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UNIVERSITY OF AGRICULTURAL SCIENCES, RAICHUR

[ICAR, NAAC accredited and, UGC u/s 12(B) & 2(f) approved]

Office of the Registrar,
Lingasugur road, Raichur-584 104,
Karnataka – India.

No. R/UASR/Rectt./ 1058 / 2023-24 Date: 17.10.2023

NOTIFICATION

Sub: Syllabus for recuritment of Assistant Professors in UAS, Raichur.-reg

Ref: 1. This office Recruitment NotificationNo.R/UASR/RECTT./ADVT.23/2023/ 2057, dtd: 04-02-2023.
2. This office Notification No. R/UASR/Rectt./Score-card/2021-22, dated: 18-11-2021 published in Karnataka Gazettee dated: 12-01-2022.
3. The approval of the Honorable Vice-Chancellor.

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In pursuance of the Recruitment Notification and Scorecard vide ref. (1) & (2), the syllabus for recruitment of the posts of Assistant Professors in the University of Agricultural Sciences, Raichur is hereby published and appended in Annexure.

For details visit University website (www.uasraichur.edu.in).

BY ORDER

REGISTRAR,
UAS, RAICHUR

REGISTRAR
University of Agricultural Sciences
RAICHUR-584 104.

AGRICULTURAL STATISTICS

Limit and continuity; Differentiation of functions, Successive differentiation, partial differentiation. Mean value theorems, Taylor and Maclaurin's series; Integration of rational, irrational and trigonometric functions.

Differential equations of first order, Linear differential equations of higher order with constant coefficients.

Simple interpolation; Divided differences; Numerical differentiation and integration. Group, Ring Field and Vector spaces, Subspaces, Basis, Gram Schmidt's orthogonalization; Galois field Fermat's theorem and primitive elements.

Linear independence and dependence of vectors, Row and column spaces; Sub- matrices and partitioned matrices; Determinant, rank and inverse of matrix; Determinant and inverse of partitioned matrices; Special matrices – Unitary, Similar, Hadamard, Circulant, Helmerts's Idempotent and Orthogonal. Eigen values and Eigen vectors. Spectral decomposition of matrices.

Kronecker and Hadamard product of matrices, kronecker sum of matrices, permutation matrices, Full rank factorization. Grammain root of symmetric matrix.

Generalized inverses, Moore – Penrose inverse, Applications of generalized inverse; Generalized inverse of partitioned matrices; Solutions of linear equations, equations having many solutions; Spectral decomposition of matrices; Differentiation and integration of matrices; Quadratic forms.

Elements of measure theory, Borel field, Probability measure; Random variable, Axiomatic approach to probability; Laws of addition and multiplication; Bayes' theorem.

Discrete and continuous variables; Functions of random variables; Distribution function and its properties Univariate and bivariate probability distributions; Conditional and marginal distributions; Independence of random variables; Transformation of random variables. Chebyshev's inequality; Bernoulli weak law of large number; Kolmogorov strong law of large numbers; Central limit theorem; Demoviere – Laplace central limit theorem.

Bernoulli, Binomial, Poisson, Negative binomial, Geometric, Hypergeometic and Uniform distributions. Rectangular, Normal, Exponenial, Gamma, Beta, Cauchy and Lognormal distributions. Bivariate normal distribution. Probability distributions of functions of random, variables. Family of Pearson distributions.

Mathematical expectation; Mathematical expectation of functions of random variables; Moment generating function, Characteristic function; Raw and central moments. Mean and variance of above mentioned distributions. Sampling distributions; Distribution of mean, difference between two means and correlation coefficient; Central; t, F and chi- square distributions, their properties and interrelationship; Variance stabilizing transformations.

Order statistics; Distribution of r^{th} order statistic; Joint distribution of several order statistics and their functions; Distribution of range and median.

Point estimation: Mean square error; Unbiasedness, Consistency, Sufficiency, Completeness; Neyman factorization theorem with application; Minimum variance unbiased estimator; Cramer Rao inequality; Rao Blackwell theorem.

Methods of estimation: Method of moments, Method of minimum chisquare, Method of maximum likelihood, their properties and applications. Confidence interval estimation for parameters of Normal, Exponential, Binomial and Poisson distributions.

Testing of hypothesis; Neyman Pearson lemma; Unbiased test; Uniformly most powerful unbiased tests and their constructions. One and two-sample tests about mean, variance, proportion, simple correlation coefficient and simple regression coefficient; Behrens-Fisher problem; Bartlett's chi-square test; Likelihood ratio test and its asymptotic properties. Chi-square tests of goodness of fit and independence.

Non-parametric tests, Robust statistics, One and two-sample sign and Wilcoxon sign rank tests, run test for randomness, Wilcoxon -Mann-Whitney U test, Kruskal-Wallis and Friedman's tests, Kendall's coefficient of concordance.

Elements of sequential analysis; Wald's sequential probability ratio test.

Concept of random vector, Expectation operator, Dispersion matrix, Marginal and joint distribution, Conditional distribution and Independence of random vectors. Multinomial distribution. Multivariate normal distribution; Marginal and conditional distributions. Sample mean vector and its distribution, Maximum likelihood estimates of mean vector and dispersion matrix. Tests of hypotheses about mean vector.
Wishart distribution and its properties; Hotelling's T^2 and Mahalanobis' D^2 statistics; Null distribution of Hotelling's T^2 ; Rao's U statistic and its distribution.
Multivariate analysis of variance; Wilk's lambda criterion arid its properties, Discriminat analysis, Computation of linear discriminant function (LDF), Classification between two multivariate normal populations based upon LDF and Mahalanobis' D2.
Canonical correlations; Factor analysis; Principal component analysis; Principal co- ordinate analysis; Cluster analysis, Similarities and Dissimilarities, Hierarchical clustering, Single and complete linkage methods.
Path analysis and computation of path coefficients; Multi-dimensional scaling; Categorical data analysis.

Theory of linear estimation; Gauss Markoff theorem; Aitkin's transformation; Hypothesis testing and analysis of variance; Analysis of covariance; Restricted estimation; Random, fixed and mixed effects models.
Basic principles of design of experiments; Orthogonality; Contrast, Mutually orthogonal contrasts.

Completely randomized, Randomized complete block and Latin square designs; Missing plot technique; Orthogonal and mutually orthogonal Latin squares; Graeco Latin square designs. Balanced incomplete block (BIB) designs, Symmetrical BIB designs, General properties, Analysis without and with recovery of intra-block information, Construction of BIB designs; Partially balanced incomplete block (PBIB) designs with two associate classes, General properties; Lattice designs; Alpha designs; Cyclic designs; Augmented designs; General analysis of block designs; Youden square designs; Cross-over designs.
Factorial experiments, Confounding in 2^n and 3^n factorial experiments, Partial and total confounding; Fractional factorial designs for symmetrical factorials. Asymmetrical factorials. Split-plot and strip-plot designs. Combined analysis of experiments.
Designs for fitting first order and second order response surfaces, Second order
Rotatable designs.
Multiple comparison procedures; Sampling in field experiments.

Complete survey *vs* sample survey; Probability sampling *vs* purposive sampling; Sampling error; Sample space, Sampling design, Sampling strategy; Confidence interval.
Simple random sampling with and without replacement, Estimation of population mean and population proportion; Inverse sampling; Stratified random sampling, Optimum allocation, Number of strata, Construction of strata boundaries, Collapsing of strata. Determination of sample size.

Ratio, regression and product methods of estimation; Separate and combined ratio estimators; Cluster sampling; Multi-stage sampling with equal probability of selection of units at each stage; Two-phase sampling; Successive sampling over two occasions. Sampling with varying probability with and without replacement, Probability proportional to size sampling Cumulative method and Lahiri's method of selection; Horvitz Thompson estimator, Ordered and unordered estimators, Sampling strategies due to Midzuno-Sen and Rao-Hartley - Cochran; Inclusion probability proportional to size sampling.
Systematic sampling; Probability proportional to size systematic sampling.
Non-sampling errors, sources and classification, Non-response in surveys; Response error,

Interpenetrating sub-samples, Imputation methods; Warner's randomized response technique.
Unbiased ratio and regression type estimators; Multivariate ratio and regression type estimators.

Physical basis of inheritance, Segregation and Linkage; Analysis of segregation, Detection and estimation of linkage for qualitative characters; Amount of information about linkage; combined estimation, Disturbed segregation.
Gene and genotypic frequencies; Random mating; Hardy-Weinberg law of equilibrium; Disequilibrium due to linkage for two pairs of genes and sex-linked genes; Forces affecting gene frequency; Equilibrium between forces in large populations, Polymorphism; Fisher's fundamental theorem of natural selection; Random genetic drift; Effect of finite population size.

Polygenic system for quantitative characters, Average effect of gene; Average effect of gene substitution; Dominance deviation; Breeding value; Epistatic interaction deviation; genotype – environment correlation, genotype – environment interaction and its application; Multiple allelism in continuous variations, Maternal effects; Different components of genetic variance and their partitioning; Effect of inbreeding on quantitative characters; Heterosis; Inbreeding depression; Effect of inbreeding or mean and variance of quantitative characters.

Resemblance between relatives; Phenotypic and genetic covariance between different relatives; Concept and estimation of genetic parameters; Heritability, Repeatability and Genetic correlation; Response due to selection, Selection index and its applications in plant and animal genetic improvement programmes; Correlated response to selection; Restricted selection index.

Mating designs; North Carolina designs and their analysis; Line x Tester Analysis: Diallel and partial diallel crosses including their construction and analysis.

Survival analysis; Phylogeny and analysis of molecular variance.

Simple and multiple linear regression models and their analysis; Estimation and testing of regression parameters, Sub-hypothesis testing. Restricted estimation; Polynomial regression: Use of orthogonal polynomials. Use of dummy variables. Regression with ordinal data. Logistic regression. Multiple and partial correlation coefficients;
Selection of variables, Stepwise and Stepwise regressions.
Regression diagnostics; Adequacy and validation of models. Examination of residuals-specification error, auto-correlation, Durbin-Watson statistic, Heteroscedasticity, Multi-collinearity. Weighted Least Squares, Outliers, Influential observations. Remedial measures regression under non-normal errors, transformation of data, Generalized least squares, Model over-fitting, model under-fitting.
Parameter estimation in non-linear models. Components of time-series. Fitting of different trend models. Auto-correlation and Partial Auto-Correlation functions. Correlogram, Determination of cyclical variations. Periodogram analysis. Linear Stationary models Auto-Regressive, moving average and mixed processes. Linear non-stationary models. Forecasting.
Simultaneous equation models. Indirect Least Squares. Pooling of cross-section and time-series data.
Demand and Supply curves. Determination of demand curves from market data.
Engel's curves. Poreto curves.

Classical optimization techniques. Constrained optimization. Optimization and inequality. Cauchy-Schwarz inequality, Jensen inequality, Markov inequality. Numerical methods of optimization. Direct Search method, Sequential Search method, Random Search method, Simplex Search method, Gradient method and Method of Steepest Ascent.

Linear Programming Techniques -Simplex method, Duality and sensitivity analysis.
Two-person zero-sum game and linear programming; Integer Programming. Statistical applications.
Non-linear programming. Kuhn-Tucker conditions. Quadratic programming. Elements of Multiple objective programming. Dynamic programming. Optimal control theory. Soft computing tools - Artificial Neural Network, Support vector machines and probabilistic reasoning. Genetic algorithm, decision tree, Bayes classifiers, Fuzzy Logic. Rough Set. Hierarchical and non- hierarchical clustering algorithm.
Simulation methods for various probability models. Resampling techniques: Jackknife and Bootstrap; Monte Simulation.

AGRILCULTURAL MICROBIOLOGY

History, development and scope of microbiology, evaluation of microbial life. Theory of spontaneous generation. prokaryotes, archaebacteria and eukaryotes. Techniques used in identification and classification of bacteria. Important groups of prokaryotes photosynthetic bacteria, blue green algae, chemoautotrophic bacteria, spore forming bacteria, mycoplasma, various, bacteriophages and actinomycetes. Heterotrophic bacteria, nitrobacteria, nitrogen-fixing bacteria and cyanabacteria, lactic acid bacteria, halophiles, thermophiles acidophiles and methanogens. Structure and classification of viruses, growth of viruses, lytic and lysogenic cycles, plant viruses viroids.

Principles of microbial ecology, Microbiology of ecosystems soil, rhizosphere, phyllosphere, water- fresh and marine, and air. Microbial interaction - symbiosis synergism, commenalism, parasitism, amensalism, antagonism and predation, adoption of micro-organisms to various ecosystems, Microbial growth curve. Mathematical expression of growth continuous and batch cultures. Diauxic and synchronous growth. Microbial nutrition. Bacterial metabolism - aerobic and anaerobic respiration, electron transport chain, microbial photosynthesis, oxidative and substrate level photo- phosphorylation. Biosynthesis of cell wall, protein breakdown by microbes.

Soil microorganisms: major groups, decomposition of organic matter, soil health. Root exudates and rhizosphere effects. Manipulation of rhizosphere microflora in plant productivity. Microbial biomass. Nitrogen cycle: ammonification, nitrification and denitrification. Biological nitrogen fixation-symbiotic and asymbiotic. Biochemistry and genetics of nitrogen fixation. Microbial transformations of phosphorus, sulphur and minor nutrients. Role of bio-fertilizers in agriculture and forestry. Bioremediation of problem soils, plant growth promotion rhizobacteria and their mode of action. Formation and composition of soil organic matter: fulvic acid and humic acid.

Isolation and preservation of different types of microorganisms. Methods of sterilization and disinfection. Microscopy: optical, phase contrast, fluorescent, dark field and electron. Microbial assay of vitamins, enzymes and antibiotics, Pollution of soil, water and air, Role of Microorganisms in pollution, sources of pollution and their impact on environment, microbiology of sewage and industrial effluents and their safe disposal, management of solid and liquid organic wastes, composting, biogas, water purification, sewages treatment, water-borne diseases and effluent management.

Industrial production of metabolites organic acids, alcohols, antibiotics. Fermentor designs and types. Control of fermentation process - batch, feed batch and continuous. Downstream processing in fermentation industry. Production of single cell proteins and probiotics, hormones, biofertilizers, biopesticides Phyto-remediation. Microbiology of raw and processed foods. Fermented food - vinegar, wine sauerkraut, pickles, cheese, yogurt. Food preservation, contamination and spoilage, food-borne illness and intoxication. Food as substrate for micro-organism, microflora of meat, fish, egg, fruits, vegetables, juices, flour, canned foods; bio-degrading microbes, single cell protein for use as food and feed, bioactive food / probiotics.

AGROFORESTRY

National forest policy 1894, 1952 and 1988; Indian Forest Act, 1927; Forest Conservation Act. 1980 and wildlife protection Act, 1972; Forests-extent, basis for classification and distribution in India; Geographical distribution and salient features of major would forest types; Phyutogeographical distribution and salient features of major would forest types; phytogeographical regions and vegetation of india; Role of forests in national economy – productive, protective and ameliorafive, tribal and rural livelihoods; forest types of India; distribution and type; successtion, climaxand retrogression; concepts of biomass, productivity, energy flow and nutrient cycling in forest ecosystem; Migration and dispersal mechanism.

Concept and definition of agroforestry, social forestry, community forestry and farm forestry; Benefits and constraints of agroforestry; Historical development of agroforestry and overview of global agroforestry systems. Classification of agroforestry systems: structural, functional, socio-economic and ecological; diagnosis and design of agroforestry design, productivity, sustainability and adoptability; Multipurpose tree species and their characteristics suitable for agroforestry.

Plant management practices in agroforestry; Tree – crop interactions: ecological and economic, Concept of complementarily, supplementarity and competition in productivity, nutrient cycling and light water and nutrient competition in agroforestry; Concept of allelopathy and its impact on agroforestry Energy plantations – choice of species and management; Lopping of top feed species such as frequency and intensity of lopping; Organic farming; Financial analysis and economic evaluation of agroforestry systems: cost benefit analysis and land equivalent ratio; agroforestry practices and system in different agro – ecological zones of India.

Extent and causes of land denudation; Effects of deforestation on soil erosion, land degradation, environment and its role in social, economic and ecological development; Biomass production for fuel wood, small timber, raw material for plant – based cottage industries, non – wood forest products such as gums, resins & tannins, medicinal plants, essential oils, edible fruits, spices, bamboo and canes; wood quality and wood preservation; plywood and pulp industries.

Forest mensuration – definition, object and scope; Measurement of diameter, girth, height, steam form, bark thickness, crown width and crown length; Measurement methods and their principles. Measurement and computation of volume of logs and felled / standing trees, Construction and application of volume tables; Biomass measurement; Growth and increment; Measurement of crops; Forest inventory; kinds of enumeration, sampling methods, sample plots and photo interpretation; Geographic information systems and remote sensing – concept and scope.

Definition object and scope of silviculture ; Site factors - climatic, edaphic, physiographic, biotic and their influence on forest vegetation; Forest regeneration; natural and artificial; Silvicultural systems – high forest and coppice systems; Silviculture of important tree species – Populus, Eucalyptus, Dalbergia, Acacia, Tectona, Shorea, Prosopis, Casurina, Pinus, Gmelina, Azadirachta, Diospyros, Pterocarpus, Anogeissus, Santalum, Quercus and Albizia.

Seed collection, processing, storage, viability and pre – treatment; Seed dormancy and method for breaking dormancy; Seed testing and germination tests; Seed certification and ISTA Rules; Forest nursery – need, selection and preparation of site, layout and design of nursery beds; Types of containers; Root trainers; Growing media and sowing methods; Management of nursery – shading watering, fertilizer application, weed control, insect pest and diseases control; planting

techniques: site selection, evaluation and protection; Soil working techniques for various edaphic and climatic conditions; Planting patterns; Plant spacing manure and fertilizer application, irrigation / moisture conservation techniques; Choice of species. Afforestation on difficult sites: saline – alkaline soils, coastal sands, lateritic soils, wetlands, ravines and sand dunes, dry and rocky areas, cold desert; Tending operations – weeding, cleaning, climber cutting thinning – mechanical, ordinary, crown and selection thinning, improvement felling, pruning and girdling; Forest fires: causes, types, impacts and control measures; Major forest pests and weeds.

Forest management: definition and scope; Concept of sustained yield and normal forest; Rotation; Estimation of growing stock, density and site quality; Management of even aged and uneven aged forest; Regulation of yield in regular and irregular forests by area, volume, increment and number of trees; working plan; joint forest management; Conservation and management; of natural resources including wildlife; Forest evaluation; Internal rate of return, present net worth and cost benefit analysis.

Tree improvement: nature and extent of variations in natural population; Natural selection; Concept of seed source / provenance; Selection of superior trees; Seed production areas, exotic trees, land races; Collection and maintenance of germplasm; Provenance testing. Genetic gains; Tree breeding: general principles, mode of pollination and floral structure; Basics of forest genetics – inheritance, Hardyweinburg Law, genetic drift, Aims and methods of tree breeding, Seed orchard: types, establishment, planning and management, progeny test and designs; Clonal forestry – merits and demerits; Techniques of vegetative propagation, issue culture, mist chamber; Role of growth substances in vegetative propagation.

Forestry in bio – economic productivity of different agro – eco – systems and environmental management; Global overview and classification of agroforestry systems; Tree – crop interaction in agroforestry; Biomass production for fuel wood small timber, raw material for plants – based cottage industries, non wood forest products such as gums, resins, tannins, medicinal plants, essential oils, edible fruits, bamboos and canes; principle and criteria of plant selection in agroforerty; use – efficiency in agroforestry.

Measurement of trees and stand – diameter, girth, height, form and crown characteristics; Measurement methods and their principles volume / biomass estimation, volume tables; Measurement of rangeland productivity; Forest enumeration: sampling methods, sample plots, surveys and photo interpretation; Concept and application of GIS and remote sensing; Introduction to internal rate of return, present net worth, cost benefit analysis and land equivalent ratio; Agroforestry and environmental conservation; Role of green revolution in forest conservation in India.

Climate change: greenhouse effect, sources and sinks of green house gases, major greenhouses gases: Global climate change – its history and future predicitions; Impact of climate change on agriculture, forestry, water resources, sea level: Livestock, fishery and coastal ecosystems: International conventions on climate change; Global warming: effect of enhanced CO_2 on productivity; Ozone layer depletion; Disaster management, floods, droughts, earthquakes; Tsunami, cyclones and landslides; Agroforestry and carbon sequestration.

Statistics: definition, object and scope; Frequency distribution; Mean, median mode and standard deviation, introduction to correlation and regression; Experimental designs; basic principles, completely randomized, randomized block, Latin square and split plot designs.

ANIMAL SCIENCE

Important breeds of cattle and buffalo, traits of economic importance and their inter-relationships - Selection of high quality animals - Role of management in improving the reproduction efficiency in farm animals. - Housing and rearing systems. Breeding Management: System of breeding Economic traits. Methods of Breeding - Prenatal and postnatal care and management of cattle and buffalo - Care of neonate and young calves - Management strategies for reducing mortality in calves, age at first calving and calving interval in cattle and buffaloes. Management of labour, Milking management, Machine milking and hand milking, Different laws governing the livestock sectors to produce quality products on par with international standards - Technique of harvesting clean and hygienic livestock products, transportation of animals, health management. Wallowing in buffaloes- Management of draught animals and summer management Feed and fodder resources used for feeding of cattle and buffaloes– Scientific technique of feeding, watering – Computation of practical and economical ration, supply of green fodder around the year and enrichment of poor quality roughages. Disease Management: Role of management in the prevention and control of diseases. Importance of deworming.

Introduction - Population structure and importance- Advantages and disadvantages of sheep farming under different systems of management – type of housing and equipments- Important sheep and goat breeds- Advantages and disadvantages of sheep and goat farming. Breeding Management: Breeding seasons - fitness of purchase for first breeding - methods of detection of heat - Natural Service and artificial insemination - Care of the pregnant Animals - Breeding stock - Use of teaser - Culling. Feeding Management: Feeding methods - Principles to be followed in feeding and watering- feeder space, waterer space, Designing feeders and waterers. - Range management - Stocking rate and pasture improvement and utilization; management under stall fed conditions, Transportation of sheep and goat. Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying- shearing - Avoidance of goatry odour in milk, Tupping Wool: Importance of wool - Fiber structure- Fleece characters - Goat fibers - Characters of mohair and pashmina, fur and Angora - Marketing of goat fibers / wool.- Planning of sheep and goat farm of various sizes - Economics of sheep and goat farming.

Breeds of pigs - Selection of breeding stock - Breeding seasons - Age and weight at first services - Methods for detection of heat – Natural service and artificial insemination - Care of pregnant sows, piglets and growers - Care of breeding boar.

Poultry housing systems Cage Vs floor system, litter management and lights for poultry, rearing turkey, duck and quails. Management of chicks, growing, laying and breeding flocks, broiler production, selection and culling of laying flocks. Procuring, care and pre-incubation storage of hatching eggs - Method of incubation, sanitation disinfection and

management of hatchery. Embryonic development and factors effecting fertility and hatchability of eggs. Chick sexing, packing and hatchery business - Transporting management of farm and hatchery waste. Economic traits of egg-type chicken and their standardization – Selection criteria – Aids to selection: Index selection and Osborne index – Restricted selection index – Economic traits of meat – type chicken and their standardization.

Disease Management: Role of management in the prevention and control of diseases. Special Management: Deworming - Dipping and spraying.

Basic terminology and classification of carbohydrates, fats and proteins. Fundamental concepts of digestion and metabolism of Carbohydrate Fat and Protein in different species of animals. Gluconeogenesis, Recent advances in glucogenic precursors on acetate utilization. NPN metabolism, urea fermentation potential and metabolizable protein. Amino acids imbalance, antagonism and toxicity. Rumen degradable Protein (RDP), and rumen undegradable protein (UDN). Critical minerals for ruminants and non-ruminants, chelates and chelated minerals. Inter-relationship of minerals with other nutrients. Impact of minerals arising from industrial affluent on animal health and production. Critical limits of minerals in edible herbages. Bioavailability studies in minerals. Impact of minerals on reproduction. Area specific minerals. Relationship of vitamins with other nutrients. Critical vitamins for ruminants and non-ruminants.Feed additives including probiotics Prebiotics, Symbiotics and feed enzymes.

Principles of feed and fodder processing and preservation techniques, their merits and demerits. Procurement, planning and purchase procedures; traditional and modern farm level storage structures. Feed storage and godown management, estimation of storage capacity and stack plan.

Nutrients and their metabolism with special reference to milk, meat and wool production. Feeding standards, their history, comparative appraisal and limitations. Classification of feedstuffs. Nutrient requirements for calves, heifers, dry, pregnant and lactating cows, buffaloes, sheep and goat. Introduction to rumen microflora and fauna. Development of rumen. Role of milk replacers and calf starters Feed formulation of large and small ruminants for different physiological stages. Concept of complete feed. Limiting nutrients and strategic feeding of high yielding ruminants. Concept of by-pass nutrients and their impact on production, reproduction and immune status. Importance of CLA, omega fatty acids, Scope for value addition in milk, Different systems of feeding buffalo for beef production. Feeding during natural calamities, feeding in various agro-climatic zones of India.

Nutrients, their metabolism and requirements for poultry and swineduring different stages of growth and production. Limiting iminoacids-lysine and methionine. Feeding systems and feed additives, feed formulations for different purposes including least cost

rations. Quality control of poultry and swine rations for efficient egg and meat production. Nutrition in relation to disease and stress. Nutritional factors affecting quality of the products. Hind gut fermentation and its importance, Nutrient requirements of rabbits and equines, Nutritional manipulation for producing value added egg, meat / pork.

Present and future feed requirements and current availability for livestock and poultry. Use of non-traditional feeds – By-products of agricultural, industrial, food processing units and forest by-products. Evaluation by chemical and biological methods. Formulation of economical rations. Level of inclusion of various non conventional feeds in livestock ration.

Selection of several traits. Evaluation of short term and long term selection experiments viz: bidirectional selection and asymmetry of response, selection plateux and limit. Genetic aspects and consequences of various mating systems. Effects of mating systems on mean and variance. Application of various mating system in animal improvement. Selection for general and specific combining ability. Genetic polymorphysim and its application in genetic improvement.

Scope and limitation of integrated farming systems - Sustainability of integrated Livestock Farming Systems and their economic importance. Integration of fish, arable farming and different livestock enterprises vis-à-vis gobar gas plant, FYM, solar and wind energy utilization, cattle, buffalo sheep, goat, pig, poultry, rabbit, silk worm, bee keeping etc. Project formulation and evaluation of various livestock enterprises.

Role of livestock in the national economy, Marketing - Objectives, strategies - Selecting and managing marketing channels - Pricing strategies - Sales promotion.

ARICULTURAL EXTENSION

Concepts and scope of extension and communication particularly for primary and secondary agriculture. Historical and emerging perspectives of agricultural, veterinary and animal husbandry extension education in India and other countries. Community Development and integrated Rural Development-concept, principles and objectives Role of agricultural extension in different sectors of agriculture and rural development. Agricultural Extension in the context of enhancing productivity Quality, Nutrition, post harvest technology, product processing, Profitability, Income and employment. Concepts of yield gaps. FLD and OFT in relation to TOT Programmes Farming System Research and Extension (FSR&E) and participatory development approaches. Concept and modules of communication, credibility, fidelity, empathy and feedback in communication. Similarities and dissimilarities among extension education, adult education and continuing / distance education Andragogy and theories of adult learning. Human behavioral dimensions and gender sensitivity in extension education programmes. Meaning and characteristics of attitude, factors affecting attitude change; Understanding of basic rural institutions, social structure, culture and norms. Social and technological change processes, group dynamics, concepts and theories of rural leadership. Group and mass communication, Interpersonal and Intrapersonal Communication Skills, Key communicators and their role in animal husbandry development. Acquiring communication skills for development of local leaders and key communications for livestock development Organizational communication. Rapport building with clientele. Problems and barriers in communication; distortion and noise in communication. Importance of feedback in veterinary extension, impact analysis of extension programmes.

Concepts of Teaching and learning processes-principles of learning as applied to agricultural extension. Individual, group and mass approaches in extension, audio- visual aids-classification, selection, use and production. Traditional media for communication in development programmes. Modularized communication – concept, approach, need process of designing instruction for transfer of communication. Basics of agricultural journalism, types of publications-bulletins, folders, leaflets, booklets, newsletters, popular and scientific articles. Selection planning and use of different extension teaching methods like demonstration, exhibition, farmers fairs, field days, tours, extension literature, etc. Preparation and presentation of different projected and non-projected audio-visual aids. Public speaking preparation of radio/video script. Principles of photography and its use in extension.

Concept of ITC and its role in agriculture and rural development ICT tools-print and electronic media, e-mail, Internet, use of multimedia, use of mobile phony, video and teleconferencing, computer-assisted instructions, touch screens, micro-computers, web technologies and information kiosks. Networking system of information and challenges in the use of ICT. E-learning information resources , sharing and networking. Types of net work –PAN, LAN, WAN, Internet, AGRINET, AKIS, Indian National Agricultural Research database. ICTs in livestock development, Digitisation, Simulation models, Utilization of Internet for promoting advanced veterinary and animal husbandry practices; communication with rural, semi-urban and urban livestock owners.

Human resources and their importance in agricultural development. Concept of human resource management. Training and development of human resources. Identifying training needs and assessment of training impact. Training - principles importance, methods and factors. Phases of training- pre training and post training. Developing training modules, training requirements, training methods. Lecture cum demonstration method, case method, group brain storming, syndicate method, business games simulation exercises in basket exercise, programmed instruction, experiential learning techniques such as sensitivity training, T-group, transactional analysis and fish bowl exercise. Evaluation of training – types and techniques of training evaluation. Motivation, stress management and organizational behavior as facilitators of human resource development. Capacity Building in relation to dairying, poultry, piggery, Goat and Sheep framing cottage industries, Rabbit farming, Apiculture, Sericulture, Bio fertilizer, Floriculture, and Bio pesticides.

Social research-concept, principles and approach. Selection and identification of research problems, methods of data collection-interview method and mailed questionnaires, variables – meaning and types, independent dependent and intervening variables. Hypothesis-concept characteristics, types and testing. Research design-concept and types, field studies, case studies and survey method. Measurement –meaning and levels, Methods of sampling and statistical tests. Reliability and validity of tests, normal distribution, tests of significance, ANOVA, correlation and regression, scaling techniques. Processing of data, coding-tabulation. Analysis and interpretation writing scientific report, citing references. Participatory approaches, PRA, RRA, PLA and PTD.

Concept, steps, principles and theories of progamme planning Steps in programme planning for livestock development, organizing campaigns mass vaccination programmes and variety of extension activities, evaluation of veterinary extension programmes, compilation and report writing. Evaluation of animal husbandry development progarmmes and schemes. Monitoring and evaluation-concept, significance, types methods and tools. Theoretical models of programme planning. Felt needs; need-based programmes. Social action. Five year plans-critical analysis with special reference to programmes for women, children and youth SWOT/TOWS analysis of development programmes. Concept and elements of diffusion and adoption for social change. Diffusion process, adoption process, models of diffusion and adoption, adopter categories and their characteristics. Factors influencing adoption and attributes of innovations. Concept and stages of Innovation-decision process, consequences of innovations.

Concept and principles of administration and management, classical and modern theories, schools of management thought. Functions of management – planning, organizing, staffing, directing and leading, controlling, coordination, reporting and budgeting. Types and methods of administrative communication. Decision-making in organization. Organizational effectiveness, organizational climate, organizational behavior, organizational development, job satisfaction and morale Time management. Performance appraisal. Coordination at different levels of extension management, methods of coordination. Management by Objective (MBO) and Total Quality Management (TQM). Project evaluation and Review Technique (PERT). Logical Frame working (LFW) and Project Management Techniques. Personal management, scope of Agri. Business Management and Institutions-National Institute of Agricultural Extension and Management (MANAGE). Indian Institute of plantation Management (IIPM), NIRD, EEI and NAARM

Monitoring, evaluation and impact analysis of extension programmes Critical analysis of organizational set up of extension administration at various levels. Agricltural Technology Information Centers (ATIC). Technology Parks. Management Information System Management of Agricultural knowledge System (MAKS) and use of Expert System. Traditional media for communication in development programmes. Problem Solving Techniques/ Negotiation, Motivational Theories & Techniques, Work motivation Organizational climate; Resource Management: concept and method; Team building; process and strategies at organizational and village levels. Mobilization and empowerment skills: concept and strategies in mobilization, concretization and empowerment of rural people.

Concept, Significance and scope. Programmes and agencies promoting entrepreneurship. Types and techniques of training for developing entrepreneurial activities in various areas. Self Help Groups-concepts, organization, mobilization, micro-finance and functioning of SHG for empowerment and sustainability. Agripreneuship–agriclinics and agribusiness centers. International cooperation in agriculture – SAIC, Common wealth, FAO, USAID, DFID, and CGIAR system critical analysis of extension system of SAARC, BRICS and other selected countries (USA, UK, Japan, Philippines, Israel etc)

Extension policies National Agricultural Extension system and Networking of State development Departments, NARS, NGOs, producers companies, agricultural cooperatives, rural banks, insurance and private sectors. History of Veterinary extension programmes-NPCBB, PM assistance livestock development programmes and rural development programmes Developmental strategies such as Watershed Development programmes Technology Mission Horticulture Mission. Front Line. Extension Programmes of ICAR/TAR-IVLP, NATP NAIP IRDP, ATMA ITD, SREP, Research- Extension- Farmer- Interface. Identification, characterization, documentation and validation of ITKs. Privatization of extension, market led extension, production to consumption and end to end innovative approaches. Issues related to globalization and IPR. Rural, Agricultural, Animal Husbandry, Dairy and Women Developmental programmes implemented by Govt. of India. Krishi Vigyan Kendras (KVKs).

Gender and empowerment: meaning, gender related definitions and importance for empowering women; need and focus on gender sensitization, gender in community diversity and its implication for empowerment. Gender perspectives in development of women social characteristics, roles, responsibilities, resources, constraints, legal issue and opportunities; economical, educational and other parameters. Gender tools and methodologies: Dimensions and methodologies for empowerment; gender budgeting; gender analysis framework- context, activities resources and programme action profile; technologies and empowerment – gender specific technologies, household technology interface, socio-cultural interface and women as consumer of technologies. Gender issues and development: health and nutrition, violence, governance, education and media.

FARM MACHINERY AND POWER

Status of farm mechanization in India; power availability on farms; hand tools used for different kinds of farm operations and materials for construction. Functional requirement, principle of working, constructional features and operation of animal and power operated equipment for land development, tillage, sowing planting, transplanting, fertilizer application, inter cultivation, plant protection, harvesting, threshing, mowing, Chaff cutting and baling; special equipment for crops such as sugarcane, cotton, groundnut, potato and plantation crops like coconut, areca nut, cashew nut etc.

Design and selection of machinery elements viz. gears, pulleys, chains and sprockets, belts, bearings, couplings and springs and fasteners. Farm machine system characteristics and evaluation, dynamic balancing and stability of farm machines, force analysis on agricultural tools and implements, pull draft, unit draft and power of farm equipment, design of soil working tools for sowing and planting; design of fertilizer applicators, inter cultivation equipment, harvesters and threshers; pneumatic and hydraulic controls.

Calibration of seed drills. Planters, plant protection equipment; methods of testing and performance evaluation of tillage equipment, seed drills and planters, fertilizer applicators, sprayers and dusters, harvesting and threshing equipment, grain and straw combines, and equipment such as sugarcane, cotton, rice and potato planter; calculations of field capacity, efficiency and rates of seed fertilizer and chemical applicators; calculation of capacity, efficiency and losses in threshers, harvesters and chaff cutters. Farm machinery selection and management for different soils, crops and operations; cost analysis of animal and tractor operated implements and tractors; matching power-implement system, estimation of energy and power requirements, reliability of farm machinery.

Engineering thermodynamics, power cycles, fuels; Various systems of IC engines; operations, adjustment and trouble shooting of different systems; calculations of power, torque, speed, firing arrangement and intervals, heat load and power transmission from piston to the flywheel; tractor power transmission, differential, final drives; power outlets such as P.T.O. and drawbar; recent trends in tractor design; emissions and control of pollutants; mechanical and power steering; tractor chassis mechanics, hitching systems, hydraulic controls for tractors, automatic position and draft control; tractor performance tests, operation and maintenance tractors and power tillers.

Anthropometry inn equipment design, physiological cost and effect of work on physiological responses, fatigue and comfort; ergonomics in design of tools; safety aspects of agricultural machinery; effect of noise and vibration on work performance; chemical hazards and control measures; operator's protective gadgets; design of tractor controls viz., hand and foot controls, visual tinge and limitations seat design etc.

Dynamic properties of soil and their measurements; stress-strain relations ship; theories of soil failure, mechanics of tillage tools; design parameters and performance of tillage tools. Introduction to traction devices, tyre function and size, their selection, mechanics of traction devices, traction theories, slippage and sinkage of wheels, evaluation and prediction of traction performance; soil compaction – causes and methods for alleviating the effect on soil and crop responses.

Conventional and renewable energy sources in agriculture; solar radiation and its measurement; characteristics of solar spectrum; solar energy collection, storage and applications; solar photovoltaic conversion and SPV powered systems. Types of wind mills and their applications; thermo-chemical conversion of biomass, direct combustion, pyroysis and gasification, chemical conversion processes, carbonization, briquetting, pelletization and densification of biomass; bioconversion into alcohols, methyl and ethyl esters, organic acids, solvents of amino acids; types of biogas plants, biogas properties, uses and distribution, alternate fuels for IC engines.
Energy requirement in agricultural production systems, energy ratio and specific energy value, inflow and outflow of energy in unit agricultural operation, energy audit, accounting and analysis.

Specification of materials, surface roughness, production drawing, computer aided drawing heat treatment, workshop practices applied in prototype production, common tools and press operations, metal cutting and machining, jigs, fixtures and gauges, casting and die-casting processes; basic joining processes, welding processes, weldments testing and metallurgy.

Mechanical measurements, sensors and transducers, application of electrical strain gauges, signal transmission and processing, dynamic measurements; measurement of temperature, pressure, strain force, torque, power vibrations etc.; determination of calorific value, fluid flow rates etc; signal conditioning and monitoring, data acquisition and storage.

FOOD SCIENCE AND NUTRITION

Colloidal chemistry as related to foods; evaluation of food by subjective and objectivemethods. Carbohydrates in foods, sources and characteristics of sugar, starch, cellulose,pectin and gums, characteristics in foods; effect of cooking and processing techniques.Protein in foods: Plant and animal foods; chemical and physical properties related to foods;effect of cooking and processing techniques. Properties, uses, changes during heating andother processing and storage of fats and oils. Classification, importance, composition of fruitsand vegetables and effect of cooking and processing on their nutritive value. Classificationand importance of beverages; food pigments; browning reaction. Definition, classification,uses and legal aspects of food additives; classification, nature and uses of leavening agents.

Functions, sources, requirements, digestion and absorption of carbohydrates; definition,composition, classification, functions and role of dietary fibre in various physiologicaldisorders. Basis of requirement, functions, sources, digestion and absorption of protein;Methods of assessing protein quality .Basis of requirement, functions, sources, digestion,absorption and deficiency disorders of lipids; essential fatty acids and eicosanoids. Requirements, functions, sources, deficiencies and toxicities of fat and water solublevitamins. Requirement, functions, sources, deficiency, toxicity and factors affectingabsorption and utilization of macro and micro minerals .Water balance; acid and basebalance.

Familiarization to terms and calculations used in preparation of various standard solutions.Sample and sampling techniques. Principles, techniques and applications of colorimetric,spectrophotometer and atomic absorption spectrophotometer, fluorimeter, flame photometer,electrophoresis and different methods of chromatography. Introduction to animal assay.Techniques in separation of biomolecules and tracer techniques in biology – radioactivity.

Assessment of the nutritional status at individual, household and institutional level: direct andindirect methods. Ecological, socio-cultural, economic and demographic correlations ofmalnutrition; prevalence, etiology, biochemical and metabolic changes in vitamin Adeficiency, PEM, iron deficiency anemia, IDD. Major nutritional problems of the state,nation and world. Nutrition intervention- Definition, importance, methods of nutritionintervention and their impact evaluation. National nutritional programmes and policies;nutritional surveillance. National programmes and policies regarding food production anddistribution.

SERICULTURE

Mulberry Crop Production Mulberry genetic variability and distribution-varieties - Soil suitability - Climatic requirements and constraints — Propagation methods — Planting methods — inter cropping - population geometry — growth analysis Soil fertility — fertilizer recommendation — integrated nutrient management — organic farming Water management — Weed management -Problem soils and management — Rain fed mulberry Chawki garden maintenance — Training and pruning —Leaf quality-concept and assessment—preservation— Sericulture in integrated farming system— Resource management in mulberry crop production— Mechanization-machineries in sericulture Pests, diseases and nematodes of mulberry and their management.

Mulberry and Silkworm Breeding Germplasm-collection-conservation-evaluation and utilization-choice of parental genotypes for selection and hybridization —inter varietal and interspecific hybridization and polycross-clonesclonal Selection-Breeding for quality-genetic relationship between mulberry and silk worm genotypes-environmental interactions. Biotic and abiotic stresses- selection of suitable host genotypes for stability and responsiveness across the environments — selection for different situations like drought and salinity-breeding for tree types- selection of genotypes-responsive to pruning-innovative breeding approaches - tissue culture/micro propagation of mulberry plants contribution of National and International Institutes Distinguishing characters of released varieties- production of nucleus and breeders planting materials. Silkworm present status of silkworm breeding establishing a silkworm breeding programme - introduction of exotic gene source. In breeding techniques-crossbreeding techniques for hybridization-different methods mutation-convergent crossing-dialled selection- selection of good inbred combiners. Selection for single trait and multi traits-breeding for tolerance to pathogens, early maturity, high temperature, post cocoon characters—breeding for biochemical parameters and sex-limited characters—recent advances in silkworm breeding.

Silkworm Biology Position of sericigenous insects in class insecta-silkworm integument- moulting process— exoskeleton—structure and Function-Body regions-head and its appendages in silkworm-mouth Parts-Types of antenna and mouth parts in silkworm and other insects—Cephalic glands. Thorax and its appendages-modification

of legs in silkworm and in other insects-type of wings and venation in Bombycidae and Saturnidae - Abdomen and its appendages - male and female genitalia in silk moths—male—female reproductive system— spermatogenesis—oogenesis— unusual types of development. Morphology and anatomy of eggs of silkworm—Diapause—physiology of diapause—biochemical changes stages of development in diapausing and non-diapausing eggs - principles underlying breaking diapause and cold storage. Structure and function of silk glandprotein requirement in silkworm—composition of amino acids in silk gland-transaminationchemistry of fibroin, sericin and P25-biosynthesis of silk-role of food supplementation on silk yield. Structure and function of digestive system—circulatory system- respiratory system. excretory system — endocrine system role of JH and anti JH analogues/ phytohormoens in cocoon production.

Silkworm Protection Insect pathology—history—Concepts-Silkworm diseases-pathogenicity-kinds of infectionsymptoms and pathologies associated with various diseases- classification of non-infectious and infectious diseases-poisoning due to gases-tobacco poisoning—nutritional and genetic diseascs. Silkworm viruses-resistance of silkworm breeds against viral infection-role of antiviral and viral inhibitory factors- non-inclusion viruses. Miscellaneous flacherie diseases - Bacterial diseases — etiology — epizootology — bacterial toxicosis- symptoms management of bacterial diseases. Protozoan diseases-biodiversity- symptoms—detection—monitoring and management-silkworm mycoses — types of fungal diseases — symptoms and management - disinfection and hygiene — disinfectants — mode of action. Pests of silkworm- uzifly -external morphology, biology, symptoms and management practices— pests of grainage-non-insect pests-mite-nematoderodents' symptoms and management practices.

Silkworm Nutrition Insect nutrition-nutritional requirements of silkworm larva-nutritional composition of mulberry leaves-feeding physiology of silkworm. Carbohydrate requirement - carbohydrate metabolism - lipid metabolism - synthesis of fatty acid in Bombyx mori — Amino acid requirement. Transamination — silk proteins physio-chemical properties fibroin and sericin synthesissuppleinentation of nutrients for high silk yield. Role of water soluble and lipid soluble vitaminsgrowth factor—role and requirement of minerals- larval excretion. Dry matter economy—intestinal flora of silkworm—Artificial diet—nutrient management through food supplementation

Non-Mulberry Sericulture Status of vanya silk industry in India—History—Types of non-mulberry silkworms—Distribution and eco races of non-mulberry silkworms-Maintenance of germplasm of non-mulberry silkworms — Eri silkworm-morphology and voltinism—and their host P lants-Castor for dual purpose. Tasar silkworm-food plants and cultivation practices—large scale Plantations-Terminalia arjuna and Teriuinaliato mentosa-Pests and diseases on food plants and their ManagementRearing of different non-mulberry Silkworms-Pests and diseases of non- mulberry silkworms— Management practices. Muga silkworm-food plants and cuhivation practices—Pests and diseases on food plants and their management Rearing technology — Economics of rearing—Marketing System-Silk reeling techniques—Recent advances in non- mulberry silk industry— Biotechno logical approaches.

Silk Reeling Technology Cocoon marketing—price fixation—sorting, mixing, drying and stifling—Cocoon cooking— principle and methods. Types of reeling machines. Comparative output of each device — advantages and disadvantages of different reeling devices. Reeling water quality. Silk throwing and weaving-processes involved in winding, doubling, twisting, rewinding for warp and weft-hank Making-Wet processing—degumming and bleaching by alkali and enzyme methods-dyeingdifferent dyes warping and weaving printing block, hand screen tables Grading of silk— standards—silk exchange- by products and its uses.

Silkworm Seed Cocoon and Egg Production Status and strategies of silkworm egg production Morphology Embryology — Biochemical changes in Eggs-Seed cocoon-preservation-selection-sorting-sex separation-cocoon melting. Moth emergence-sexing-pairing and departing-egg Laying-Handling of eggs-embryological tools- diapausing and non-diapausing eggs - Acid treatment -preservation schedule - incubation/Black boxing technique- bivoltine seed production. Seed crop monitoring-agenciesseed Organization-Seed Acts-licensing procedures- pests of grainage — pebrine diagnosis and management-cocoon melting — seed acts.

SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Scope of soil physics and its relation with other branches of soil science; soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts. Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation. Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential. Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum. Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms.Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation - types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions.Potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions. Sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability. Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use

efficiency; blanket fertilizer recommendations – usefulness and limitations; site-specific nutrient management; plant need based nutrient management; integrated nutrient management. Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Chemical (elemental) composition of the earth's crust and soils. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay-organic interactions. Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand exchange – innersphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC onligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition. Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management spects. Chemistry of acid soils; nature of soil acidity, sources of soil acidity; active and potential acidity; sub-soil acidity; effect on plant growth; management of acid soils, lime requirement of acid soils; biological sickness of soils and its management. Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments.Chemistry and electrochemistry of submerged soils.

Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils. Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification; major soils of India; soil maps – their usefulness. Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; soil correlations and soil units; benchmark soils; cartography, mapping units, soil mapping, techniques for generation of soil maps; thematic soil maps; soil survey interpretations.