changes in cotton due to mercerization, various factors affecting mercerization, methods of mercerization – yarns and fabrics, machines used for mercerization, slack mercerization, Hot mercerization, Faults in mercerization and their remedies, Test methods for mercerized materials. Latest developments in mercerization.

Characterization of solid state structure of textile fibres using X-rays IRS, NMR, UVS, SEM, TEM & DGC. Various Two phase models for studying two phase and one phase physical structure fibres. Description of physical structure of cotton, wool, silk, PET, Nylon and acrylic fibres.

**Moisture relations :** Concept of moisture equilibrium, moisture hysteresis, moisture regain, heat of absorption, swelling of textile fibres. Effect of moisture on various property of fibres.

Mechanical properties: Stress and strain behaviour, factors affecting tensile behaviour, structure and tensile property correlation, Elastic recovery and weaklink effect.

Stress relaxation, creep, factor affecting stress relaxation, dynamic mechanical properties and their application.

Flexural and tensional properties, Frictional properties, Amontons laws of friction, deviation of these laws in fibre friction, Bowden and Tabors theory of friction.

Optical properties, measurement of birefringence, luster. Importance of optical properties.

Electrical properties: Electrical resistance, static electricity, dielectric properties. Measurement of these properties.

Thermal properties: Thermal conductivity, specific heat, thermal conductivity and thermal expansion.

Introduction to synthetic fibres. Production of raw materials for synthetic fibres. Study of Production of PET by DMT & TPA routes. Study of Production of polyamides, nylon-6 effect of various parameters on nylon-6 Production study of semi-continuous & integrated continuous process for Production of nylon-6, Production of nylon-66.

Introduction to high performance fibres. Study of Production of carbon, boron, silicon, carbide, alumina & glass fibres. Study of Production of aromatic polyamides viz. Nomex, Kevlar, technova. Concept of liquid crystal, thermo tropic & Leo tropic polymers & fibres. Study of Production of LDPE, HDPE, by GEL spinning technique. Production and properties of PBZT AND PBZO fibres.

### **Texturising:**

Introduction to texturising. Study of different methods of texturising. False twist, draw texturing, airjet texturing, stuffer box crimping, knife edge crimping, knit-de-knit crimping. Solvent texturing. Study of various parameters affecting false twist texturing, measurement of crimp rigidity. Physical bulk & instability of textured yarns. Modern developments in texturing process.

### **Drawing:**

Introduction, tasks of draw frame, passage of material through draw frame, Operating principle of draw frame. Operating devices, roller drafting systems, behaviour of fibres of drafting zone. Friction field, distribution for drafting arrangement, elements of drafting arrangements, suction system for drafting arrangement. Monitoring and autolevelling in drawframe. Brief study on bercolisation, scouring, buffing, roller eccentricity, shore hardness. Calculations pertaining to drawframe. Quality control studies in drawframe.

### **Combing:**

Objects of combing, Hook theory. Preparatory process for combing sliver lap, ribbon lap, and uni lap machines. Types of comber. Sequence of operations in rectilinear comber, straightening of hooks, parameters influencing the combing operations. Influence of feed stock on combing, influence of combing operation on quality. Noil theory. Influence of machine components and setting on combing Nipper assembly, combs, takes off material, drafting arrangements, waste

removal, transport operations in combing room. Detailed study of modern combing with reference to cylinder speed, rate of delivery, detaching mechanism, drafting system. Calculations in comber, fractionating efficiency, quality control studies in combing.

### **Speed Frame:**

Objects of speed frames, operating sequence, operating regions of speedframe, drafting arrangements and systems. Spindle and flyer – design of spindle and flyer. Winding of bobbin – mechanism, package built bobbin drive, cone drive, lifter motion and builder motion, bobbin leading and flyer leading mechanism, chase length, differential gearing mechanism. Study of features of various modern speedframes. Quality control studies in speedframe, calculations pertaining to speedframe.

### **Shedding :**

Different types of shed. Positive and negative tappet shedding. Heald reversing mechanism. Staggering of healds, tappet shedding and their characteristics. Different types of tappets. Merits and demerits of tappet shedding, timing, setting, early and late shedding. Study of different types of reed, reed count, healds, heald count

### **Picking:**

Methods of picking, essentials of goods picking, defects in negative picking. Timing setting of picking mechanism. Different types of under picking mechanisms. Early and late picking. Shuttle checking devices, box settings, pickers, picking band, stick, check strap buffer, swell etc., Shuttle trap, weak and harsh pick.

### **Beat-Up :**

Theory of Beat up. Design features and working of beat up mechanism, eccentricity of sley. Factors affecting the sley eccentricity.

### **SecondaryMotions:**

Take up motion, - 7 wheel take up. Timing and settings, continuous take up motion. Let-off motions - positive and negative types.

### **AuxiliaryMotions :**

Warp stop, mechanical, electrical type. Weft stop motions - side weft fork and centre weft fork. Warp stop motion - loose reed and fast reed mechanism. Warp easing motion and anticrack motion. Loom banging off and loom brake. Study of types of temples. Fabric defects - causes and remedies. Filament weaving.

Speed and production calculation of plain looms.

**BoxMotions:** 4x4 box motion, circular box motion.

**Automatic Looms:** Cop changing, shuttle changing looms, feelers, types of feelers, shuttle eye cutters, temple eye cutters and their settings -

Chemicals and auxiliaries used for textile dyeing and their functions. Chemical constitution of dyes.

Effect of fibre structure on dyeing behaviour.

Theories of dyeing, action of electrolytes, effect of dyebath temperature, Effect of material to liquor ratio, Effect of dyebath pH, Mechanism of dyeing, various factors affecting dyeing, selection of dyes for specific end uses, Evaluation of fastness properties of dyed materials.

Properties, Selection and application of various dyes like direct dyes, basic dyes, acid dyes, sulphur

dyes, Azoic dyes, Vat dyes, Sol-vat dyes, Mordant dyes, Reactive dyes, Disperse dyes, Modified basic dyes on important natural and manufactured fibres. Various after treatments given to dyed goods.

Introduction to natural dyes and their methods of application

Preparatory process for garment dyeing, speciality chemicals and dyes used for garment dyeing.

Different types of dyeing practices for various types of garments, precautions to be taken for effective dyeing of garments. Quality control in garment dyeing.

Working principles of dyeing machinery for yarns, fabrics and garments. Latest developments in dyeing machinery

Brief study on eco-friendly dyeing processes.

Dyeing of blends and knitted fabrics

Introduction to colour measurement and computer colour matching.

### **Ring Frame:**

Objects of ring spinning. Working principle of ring frame. Detailed study of the ring frame mechanisms. Variation in yarn tension during spinning. Twist flow in Ring spinning - effect of various parameters. Yarn and package faults. Latest developments in ring spinning. Setting in ring frames and production calculations in direct & indirect systems. Modifications required in ring frames to process various types of blends.

Rings & Travelers - types, cross section, manufacture & selection. Traveler numbering. Function of lappets & separators. Forces acting on the traveler and yarn balloon in ring spinning. Resultant of the forces acting on the traveler.

### **Doubling Frame:**

Objects of doubling process. Construction and working of a doubler. Dry doubling and wet doubling. Different methods of threading the yarn through delivery rollers. Properties of various doubled, cabled, voile, poplin, crepes, chiffon yarn etc. Sewing thread production & properties. Fancy yarns and fancy doublers - methods of threading for some fancy yarns. Preparation of standard yarn packages. Hosiery yarn and its manufacture, properties and end uses.

### **Open End Spinning:**

Limitations of Ring spinning. Principles of Break Spinning. Working principle of Rotor Spinning. Comparison of ring and O E yarns. Recent developments in O E Spinning. Setting and speeds required to process various blends. Production calculations. Different types of rotors and opening rollers used in open end spinning.

### **Dobby Looms:**

Mechanical design and working principles of different types of dobbies such as negative, positive, cam, paper, rotary, cross border dobbies, Lattice pegging methods, cyclic diagram of operation of the doobby mechanism.

### **Jacquard:**

Mechanical design and operating principles of single lift single cylinder. Double lift single cylinder. Double lift Double cylinder and cross border jacquard. Methods to increase the figuring capacity. Piano card cutting machine. Card punching. Card lacing, casting out in jacquard. London and Norwich harness mounting systems. Cyclogram of the jacquard shedding. Different types of tie-ups. Review of developments in jacquards.

Shuttle-less Weaving: Study of special features of rapier, projectile, water-jet, Air-jet looms.

Study of above types of shuttle-less weaving machines with reference to: Types of weft supply creels, Types of weft tensioning devices, Weft feed system, Types of weft insertion systems, Different carrier breaking system, Consolidation of picking force in air jet picking systems. Weft mixing systems, Systems of weft beat up, Types of selvages.

Introduction to textile printing - An overview of the printing process.

Selection of dyes/pigments/auxiliaries and textile substrate to suit the end use of the printed textile materials.

The constituents and characteristic of printing paste. Brief study of different binders, thickeners, solvents, discharging agents and other ingredients of printing paste.

Styles of printing – Direct, discharge, resist and special styles- chemical and mechanisms used for the above styles.

Methods of printing – Printing by Hand block, Roller, hand screen, semi-automatic screen, flat bed and rotary screen printing methods. Developments in printing machinery.

Transfer printing – Principle, mechanisms and continuous transfer printing – Transfer printing machinery.

The print paste preparation and preservation. Printing of natural and synthetic fibre fabrics with various classes of dyes/pigments.

Methods of print fixation – Drying, curing by dry heat, steam fixation etc.

Finishing process: An overview - objects and methods of finishing. Classification of various finishes – Various finishing chemicals used and their properties.

Calendering and various calendering machines used. Sanforization – principle and the process. Resin and anti-crease finish on cotton and protein fibre fabrics. Water repellent finishes, fire retardant and fire proof finishes.

Finishing of woollen materials, silk fabrics and blended products. Finishing of synthetic fibre fabrics - heat setting, de-lustering, anti-static, soil release, etc.

Introduction to textile testing and quality control. Sampling techniques. Moisture relation and testing. Fiber dimensions Viz., length, fineness, maturity and strength. Their technological importance and determination by various conventional and High Volume Instruments (HVI). FQI & its importance.

Study of various systems of yarn count & its measurements by various methods & instruments.

Nep counting. Yarn twist & its effects on yarn & fabric properties. Principles & measurements of single & double yarn twist. Importance of twist multiplier.

Yarn strength & its testing. Methods and principles of yarn strength testing.

Principles of various evenness testers & measurement of evenness for sliver, roving & yarns. Causes & effects of irregularity in sliver, roving & yarns. On-line quality control systems. Yarn friction & its measurements.

Determination of fabric length, width, thickness, weight. Thread density, crimp, air permeability. Thermal property, stiffness, handle, drape, shear, serviceability, wear, & abrasion resistance. Pilling, flammability, aesthetic properties. Fabric strength- tensile, tearing, bursting. Water & fabric relations & testing. Study of water penetration, shrinkage test, wetting of apparels & industrial fabrics. Penetration of fabrics by water under pressure.

Assessment of fabric quality for garment industry- Testing & Inspection.

Study of fabric cyclic properties like bending, shear, fatigue.

Estimation of color fastness of dyed fabrics.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VTU-ERT**

**Part II: *Discipline Oriented Section***

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Chemical Engineering**

Process Calculations and Thermodynamics: Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom analysis.

First and Second laws of thermodynamics and their applications; equations of state and thermodynamic properties of real systems; phase equilibria; fugacity, excess properties and correlations of activity coefficients; chemical reaction equilibria.

Momentum Transfer and Mechanical Operations: Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation, Macroscopic friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory, size reduction and size separation; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, mixing and agitation; conveying of solids.

Heat Transfer: Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation; types of heat exchangers and evaporators and their design.

Mass Transfer: Fick's law, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stagewise and continuous contacting and stage efficiencies; HTU & NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, crystallization, drying, humidification, dehumidification and adsorption.

Chemical Reaction Engineering: Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Instrumentation and Process Control: Measurement of process variables; sensors, transducers and their dynamics, dynamics of simple systems, dynamics such as CSTRs, transfer functions and responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response (including Bode plots) and controller tuning, cascade, feed forward control.

Plant Design and Economics: Design and sizing of chemical engineering equipment such as

compressors, heat exchangers, multistage contactors; principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow, optimization in Design.

Chemical Technology: Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers.

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# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

## Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT

### Part II: Discipline Oriented Section

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

### BIO-TECHNOLOGY

#### 1. BASCS OF UNIT OPERATIONS

Basics of Sedimentation, Setting, Filtration, Size reduction, and Mixing. Basic modes of heat transfer, Uni-layer, Multi-layer, and Steady state conduction. Principles of Diffusion, Distillation, Drying, Evaporation, Extraction, Adsorption and Ion-exchange operations.

#### 2. FUNDAMNETALS OF MOMENTUM TRANSFER

Fluid definition, Classification, governing equations, Hydrostatic equilibrium, barometric equation, Pressure measurements, Manometric equation, Shear stress, Shear strain, Netwon's law, Fluid flow, Types of flow, Laminar and turbulent flow. Continuity equation, Energy balance equation, Beronulli's equation, Euler equation, Momentum balance, Flow through circular and non circular sections, Hagen-Poiseulles equations, Losses through pipe and fittings, Turbulent flow, and Friction factor.

#### 3. BASIC BIOCHEMISTRY

Structure and properties of mono, di, and polysaccharides, structure and properties of fatty acids, neutral fats, phospholipids, glycolipids and steroids, structure and properties of aminoacids, peptides, and proteins. Biologically important peptides. Structure and properties of purines, pyrimidines, nucleosides, nucleotides, ribonucleic acids, nucleoprotein complexes.

#### 4. FUNDAMENTALS OF CELL STRUCTURE AND FUNCTION

Eukaryotic and prokaryotic cells, Plant and animal cells, Types of cell functions, cell division, Mitosis and Meosis. Formal structure in cytolplasm, Nucleus, Mitochondria, Ribosome, Golgi bodies, Lysosomes. Endoplasmic Reticulum, Peroxisomes, Chloroplast and Vacuoles. Cell to cell integration, Cell locomotion (Ameoboid Flagella, Cillar). Muscle and Nerve cell. Structure and functioning of endocrine cells including neuro-secretary cell.

#### 5. BASICS OF BIOPHYSICAL AND BIOCHEMCIAL TECHNIQUES

Rayleigh scattering, ultra centrifugation, viscometry, crystallization, X-ray crystallography, neutron diffraction, NMR spectroscopy, electron microscopy, STM, AFM, luminescence, fluorimeter, falme, photometry, optical activity, CD, UV, IR, Laser Raman and ESR, EPR. Calorimetry, DSC, Spectrophotometry, Mass spectrometry, LC-MS, MALDI-TOF, Chromatography, Electrophoresis.

#### 6. FUNDAMENTALS OF THERMODYANAMICS

System, Surrounding and Process, Closed and Open system, State and Properties, Intensive & Extensive Properties, State and Path functions, Equilibrium state and Phase rule, Zeroth law of Thermodynamics, Heat reservoir and Heat engines, Reversible and Irreversible processes. General statement of First law of Therodynamics, First law for Cyclic Process, Non-Flow Process, Flow process, Heat capacity.

## **7. BASIC GENETICS AND GENETIC ENGINEERING**

Nature of genetic material, DNA replication, Mendelian Laws of inheritance, monohybrid and dihybrid inheritance, law of segregation and independent assortment, Gene interactions, supplementary genes, Complementary genes, Epistasis. Identification of genetic material, classical experiments- Hershey & Chase, Avery McLeod etc. Multiple alleles and groups antigens. Role of genes within cells, genetic code, genetic elements that control gene expression, method of creating recombinant DNA molecules, vectors in recombinant DNA technology, biology and salient features of vectors, types of vectors- plasmids, cosmids, phages and viruses. Gene transfer techniques, genetic engineering of plants and animals, structure and functions of T-DNA in the expression of genes, Ti plasmid mediated gene transfer.

## **8. INTRODUCTORY BIOINFORMATICS**

Databases: Sequence database, Structure database, Medical Databases. Sequence alignment and database searches: Optional Alignment, Database similarity searching, FASTA, BLAST. Aspects of Multiple Sequence Alignment. Phylogenetic analysis: Tree- Building Methods, Evaluating Trees and Data. Predictive methods for Detecting Functional Sites in the DNA. Predictive methods for secondary structure, tertiary folds from protein sequences. Plasmid mapping and primer design.

## **9. BIOPROCESS PRINCIPLES**

Concept of mole and Molecule, Composition, of mixtures of Solids, liquids and gases. Composition of mixtures and solutions- Percentage by weight, mole and Volume; Normality, Molarity, Molality, and ppm, pH and pK Buffer Calculations. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses; generalized process flow sheets. Process flow sheet and unit operations in chemical and bioprocess industries; General material balance equation for steady and unsteady states. Basic concepts of Energy Balance.

Couples reactions and energy rise compounds, Reaction Stoichiometry, criteria of biochemical reaction equilibrium, equilibrium constant and standard free energy change, effect of temperature, pressure on equilibrium constants and other- factors affecting equilibrium conversion, liquid phase reactions, heterogeneous bioreaction equilibria, phase rule for reacting systems.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VTU-ERT**

**Part II: Discipline Oriented Section**

50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**CHEMISTRY**

(Topics Studied up to the Bachelor Degree Level should be considered for setting the comprehensive questions in the subject)

- 1. Periodic Properties** - Atomic radii - Ionization energy in groups and periods - Electron affinity Chemical Bonding.
- 2. Organic Chemistry** - Classification and nomenclature of organic compounds. Electronic effects and reactive intermediates -Principles of purification of organic compounds - Halogens - Cycloalkanes - Aromatic hydrocarbons - Elimination Reaction - Organo-metallic compounds - Alcohols - Phenols - Carboxyl compounds - Carboxylic acid - Hydroxy acids - Amines - Diazonium Compounds. Active methyl compounds -Carbohydrates - Stereo-chemistry - Amino acids - Peptides - proteins. Oils and Fats - Waxes - Dyes - Terpenes. Drugs - Hormones - Vitamins -
- 3. Inorganic Chemistry** - Molecular orbital theory - General characteristics of s - block and p. block - elements - Gravimetry - Statistical analysis of results of quantitative measurements (errors - accuracy - precession etc). Nobel Gases - Non-aqueous solvents - Ion exchange - Metallurgy - Gaseous fuels.
- 4. Physical Chemistry** - Liquid mixtures - Properties of liquid Mixtures - Colligative Properties - Chemical Kinetics - Colloids - Emulsions - Crystallography. Electrochemistry - Hydrolysis of salts - Ionic equilibria. Distribution law.
- 5. Nuclear chemistry** - Fundamental properties of nucleons - isotopes - nuclear stability - binding energy - nuclear models - fission and fusion - nuclear transmutation - radioactivity - nuclear reactors - accelerators. Application of nuclear chemistry.
- 6. Thermodynamics** - Gas laws - Thermodynamic processes - State function - Laws of Thermodynamics - Heat engine - Free energy - Entropy - Phase equilibria.
- 7. Co-ordination Chemistry** - Basic concepts - Valance bond theory - Crystal field theory - Bio-inorganic chemistry - Enzymes - Occurrence - properties and structure of enzymes.
- 8. Radiation Chemistry** - Primary and secondary states in radiochemical reactions. Ionic yield - energy yield - comparison with photochemistry - Radiolysis - Units of Measurement of radiation.
- 9. Molecular Chemistry** - Types of spectra - Rotational energy - Calculation of bond length - Vibrational energy - Selection rules and transitions. NMR Spectroscopy.
- 10. Polymer Chemistry** - Inorganic polymers - Properties - Glass transition temperature.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VTU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Physics**

(Topics Studied up to the Bachelor Degree Level should be considered for setting the comprehensive questions in the subject)

(Topics Studied up to the Bachelor Degree Levels should be considered for setting the comprehensive questions in the subject)

- 1. Mechanics and Properties of Matter** - Frames of Reference - Rigid body dynamics - Moment of Inertia - Laws of Conservation. Elasticity - Viscosity - Surface Tension.
- 2. Heat and Thermodynamics** - Kinetic Theory - Laws of Radiation - Thermodynamics - Liquefaction of Gases - Entropy - Heat engines and Refrigeration. Thermal Conductivity.
- 3. Waves Acoustics** - Progressive waves - Superposition - Doppler effect - Acoustics of Buildings - Fourier transforms - Ultrasonics.
- 4. Optics** - Theories of Light - Interference - Diffraction - Polarisation - Optical Instruments - Resolving Power. Laser - Production, Properties and Applications.
- 5. Electricity and Magnetism** - Electrostatics - Galvanometers - Measuring Instruments) - Alternating and Direct current - Generation and Analysis - Thermoelectricity - Electromagnetism .
- 6. Atomic and Molecular Physics** - The electron - Atomic Models - Atomic spectra - Molecular spectra - Related measurements. Zeeman effect. X - rays - Crystallography.
- 7. Nuclear Physics** - The nucleus - Nuclear models - Mass spectrographs - Radioactivity - Accelerators - Nuclear detectors - Nuclear reactions - Cosmic ray - Mossbauer effect - Magnetic Resonance - Applications - Elementary Particles.
- 8. Solid State Physics** - Relativity - Special and General Theories of relativity - Statistical Physics - Specific Heats of Solids - Band Theory of solids - Classification of solids - Electrical Conductivity in solids - Dielectric and Magnetic Properties - Specific Heats of Solids - Semiconductors - Applications - Semiconductor devices - Transistors - Amplifiers - Oscillators - Digital electronics - Superconductivity.
- 9. Quantum Physics** - Failure of Classical Physics - Duality - Wave function - Schrodinger wave equations. Solutions - Eigen values.
- 10. Recent Trends in Physics** - Liquid Crystals - Optical Fibers - Smart Materials - Nano-Materials.

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# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

## Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT

### For Faculty General Science

#### Part II: *Discipline Oriented Section*

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

### **MATHEMATICS**

#### **(FOR BACKGROUND OF M.SC.(MATHS))**

(Topics Studied up to the Bachelor Degree Level should be considered for setting the comprehensive questions in the subject)

#### **1. TRIGONOMETRY**

Trigonometric ratios and relations, simple problems. Complex numbers: Definition and properties, De Moivre's theorem, roots of complex numbers

#### **2. INFINITE SERIES**

Convergence and divergence of series of positive terms. Standard tests for convergence. Alternating series, Leibnitz test.

#### **3. LINEAR ALGEBRA**

Matrices and determinants, Inverse of a matrix, rank of a matrix, consistency of a system of linear equations. Eigen values and eigen vectors

#### **4. CALCULUS**

- a) **DIFFERENTIAL CALCULUS:**  $n^{\text{th}}$  derivative of standard functions, polar curves, angle between polar curves. Partial differentiation, maximum and minimum for function of single and two variables. Curvature and radius of curvature, mean value theorems, Taylor's and Maclaurin's expansion for a function of single variable. Indeterminate forms.

**b) INTEGRAL CALCULUS**

Tracing of standard curves. Beta and gamma functions. Length, Area , Volume using multiple integrals.

**5. DIFFERENTIAL EQUATIONS**

Solutions of first order and first degree differential equations,

**6. APPLIED MATHEMATICS**

a) Laplace Transforms, Fourier Series & Fourier Transforms

**b) NUMERICAL METHODS**

Solutions of algebraic and transcendental equations, finite differences and related problems, numerical differentiation and numerical integration , Numerical solution of ordinary and partial differential equations, application to Engineering problems.

**c) STATISTICS AND PROBABILITY**

Correlation and regression, analysis of variance.

**Probability** : Axioms , Including Bayes theorem, conditional probability, probability distribution-Binomial poisson, normal, geometric and exponential distribution.

**TEXT BOOKS:**

1. Higher Engineering Mathematics – Dr. B.S. Grewal (37<sup>th</sup> Edition)
2. Elementary Engineering Mathematics- Dr. B.S. Grewal
3. Advanced Engineering Mathematics –Erwin Kreyszig
4. Introduction to Numerical Analysis –S.S. Sastry

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# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme  
Syllabus for the **VTU-ERT**

## **Part II: Discipline Oriented**

**Section** Questions carrying one  
marks (Objective/multiple choice)

- 50 questions

## **Business Administration**

### **Module 1**

Management: Definition, nature, purpose and functions. Principles of management. Planning: nature-type-steps; Organizing: Organization structure, span of management, centralization, decentralization. Staffing:-overview. Directing and controlling, MBO.

### **Module 2**

Organization behaviour: nature: Learning, Personality: definition-traits-determinants. Perception; Meaning, factors influencing perception, perception and decision making.

### **Module 3**

Marketing Management: Meaning-importance – Marketing management process- Marketing mix.

### **Module 4**

Human Resource Management: definition, nature, scope-managerial and operative functions of HRM. Objections of HRM.

### **Module 5**

Financial Management: Definition, scope, functions, objectives, Time value of money.

Latest Management concepts in all the above modules.

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**SCHEME OF VTU-ERT**  
For Ph.D/M.Sc.(Engg)

**Business Administration**

**Part I: *Verbal Ability, Numerical Analysis Quantitative ability***

Questions carrying one mark

- 30 questions

**Part II: *Discipline Oriented***

***Section*** Questions carrying one  
marks (Objective/multiple choice)

- 50 questions

<b>Part III : <i>Aptitude section</i></b>	
Reading Comprehension data Sufficiency & Data Interpretation, Logical Reasoning computer awareness	- 20 questions

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme**  
**Syllabus for the VTU-ERT**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one marks

(Objective/multiple choice, preferably involving numericals covering full syllabus)

## Polymer Science and Technology

Fundamentals of polymer science- definition to polymer/macromolecules, copolymer, blends, composites, fibres, etc. Classification of polymers, functionality of monomers. Explain the terms crystallinity, amorphous, tacticity, stereoregularity, Tg/Tm, configuration/conformation.

*Chemistry and Mechanism of Polymerization:*

*Methods of Polymerization* - Bulk, solution, suspension, emulsion, solid phase, gas phase polymerizations

*Molecular weight and size:* The concept of molecular weights (number average, weight average, viscosity average and z average molecular weight - definitions and mathematical expressions), molecular weight distribution (MWD) & its importance and polydispersity.

Polymer properties – approach and the concept of chemical structure of polymers

Polymer testing/characterization – density, bulk density, UTM, stress-strain curves (types), definition for tensile modulus, impact strength, thermal methods-DSC and TGA (basics), melt viscosity (MFI)

Chemistry, properties and uses of some polymers – Types of polyethylene (LDPE & HDPE), nylons, PP, PS, PAN, PMMA, PET, PC, NR, SBR, epoxies

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**VTU-ERT Syllabus for  
PhD  
(Architecture)**

SYLLABUS

City Planning: Historical development of city planning, principles of city planning, new towns, survey methods, site planning and planning regulations and building bye laws.

Housing : Concept of shelter, housing design and policies, role of government agencies, finance and management.

Landscape Design: Principles of landscape design, landscape elements, materials, planning design.

Visual and Urban Design: Principles of visual composition, proportion, scale, rhythm, symmetry, asymmetry, balance of form and color, sense of place and space, division of space, focal point vista, visual survey.

History of Architecture: Indian - Indus valley, Vedic, Buddhist, IndoAryan, Dravidian and mughal periods; European - Egyptian, Greek, Roman, Medieval, and Renaissance periods.

Development of Contemporary Architecture: Development and impact on society since industrial revolution, influence of modern art on architecture, works of national and international architects, post modernism in architecture ..

Planning Theory: Planning process, comprehensive planning, land use and density in residential and non-residential areas, central place theory, rank- size rule, settlement pattern, land utilization, and district level planning.

Techniques of planning: Application of remote sensing techniques in urban and regional planning, planning surveys, methods of preparation of urban and regional development plans. structure plans, strategy plans etc.; and site planning principles and design.

Introduction to Research: Science and Comprehension sense. Four methods of knowing, science and its functions. Scientific explanation and theory, scientific research- a definition. Problems and Hypotheses, problem values and definitions. Generality and specific problems and hypotheses.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**

**DISCIPLINE ORIENTED SYLLABUS FOR Ph.D. APTITUDE TEST**

**ENVIRONMENTAL ENGINEERING**

**ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT**

- ☞ Ecosystems – types and symbiotic relationship, Energy flow
- ☞ Environmental Impact Assessment – Objectives, Types, Limitations
- ☞ Public Participation, Environmental Management Plan (EMP)

**ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY**

- ☞ Equilibrium and Colloidal Chemistry
- ☞ Organic Chemistry and Analytical Chemistry
- ☞ Bacteria, Algae and Fungi
- ☞ Virology
- ☞ Bacterial Metabolism and Metabolic Pathways

**WATER TREATMENT AND DISTRIBUTION**

- ☞ Water Quality Guidelines and Drinking Water Standards
- ☞ Aeration, Sedimentation, Coagulation and Flocculation
- ☞ Filtration, Adsorption, Softening
- ☞ Rural Water Supply
- ☞ Water Distribution Network – types, advantages
- ☞ Design Equations and their Applications

**WASTEWATER COLLECTION, TREATMENT & DISPOSAL**

- ☞ Objectives, Wastewater categories and Characteristics
- ☞ Preliminary Treatment Units
- ☞ Primary Treatment Units
- ☞ Secondary treatment – Aerobic, Anaerobic, Suspended and Attached Growth Systems
- ☞ Kinetics and Biokinetic Coefficients
- ☞ Batch and Continuous Reactor Systems
- ☞ Wastewater Collection System - Types, Design Principles
- ☞ Stabilization Ponds
- ☞ Industrial Wastewater Treatment
- ☞ Rural Sanitation Systems

## **SOLID WASTE ENGINEERING AND MANAGEMENT**

- ☞ Sources, Generation rates, Quantification and Characterization
- ☞ Collection, transportation, treatment and disposal
- ☞ Leachate and Gases Control in Sanitary Landfills
- ☞ Composting, Incineration and Pyrolysis

## **ATMOSPHERIC & NOISE POLLUTION CONTROL**

- ☞ Major Air Pollution Sources, Meteorology
- ☞ Air Pollutants and their Impact on Environment, Human and Property
- ☞ Air Pollution Standards, Air pollution Control – SPM and Gaseous
- ☞ Gaussian Dispersion Model and its Application
- ☞ Stability Classes, types of Plumes and Behaviour
- ☞ Atmospheric Inversion – causes and effects on pollutants dispersion
- ☞ Noise – sources, effects, measurement and control

## **WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS**

- ☞ World water resources, Indian water resources, Karnataka's water resources
- ☞ Estimation of Precipitation, Hydrograph Theory
- ☞ Flow Measurements – different methods
- ☞ Storm runoff Estimation and Design Principles of Storm Sewers
- ☞ Water Hammer Analysis
- ☞ Confined and Unconfined Aquifers
- ☞ Artificial Recharge, Ground Water Pollution

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→ 31/08/08

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM Topics  
of Syllabus for the Qualifying Exam for the Ph.D. Programme  
Syllabus for Geology**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one mark

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Physical Geology-**

The dynamics of Earth- Outer zones, crust and inner zones of the Earth, continents and ocean floor  
Weathering and Erosion. Volcano 's, Rivers, Wind, Coastal scenery and work of sea.  
Earthquake , Plate tectonics, Orogenic belts, Geosynclines.

**Mineralogy and Crystallography-**

Physical properties of Minerals, origin and occurrences of Minerals.  
Crystal - Forms of crystals, symmetry elements, and crystal systems,  
Optical properties of Minerals.  
Study of Minerals-Oxide group, Carbonate group, Feldspar group, Mica group, Silicate group and ore  
minerals for their properties , uses and occurrences.

**Petrology**

Igneous rocks – Textures, structures and classification  
Sedimentary rocks – Characters, textures, structures and classification  
Metamorphic rocks – Agents of metamorphism, Textures, structures kinds of metamorphism Study  
of rocks for their properties, uses and occurrences – Granite, Basalt, Dolerite, Gabbro, Pegmatite,  
Sandstone, Conglomerate, Shale, Limestone, Gneiss, Marble, Phyllite, Slate and Schists.

**Structural Geology**

Mechanical principles  
Attitude of beds  
Folds – Parts and nomenclature  
Joints – Geometric and genetic classification  
Faults – Identification in field, parts and classification  
Unconformities – Recognition of unconformities and types of unconformities

**Stratigraphy and Paleontology**

Principles of stratigraphy  
Stratigraphic units  
Physical divisions of India  
Fossils, Important use of fossils  
Standard geological time scale  
Paleo botany,- Introduction, Plants classification. Evolution of plants and their geological distribution,  
invertebrate paleontology classification.

**Hydro Geology**

Ground water, occurrences and vertical distribution  
Aquifer, kinds and types  
Ground water prospecting  
Ground water quality  
Ground water pollution

**Remote sensing and GIS**

Applications, concepts, elements, electromagnetic radiation, electromagnetic spectrum, Passive and  
active remote sensing, EMR interaction with atmosphere and earth materials, satellites, parameters  
of sensors

GIS – applications, components of GIS, Maps, projections.

Reference-

A Text Book of Geology by- P K Mukerjee  
Holmes Principals of Geology by-Arthur Holmes. Structural Geology by- M P Billings  
Ground Water by- D K Todd  
Ground Water by- H M Raghunath  
Basics of Remote Sencing & GIS by-Dr S Kumar  
Petrology by-Tyrrel

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

## Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT- for Nanotechnology

**Introduction to nanoscience and nanotechnology:** History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions, nanosized effects surface to volume ratio, crystal structure, atomic structure, molecules and phases, energy bands- insulators, semiconductors and conductors, Nanoscale-molecular and atomic size, quantum effects.

**Nanomaterials synthesis:** Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, Sonochemical synthesis, Hydrothermal, solvothermal, solution combustion process.

Physical Methods-Ball milling, Physical Vapour deposition (PVD), Chemical Vapor deposition (CVD), Sputter deposition, electric arc deposition, Lithography techniques.

Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

### MATERIAL CHARACTERIZATION TECHNIQUES

Compositional and structural Characterization techniques: X-ray Photoelectron Spectroscopy (XPS), Energy Dispersive X-ray analysis (EDAX), Principles and applications of X-ray diffraction; electron diffraction, Surface characterization Techniques- High resolution microscopy; Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), scanning tunneling microscopy (STM).

Spectroscopic techniques: Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy techniques: micro Raman and laser Raman.

### Nanobiotechnology and Medical application

Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy

### Nanoelectronics

Introduction, Electronic structure of Nanocrystals, Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantum dot, Single electron devices, Nanostructured ferromagnetism, Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magnetoresistance, Introduction of spintronics, Spintronics devices and applications.

### Carbon based Nanostructures

Carbon Nanotubes (CNT), Graphene, Fullerenes, history and types, Carbon clusters, Single wall tubes, Multiwall tubes, Macroscopic Nanotube materials, Physical properties (Mechanical Properties, Thermal Properties, Electronic Properties, magnetic and superconducting properties), Applications of Carbon Nanotubes.

## **NANOCOMPOSITES - DESIGN AND SYNTHESIS**

Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity.

Synthesis methods for various nanocomposite materials: mechanical alloying, thermal spray synthesis etc. Nano composites for hard coatings; DLC coatings; Thin film nanocomposites; Modeling of nanocomposites.

### **Text Books and References**

1. T. Pradeep , “*NANO The Essential , understanding Nanoscience and Nanotechnology*”. Tata McGraw-Hill Publishing Company Limited, 2007.
2. Introduction to Nanotechnology, Chareles P.poole jr. and frank J.Owens, wiley inter science.
3. Nanotechnology Principles and Practices by Sulabha K. Kulakarni.
4. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
5. Introduction to Solid State Physics, C. Kittel, Wiley Eastern
6. Fundamentals of Nanoelectronics by George W. Hanson (Pearson Education,New delhi)
7. . Nanotechnology and Nano Electronics – Materials, devices and measurement Techniques by WR .Fahrner – Springer
8. NanoBiotechnology-BioInspired Devices and materials of the Future by Oded Shoseyov, Ilan Levy.
9. . Bio Nano Technology by Good Sell, Wiley Liss
10. A practical approach to X-Ray diffraction analysis by C.Suryanarayana
11. Electron Microscopy and analysis by P.J. Goodhew and F.J. Humpreys
12. Scanning electron microscopy and x-ray microanalysis by J.I. Goldstein
13. Characterization of nanostructured materials by Z.L. Wang
14. Modern Raman Spectroscopy: A practical approach by E. Smith and G.Dent
15. Principles of Instrumental analysis by D.A. Skoog, F.J. Hollen and T.A. Niemann
16. Nanocomposite Science & Technology by P.M. Ajayan, L.S. Schadler and P.V. Braun, Wiley-VCH GmbH Co.

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

SCHEME OF **VTU-ERT**

For Ph.D/M.Sc.(Engg)

**For Faculty of Engineering & General Science**

## **Common to:**

Civil Engineering Science / Mechanical Engineering Science' / Electrical Engineering Science / Computer Sciences / Textile / Silk Engineering / Chemical Engineering / Polymer Science /Bio-Tech/ Architecture / Physics / Chemistry /Mathematics/Computer Application/Geology/Nanotechnology

## **Part I: Mathematics Section**

Questions carrying one mark

(Objective/multiple choice, covering full syllabus)

**- 30 questions**

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**

**Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme  
Syllabus for the VTU-ERT**

**Common to:**

Civil Engineering Science / Mechanical Engineering Science' / Electrical Engineering Science / Computer Sciences / Textile / Silk Engineering / Chemical Engineering / Polymer Science /Bio-Tech/ Architecture / Physics / Chemistry /Mathematics/Computer Application/Geology/Nanotechnology /Physical Education/Library Science and MBA

**- 20 questions**

**Part III : Aptitude section**

Reading Comprehension data Sufficiency & Data

Interpretation, Logical Reasoning computer awareness

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**  
SCHEME OF VTU-ERT  
For Ph.D/M.Sc.(Engg)

**Business Administration**

**Part I: *Verbal Ability, Numerical Analysis Quantitative ability***

Questions carrying one mark

- 30 questions

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM Topics  
of Syllabus for the Qualifying Exam for the Ph.D. Programme  
Syllabus for Geology**

**Part II: Discipline Oriented Section**

- 50 questions

Questions carrying one mark

(Objective/multiple choice, preferably involving numericals covering full syllabus)

**Physical Geology-**

The dynamics of Earth- Outer zones, crust and inner zones of the Earth, continents and ocean floor  
Weathering and Erosion. Volcano 's, Rivers, Wind, Coastal scenery and work of sea.  
Earthquake , Plate tectonics, Orogenic belts, Geosynclines.

**Mineralogy and Crystallography-**

Physical properties of Minerals, origin and occurrences of Minerals.  
Crystal - Forms of crystals, symmetry elements, and crystal systems,  
Optical properties of Minerals.  
Study of Minerals-Oxide group, Carbonate group, Feldspar group, Mica group, Silicate group and ore  
minerals for their properties , uses and occurrences.

**Petrology**

Igneous rocks – Textures, structures and classification  
Sedimentary rocks – Characters, textures, structures and classification  
Metamorphic rocks – Agents of metamorphism, Textures, structures kinds of metamorphism  
Study of rocks for their properties, uses and occurrences – Granite, Basalt, Dolerite, Gabbro, Pegmatite,  
Sandstone, Conglomerate, Shale, Limestone, Gneiss, Marble, Phyllite, Slate and Schists.

**Structural Geology**

Mechanical principles  
Attitude of beds  
Folds – Parts and nomenclature  
Joints – Geometric and genetic classification  
Faults – Identification in field, parts and classification  
Unconformities – Recognition of unconformities and types of unconformities

**Stratigraphy and Paleontology**

Principles of stratigraphy  
Stratigraphic units  
Physical divisions of India  
Fossils, Important use of fossils  
Standard geological time scale  
Paleo botany,- Introduction, Plants classification. Evolution of plants and their geological distribution,  
invertebrate paleontology classification.

**Hydro Geology**

Ground water, occurrences and vertical distribution  
Aquifer, kinds and types  
Ground water prospecting  
Ground water quality  
Ground water pollution

**Remote sensing and GIS**

Applications, concepts, elements, electromagnetic radiation, electromagnetic spectrum, Passive and  
active remote sensing, EMR interaction with atmosphere and earth materials, satellites, parameters  
of sensors  
GIS – applications, components of GIS, Maps, projections.

Reference-

A Text Book of Geology by- P K Mukerjee

Holmes Principals of Geology by-Arthur Holmes. Structural Geology by- M P Billings

Ground Water by- D K Todd

Ground Water by- H M Raghunath

Basics of Remote Sencing & GIS by-Dr S Kumar

Petrology by-Tyrrel

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

## Topics of Syllabus for the Qualifying Exam for the Ph.D. Programme Syllabus for the VTU-ERT- for Nanotechnology

**Introduction to nanoscience and nanotechnology:** History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions, nanosized effects surface to volume ratio, crystal structure, atomic structure, molecules and phases, energy bands- insulators, semiconductors and conductors, Nanoscale-molecular and atomic size, quantum effects.

**Nanomaterials synthesis:** Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, Sonochemical synthesis, Hydrothermal, solvothermal, solution combustion process.

Physical Methods-Ball milling, Physical Vapour deposition (PVD), Chemical Vapor deposition (CVD), Sputter deposition, electric arc deposition, Lithography techniques.

Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

### MATERIAL CHARACTERIZATION TECHNIQUES

Compositional and structural Characterization techniques: X-ray Photoelectron Spectroscopy (XPS), Energy Dispersive X-ray analysis (EDAX), Principles and applications of X-ray diffraction; electron diffraction, Surface characterization Techniques- High resolution microscopy; Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM), scanning tunneling microscopy (STM).

Spectroscopic techniques: Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy techniques: micro Raman and laser Raman.

### Nanobiotechnology and Medical application

Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles, DNA double nanowires, Nanomaterials in drug delivery and therapy, Nanomedicine, Targeted gold nanoparticles for imaging and therapy

## **Nanoelectronics**

Introduction, Electronic structure of Nanocrystals, Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantum dot, Single electron devices, Nanostructured ferromagnetism, Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magnetoresistance, Introduction of spintronics, Spintronics devices and applications.

## **Carbon based Nanostructures**

Carbon Nanotubes (CNT), Graphene, Fullerenes, history and types, Carbon clusters, Single wall tubes, Multiwall tubes, Macroscopic Nanotube materials, Physical properties (Mechanical Properties, Thermal Properties, Electronic Properties, magnetic and superconducting properties), Applications of Carbon Nanotubes.

## **NANOCOMPOSITES - DESIGN AND SYNTHESIS**

Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity.

Synthesis methods for various nanocomposite materials: mechanical alloying, thermal spray synthesis etc. Nano composites for hard coatings; DLC coatings; Thin film nanocomposites; Modeling of nanocomposites.

## **Text Books and References**

1. T. Pradeep , “*NANO The Essential , understanding Nanoscience and Nanotechnology*”. Tata McGraw-Hill Publishing Company Limited, 2007.
2. Introduction to Nanotechnology, Charles P. Poole jr. and Frank J. Owens, Wiley Inter science.
3. Nanotechnology Principles and Practices by Sulabha K. Kulakarni.
4. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
5. Introduction to Solid State Physics, C. Kittel, Wiley Eastern
6. Fundamentals of Nanoelectronics by George W. Hanson (Pearson Education, New delhi)
7. . Nanotechnology and Nano Electronics – Materials, devices and measurement Techniques by WR .Fahrner – Springer

8. NanoBiotechnology-BioInspired Devices and materials of the Future by Oded Shoseyov, Ilan Levy.
9. . Bio Nano Technology by Good Sell, Wiley Liss
10. A practical approach to X-Ray diffraction analysis by C.Suryanarayana
11. Electron Microscopy and analysis by P.J. Goodhew and F.J. Humphreys
12. Scanning electron microscopy and x-ray microanalysis by J.I. Goldstein
13. Characterization of nanostructured materials by Z.L. Wang
14. Modern Raman Spectroscopy: A practical approach by E. Smith and G.Dent
15. Principles of Instrumental analysis by D.A. Skoog, F.J. Hollen and T.A. Niemann
16. Nanocomposite Science & Technology by P.M. Ajayan, L.S. Schadler and P.V. Braun, Wiley-VCH GmbH Co.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**  
SCHEME OF UNIVERSITY LEVEL RESEARCH APTITUDE TEST (VTU-ERT)  
**For Ph.D/M.Sc.(Engg)**  
**For Library Science**

**Part I: Unit: 1 to Unit 10**

Questions carrying one mark  
(Objective/multiple choice, covering full syllabus)  
- 80 questions

**Part II : Aptitude section**

Reading Comprehension data Sufficiency & Data  
Interpretation, Logical Reasoning computer awareness  
- 20 questions

**TOTAL 100 marks**

**LIBRARY SCIENCE**

Unit-1

Library and society, information society, Library philosophy, data, information & knowledge, Communication models, five laws of library science, professional organisations and associations.

Unit-2

Types of libraries, library classification and cataloguing, trends in library classification and cataloguing, metadata formats,

Unit-3

Library information sources and services, documentary and non documentary, library standards, library extension activities, electronic resources and services, Institutional repositories, internet resources and web technology, web designing tools,

Unit-4

Introduction to Information technology, computer hardware and software, data representation and file organisation, programming languages, computerisation of libraries, library automation software's, Database management systems, computer networks & library networks

Unit5

Management of library and information science, planning of library and information centers, financial management in libraries, HRM in libraries, scientific management, TQm in libraries, knowledge management, library security measures,

Unit-6

Information systems and services, national and international information systems, IRS, abstracting and indexing , types of indexing systems, search techniques,

Unit-7

Basics of Research methodology, types of research, research design, hypothesis, research methods, tools and techniques, statistical techniques and softwares, analysis and interpretation, report writing. Citation formats

Unit-8

Digital libraries and information management, digital technologies and digital library initiatives, digital resource management, institutional repositories, digital library software's-open source and commercial, digital preservation and archiving

Unit-9

Scientometrics, citation analysis, bibliometric laws, growth of literature, webometrics, scientometric tools and techniques

Unit-10

Content management and its softwares, knowledge management, information literacy, electronic resource management, web technology and semantic web, marketing of library information products and services,

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**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**  
SCHEME OF UNIVERSITY LEVEL RESEARCH APTITUDE TEST (VTU-ERT)  
For Ph.D/M.Sc.(Engg)  
**FOR PHYSICAL EDUCATION**

**Part I:**

Questions carrying one mark  
(Objective/multiple choice, covering full syllabus)  
- 80 questions

**Part II : *Aptitude section***

Reading Comprehension data Sufficiency & Data  
Interpretation, Logical Reasoning computer awareness  
- 20 questions

**TOTAL 100 marks**

**Sports Medicine**

**Unit: I**

- a) Concepts and content of sports medicine
- b) Duties of athletic trainer. c) Role of Sports physician

**Unit: II**

- a) Concept of Doping:
  - i) Doping classes: Stimulant, Narcotic analgesic, Anabolic Steroids, Beta Blockers, Diuretics.
  - ii) Doping methods: Blood Doping, Pharmacological, chemical and physical manipulation.
  - iii) Classes of drugs subject to certain restriction, Alcohol, Marijuana, Local anesthetics, Cortico steroids
- b) Smoking and its bad effects.

**Unit: III**

Therapeutic modalities:

Hydrotherapy: Treatment and rehabilitation in the following

Electro therapy: Conditions

Heat therapy: Sprain, Strain, low back problem and Remedial exerciser

**Unit: IV**

- A) Specific sports injuries of shoulder Elbow, wrist and fingers, Abdomen, thigh, knee, ankle and foot.
- B) Nutrition:
  - a) Preparation of diet for various games and sports- Body weight and caloric need of sports and games.
  - b) Caloric value of different food items
  - c) Body height and weight index.

## **Books for Reference:**

- 1) Leonard Lorson - Foundations of Muscular activity
- 2) Williams J.G.P. - Sports medicine
- 3) Alok Ghosh - Hand book of sports medicine and Physical fitness.
- 4) Park J.E. - Preventive and social medicine
- 5) Eriksson B.O and - Sports medicine, Health and Others Medication.
- 6) Berger R.A. - Applied Exercise Physiology
- 7) Sundararajan G.S - Sports medicine
- 8) Herbert A De vries - Physiology of Exercises
- 9) Khanna G.C. & Exercise physiology and Sports Jayprakash C.S. medicine
- 10) Clarke D.H. - Exercise Physiology
- 11) Pacharui S.K. - Sports medicine
- 12) Dr. Sharma N.P. - Handbook of sports medicine
13. Shaver L.G. - Essentials of exercise physiology
14. Appenzellar Otto - Sports medicine-fitaess-Training
15. Dr. Pande P.K. - Out line of sports medicine
16. Dr. Pande P.K. - Know How sports medicine
17. Roy 85 Irwin - Sports medicine.

# **Sports Physiology**

## **Unit: I**

### **Structure and function of Muscle:**

Classification of muscles, structure of muscle tissues, Various theories of muscular contraction: Hypertrophy of muscle in relation to physical activity.

## **Unit: II**

### **Neuromuscular Physiology:**

Neuro Motor units, Neuro muscular junction, Bioelectric potential, Muscle tone, posture and equilibrium.

## **Unit: III**

### **Bio-Energetics:**

Fuel for muscular work and energy for muscular contraction, Aerobic and Anaerobic system, Inter relationship of Aerobic and anaerobic system with special reference to different activities, Anaerobic Threshold training.

## **Unit: IV**

### **Physiological Changes due to exercise and training:**

Effect of exercises and training in relation to oxygen dept, second wind, Micro-circulation: Effect of exercise on carbohydrate, fat and protein metabolism. Fluid balance and electrolyte- Sports anemia.

## **Books for Reference:**

1. Guyton A.C. Text Book of Medical Physiology. W.B. saunder company, Philadelphia, 1976.
2. De. Varies H.A.: Physiology of exercise for physical Education and Athletics, staples, press London.
3. Karopovich P.V.: Physiology of muscular Activity.
4. Bourne G.M. The structure and function of muscle Academic of press. London: 1972.
5. Morehouse L.E. and miller A.T. physiology of exercise. C.V. Mosbey company saint Louise 1976.
6. P.O. Astrand and K. Rodahl text-book of work physiology, M.C. graw-hill kogakusha Ltd., 1970.
7. Mathew D.K. F Fox E.L. Physiological basic of physical education and athletics. W.B. Saunders co-philadelphia, 1976.
8. Katch: Exercise Physiology, Energy, nutrition and human performance-Henery kimpson U.K. 1981.
9. Berger A.R. Applied exercise Physiology, Lea and febiger. Philadelpia, 1982.
10. Shaver L.G. Essentials of exercise physiology sarjeent publication, New Delhi-1982.
11. Carola Robert, Harley J.P.'Noback C.R. Anatomy and physiology.
12. Rasch and Burke - Applied Anatomy and Kinesiology.
13. Khanna G.L. Jayprakash C.S. Exercise physiology and sports medicine.
14. Biomechanics - E. Kreighbaum K.M. Barthels
15. Sports Medicine - Erikson and others.

## **Sports Psychology**

### **Units I**

- B) History, development & importance of Sports psychology
- C) Future of psychology in physical educational & Sports

### **Units II**

- Personality: Definitions, Dimensions of personality.
- C) Physique-mind and intellect, emotional stability social stability.
- D) Factors affecting the development of personality. -Traits of sportsman through sports participation.
- E) Assessment of sports personality.

### **Units III**

- Principles in sports psychology: Psychology and sports performance
- a) Principles and application.
- b) Coaching, Decisions and Research in sports psychology.

### **Units IV**

- Intelligence
- Intelligence of sports performance, Motivation
- Definition: Motives, Drive, Need.

Organic motives-Emergency motives-objectives motives.

Learning

Theories of Learning

- 1) Association Theories of Learning.
- 2) Cognitive Theories of Learning
- 3) Cybernetic Theories of Learning

### **Books for Reference:**

1. Psychology in sports- by Richard in suinn, Published by- Surjeet publications T.K. Kolhapur Road, Kamala Nagar, Delhi:
2. Psychology in P.E and Sports by Dr. M.L. Kamalesh Published by Metropolitan Book Co. Pvt. Ltd. 1 Netaji Subhash Marg New Delhi. .
3. Alderman R.N. Psychological behavior in sports, Philadelphia London : Saunder Compy, 1974.
4. But Dorcessusan, Psychology of sports, New York.
5. Cratty Bryant J Movement behaviour and motor learning, Philadelphia : Law and Febiger, 1975.
6. Cratly, Brant J. Psychology and physical Activity anglewood : Glifs New Jesey, Prentice Hall Inc. 1978.
7. Kane J.Ed. Psychological Aspects of physical education and sports : London : routedge and Keger Paul - 1972.
8. Runi A Sports Psychology, Patiala N.S. N.I.S. 1980.
9. Singer, Rober N. Motor Learning and Human Performance, New York : Mc-Millan Publishing co-Inc. 1975.
10. Singer, Robert New coaching Athletics and psychology New-York: Mc-Macillan publishing co. Inc.
11. Tut ko and Richards , Psychology of coaching allyu iind Bacon, Inc 1971.
12. Harton D.L. & Turnage T.W. : human Learning Prendce Hall, 1976.
13. Hules S.H. Doase, James & Egeth Howard : The Psychology of Learning IV Education Mc-Graw-Hill 1979.
14. Linda K , Bunkar, Robert J. Reteils Anns Reilly : Sports, Psychology sandy sharp I thaca, New York, 3 985.
15. H.T.A. Withing K. Harmon & Others : Personality and performance. Henry Kempt on Publishers, London, 1973.

## **Sports Nutrition**

### **Unit I**

Introduction to Sports Nutrition

Importance & Scope of Sports Nutrition

Concept of Sports Nutrition.

Trends in Sports Nutrition

### **Unit II**

Content of Nutrition

Proportion of carbohydrates, fat & protein

Principles of Sports Nutrition

Recommendation for fat & protein

Water, exercise & dehydration

### **Unit III**

Diet prescription & ergogenic aids  
Sports supplement  
Nutrition according to Body composition & for special population  
Pre meal, exercise & energy expenditure

### **Unit IV**

Proportion of diet content.  
Sports supplement.  
Intake & energy expenditure.

#### **Books for Reference:**

1. Manore, M. & Thompson, J. (2000). Sport nutrition for sport & performance. Champaign: Human kinetics.
2. Kern, m. (2005). Sports nutrition. Tayloy.
3. Driskell, J. A. & Wolinsky, I. (2006). Sports nutrition. New Delhi: Friends publications.
4. Groff, J. (2000). Advanced nutrition & human metabolism. Wadsworth.

## **Sports Training**

### **Unit 1**

Introduction and Trends in Sports Training  
Meaning, Definition, Scope of Sports Training  
Aim and Characteristics of Sports Training  
Trends in Sports Training  
Talent Identification

### **Unit 2**

Training Methods  
Principles of Sports Training,  
Load, Adaptation, Recovery  
Sports Fitness Training Methods  
Periodization

### **Unit 3**

Training Program  
Long Term and Short Term Training Plans  
Technique, Skill, and Psychological Training  
Design Training Program  
Evaluation of Training Program

Conditioning methods to improve the motor components like, strength, speed, Endurance, flexibility, co-coordinative abilities.

Preparation for competitions in relation to improve various performance factors, Physical preparation technical preparation. Tactical preparation. Psychological preparation and sociological preparation.

### **Books for Reference:**

1. Singh, H. (1991). Science of sports training. New Delhi: DVS publication
2. Uppal. A. K. (2001). Principles of sports training. New Delhi: Friends publication
3. Rainer Martens (2005). Successful coaching
4. Beachel & Taylor (2006). Essentials of strength training & conditioning

## **Sports Biomechanics**

### **Unit 1**

Introduction and Trends in Biomechanics

Meaning, Definition, Scope of Biomechanics

Importance of Biomechanics

Trends in Biomechanics

### **Unit 2**

Analysis of Techniques and Training

Analysis of fundamental Skills and Sports Skills

Video Film Analysis - Cinematography and Videography

Tools of Biomechanical Analysis - Electrography and Dynamography - LED's and

Electromagnetic Markers - Force transducers and Pressure Sensors

### **Unit 3**

Skill Analysis

Athletics – Field Event

Athletics – Track Events

Athletics – Jumping Events

### **Unit 4**

Skill Analysis of Various Sports events: Cricket, Foot ball, Basket ball, hockey, Archery, Badminton

### **Books for Reference:**

1. Hay, J (1981). The Biomechanics of sports techniques. New Jersey: Prentice Hall.
2. Bunn, J. W. (1981). Scientific principles of coaching. Englewood: Cliffs. Prentice Hall.
3. McGinnis, P. M.(2005).Biomechanics of sports exercises. USA: Human Kinetics.
4. Sunderrajan, G.S. Biomechanics of sports and games. Ludhiyana: Tondon Publication.
5. Susan, J. H (2003). Basic Biomechanics.(4th Edn.) Mc.Graw Hill Publication.
6. Rajlakshmi, D. (2007). Biomechanics for sports and games. Sports Educational Technologies.
7. Hoffman, S.J. (2005). Introduction to Kinesiology. Human Kinesiology Publication.
8. Uppal. A. K. and Lawrence, M. P. Kinesiology. New Delhi. Friends Publication: India.
9. Knudson, D. (2007). Fundamentals of Biomechanics. Chico, USA: Springer Publication.
10. Scott, M. G. Analysis of Human Motion. Newyork.