

MF&AS Competitive Examination Syllabus

General ENGLISH

General English (including Drafting and Precis Writing)

MF&AS Competitive Examination Syllabus**GENERAL STUDIES****PAPER I**

- (1) Modern History of India and Indian Culture
- (2) Cultural heritage of Mizoram
- (2) Current events of National and International importance
- (3) Statistical analysis, graphs and diagrams

In Paper I, Modern History of India and Indian Culture will cover the broad history of the country from about the middle of the nineteenth century and would also include questions on Gandhi, Tagore and Nehru. Cultural heritage and traditional places and heroes, traditional practices and life styles, Mizo Lalte leh Khua leh tui-in awm dan. The part relating to statistical analysis, graphs and diagrams will include exercises to test the candidates ability to draw common sense conclusions from information presented in statistical, graphical or diagrammatical form and to point out deficiencies, limitations or inconsistencies therein.

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GENERAL STUDIES**PAPER II**

- (1) Indian Polity
- (2) Indian economy and Geography of India and
- (3) The role and impact of science and technology in the development of India.

In paper II, The part relating to Indian Polity will include questions on the political system in India. In the part pertaining to the Indian Economy and Geography of India, including Geography of Mizoram, questions will be put on planning in India and the physical economic and social geography of India. In the third part relating to the role and impact of science and technology in the development of India, questions will be asked to test the candidate's awareness of the role and impact of science and technology in India, emphasis will be on applied aspects.

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MF&AS Competitive Examination Syllabus

BOTANY

PAPER I

1. Microbiology, Viruses, bacteria, plasmids - structure and reproduction. General account of infection and immunology. Microbes in agriculture, industry & medicine and air, soil & water. Control of pollution using micro-organisms.
2. Pathology : Important plant diseases in India caused by viruses, bacteria, mycoplasma, fungi and nematodes. Modes of infection, dissemination, physiology and parasitism and methods of control, mechanism of action of biocides. Fungal toxins.
3. Cryptogams : Structure and reproduction from evolutionary aspect and ecology and economic importance of algae, fungi, bryophytes and pteridophytes, Principal distribution in India.
4. Phanerogams : Anatomy of wood, secondary growth Anatomy of C2 and C plants, stomatal types Embryology, barriers to sexual incompatibility. Seed structure, pomixis and polyembryony. Polynology and its applications. Comparison of systems of classification of angiosperms. Modern trends in biosystematics, Taxonomic and economic importance of Cycadaceae, Pinaceae, Gnetaceae, Magnoliaceae, Ranunculaceae, Cruciferae, Rosaceae, Leguminosae, Euphorbiaceae, Malvaceae, Dipterocarpaceae, Umbelliferae, Asclepiaceae, Verbanaceae, Solanaceae, Rubiaceae, cucurbitaceae Composite, Gramineae, Plume, Liliaceae, Musaceae and Orchidaceae.
5. Morphogenesis : Polarity, symmetry and totipotency. Differentiation and differentiation of cells and organs. Factors of morphogenesis. Methodology and applications of cell, tissues, organ, and protoplast culture from vegetative and reproductive parts, Somatic hybrids.

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BOTANY

PAPER II

1. Cell Biology : Scope and perspective. General knowledge of modern tools and techniques in the study of cytology. Prokaryotic and eukaryotic cells structural and ultrastructural details. Functions of organelles including membranes. Detailed study of mitosis and meiosis. Numerical and structural variations in chromosome and their significance. Study of Polytene and lampbrush chromosomes structure, behaviour and cytological significance.

2. Genetics and Evolutions : Development of genetics and gene concepts. Structure and role of nucleic acids in protein synthesis and reproduction. Genetic code and regulation of gene expression. Gene amplification. Mutation and evolution. Multiple factors, linkage and crossing over. Methods of gene mapping. Sex chromosomes and sexlinked inheritance. Male sterility, its significance in plant breeding. Cytoplasmic inheritance. Elements of human genetics. Standard deviation and Chi-square analysis genetics engineering . Organ evolution-evidence mechanism and theories.

3. Physiology and Biochemistry : Detailed study of water relations. Mineral nutrition and ion/transport. Mineral deficiencies. Photosynthesis-mechanism and importance, photosystems I and II, Photorespiration. Respiration and fermentation. Nitrogen fixation and nitrogen metabolism, Protein synthesis. Enzymes. Importance of secondary metabolites. Pigments as photoreceptors, photoperiodism, flowering. Growth indices, growth movements. Senescence.

Growth substances - their chemical nature, role and applications in agri-horticulture. Agrochemicals. Stress physiology Vernalization

Fruit and seed physiology-dormancy, storage and germination of seed. Perthenocraphy, fruit ripening.

4. Ecology : Ecological factors. Concept and dynamics of community, sucession. Concept of biospheres. Conservation of ecosystems. Polution and its control. Forest types of India. Afforestation, deforestation and social forestry. Endangered plants.

5. Economic Botany : Origin of cultivated plants. Study of plants as sources of food, fodder and forage, fatty oils, wood and timber, fibre, paper, rubber, beverages, alcohol, drugs, narcotics, resins and gums, essential oils, dyes, mucilage, insecticides and presticides. Plant indicators. Ornamental plants. Energy plantation.

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CHEMISTRY

PAPER I

1. Atomic structure & chemical bonding : Quantum theory, Heisenberg's uncertainty principle, Schrodinger wave equation (time independent). Interpretation of the wave function, particle in a one-dimensional box, quantum numbers, hydrogen atom wave functions, Shapes of s.p. and orbitals Ionic bond, Lattice energy, Born Haber cycle, Fajans rule, dipole moment, chracteristics of ionic compounds, electronegativity differences. Covalent bond and its general characteristics, valence boad approach. Concept of resonance & resonance energy. Electronic configuration of H₂⁺ H₂ N₂ O₂ F₂ NO, CO and HF molecules in terms of molecular orbital approach Sigma and pi bonds, Bond order, bond strength & bond length.

2. Thermodynamics : Work heat and energy. First law of thermodynamics Enthalpy, heat capacity. Relationship between Cp and Cv. Laws of thermochemistry. Kirchoff's equation. Spontaneuos

and non-spontaneous change second law of thermodynamics. Entropy changes in gases for reversible and irreversible processes. Third law of thermodynamics. Free energy, variations of free energy of a gas with temperature, pressure and volume Gibbs - Helmholtz equation. Chemical potential. Thermodynamic criteria for equilibrium. Free energy change in chemical reaction and equilibrium constant. Effect of temperature & pressure on chemical equilibrium. Calculation of equilibrium constants from thermodynamic measurements.

3. Solid State : Forms of solids, law of constancy of interfacial angles. Crystal systems and crystal classes (crystallographic groups). Designation of crystal faces, lattice structure and unit cell. Laws of rational indices. Bragg' law X-ray diffraction by crystals Defects in crystals. Elementary study of liquid crystals.

4. Chemical Kinetics : Order and molecularity of a reaction. Rate of equations (differential & integrated forms) of zero, first and second order reactions. Half life of a reaction. Effects of temperature, pressure and catalysts on reaction rates. Collision theory of reaction rates of bimolecular reactions. Absolute reaction rate theory. Kinetics of polymerisation and photo chemical reactions.

5. Electrochemistry : Limitations of Arrhenius theory of dissociation. Debye-Huckel theory of strong electrolytes and its quantitative treatment. Electrolytic conductance theory and theory of activity coefficients. Derivation of limiting laws for various equilibria and transport properties of electrolyte solutions.

6. Concentration cells, liquid junction potential, application of e.m.f. measurements of fuel cells.

7. Photochemistry : Absorption of light, Lambert-Beer's law. Law of photochemistry. Quantum efficiency. Reasons for high and low quantum yields. Photo-electric cells.

8. General Chemistry of 'd' block elements :

(a) Electronic configuration, Introduction to theories of bonding in

transition metal complexes, Crystalfield Theory and its modifications, applications of the theories in the explanation of magnetism and electronic spectra of metal complexes.

(b) Metal Carbonyles : Cyclopentadienyl, Olefin and Acetylene complexes.

(c) Compounds with metal-metal bonds and atom clusters.

9. General Chemistry of f block elements : Lanthanides and actinides, Separations, Oxidation states, magnetic and spectral properties.

10. Reactions in non-aqueous solvents (liquid ammonia and sulphur dioxide).

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CHEMISTRY

PAPER II

1. Reaction mechanisms : General methods (both kinetic and non-kinetic) of study of mechanisms of organic reactions illustrated by examples.

Formation and stability of reactive intermediates (carbocations, carbonions, free radicals, carbenes, nitrens and benzyne).

SN1 and SN2 mechanism - H1, E2, and ElcB eliminations. cis and trans addition to carbon to carbon double bonds-mechanism of addition to carbon-oxygen double bonds. Michael additon-addition to conjugated carbon-carbon double bonds-aromatic electrophillic and nucleophillic substitutions-allylic and benzylic substitutions.

2. Pericyclic reactions : Classification and examples an elementary study of Woodward-Hoffman rules of the pericyclic reactions.

3. Chemistry of the following name reactions: Aldol condensation, Claisen condensation, Dieckmann reaction, Perkin reaction, Reimer-Tiemann reaction, Cannizzro reaction.

4. Polymeric Systems :

(a) Physical Chemistry of polymers; End group analysis, Sedimentation, Light Scattering and Viscosity of polymers.

(b) Polyethylene, Polystyrene, Polyvinyl Chloride, Ziegler Natta Catalysis, Nylon, Terylene.

(c) Inorganic Polymeric Systems, Phosphonitric halide compounds; Silicones; Borazines.

Friedel-Craft reaction, Reformatsky reaction, pinacol-pinacolone, Wagner-Meerwein and Beckmann rearrangements, and their mechanisms - uses of the following reagents in organic synthesis : O5 O4 H10 NBS, diborane, Na-liquid ammonia NaBH4 L1A 1H4.

5. Photochemical reactions of organic and inorganic compounds : Types of reactions and examples and synthetic uses-Methods used in structure determination, Principles and application of UV-visible, IR IH2,NMH and mass spectra for structure determination of simple organic and organic molecules.

6. Molecular Structural determinations : Principles and Applications to simple organic and in-organic Molecules.

- (i) Rotational spectra of diatomic molecules (Infrared and Raman), isotopic substitutions and rotational constants.
 - (ii) Vibrational spectra of diatomic linear symmetric, linear asymmetric and bent triatomic molecules (Infrared and Raman).
 - (iii) Specificity of the functional groups (Infrared and Raman).
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(iv) Electronic Spectra-Singlet and triplet states, conjugated double bonds, $\alpha\beta$ unsaturated carbonyl compounds.

(v) Nuclear magnetic Resonance :Chemical shifts, spin-spin coupling.

(vi) Electron Spin Resonance : Study of inorganic complexes and free radicals.

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COMMERCE AND ACCOUNTANCY

PAPER I : Accounting and Finance

Part I : Accounting, Auditing and Taxation :

Accounting as a financial information system-impact of behavioural sciences. Methods of accounting of changing price levels with particular reference to Current Purchasing Power (CPP) accounting - Advanced problems of company accounts. Amalgamation absorption and reconstruction of companies - Accounting of holding companies Valuation of shares and goodwill - Controllership functions property control legal and management.

Important provisions of the Income Tax Act, 1961 - Definition Change of Income Tax Exemptions Depreciation and investment allowance - Simple Problems of computation of income under the various heads and determination of assessable income - Income-Tax authorities.

Nature and functions of Cost-Accounting-Cost Classification-Techniques of segregating semivariable costs into fixed and variable components - job costing - FIFO and weighted average methods of calculating equivalent units of production - Reconciliation of cost and financial accounts - marginal costing - Cost-volume profit relationship; Algebraic formulae and graphical representation-Shutdown point-Techniques of cost control and cost reduction budgetary control-flexible budgets-Standard costing and variance analysis-Responsibility accounting-bases of charging overheads and their inherent fallacy-costing for pricing decision. Significance of the attest function-Programming the audit work-Valuation and verification of assets, fixed wasting and current assets-Verification of liabilities-Audit of limited companies-appointment status powers, duties and

liabilities of the auditor-Auditor's report-Audit of share capital and transfer of shares-Special points in the audit of banking and insurance companies.

Part II : Business, Finance and Financial Institutions.

Concept and scope of Financial Management-Financial goals of corporations-Capital budgeting; Rules of the thumb and Discounted cash flow approaches-Incorporating uncertainty in investment decisions. Designing an optimal capital structure-Weighted average cost of capital and the controversy surrounding the Modigliani and Miller model, Sources of raising short-term intermediate and long term finance-Role of public and convertible debentures-Norms and guidelines regarding debt-equity ratios-Determinants of an optional dividend policy-optimising models of James En.Walter and John Liner, forms of dividend payment-Structure of working capital and the variable affecting the level of difference of components-Cash flow approach of forecasting working capital needs-Profiles of working capital in Indian Industries-Credit management and Credit Policy-Consideration of Tax in relation to Financial Planning and cash flow statements. Organisation and deficiencies of Indian Money Market structure of assets and liabilities of Commercial Banks-Achievements and failures of Nationalisation-Regional Rural Banks-Recommendations of the Tendron (P.L.) Study Group on following of Bank credit, 1976 and their revision by the Chore (K.B.) Committee, 1979-An assessment of the monetary and credit Policies of the Reserve Bank of India-Constituents of the Indian Capital Market-Functions and working of all India term financial institutions (IDBI, IFCI, ICICI, and IRCI)- Investment policies of the Life Insurance

Corporation of India and the Unit Trust of India-Present state of stock exchanges and their regulation. Provision of the Negotiable Instruments Act, 1881. Crossings and endorsements with particular reference to statutory protection to the paying and collecting bankers. Salient provision of the Banking Regulation Act, 1949 with regard to chartering, supervision and regulation of banks.

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COMMERCE AND ACCOUNTANCY

PAPER II

ORGANISATION THEORY AND INDUSTRIAL RELATIONS.

Part I : Organisation Theory

Nature and concept of Organisation-Organisation goals : Primary and secondary goals, Single and multiple goals, ends means chain - Displacement, succession, expansion and multiplication of goals- Formal organisation, Type, Structure - Line and Staff, functional matrix and project-informal organisation-functions and limitations.

Evolution of organisation theory :

Classical, Neo-classical and system approach-Bureaucracy, Nature and basis of power, sources of power, power structure and politics-Organisational behaviour as a dynamic system: technical, social and power systems-interrelations and interactions-Perception-Status system. Theoretical and empirical foundation of Maslow, Mc Gregor, Herzberg, Likert, Vroom, Porter and Lawler, Adam-Homan's Model of motivation. Morale and productivity-Leadership: Theories and styles- Management of conflicts in organisation-Transactional Analysis Significance of culture to organisations, Limits of rationality-Simon-March approach. Organistional change, adaptation, growth and development-Organisational control and effectiveness.

Part II : Industrial Relations :

Nature and scope of industrial relations, industrial labour in India and its commitment-Theories of unionism-Trade Union movement in India-Growth and structure-Role of out-side leadership-Workers education and other problems-Collective bargaining-approaches conditions, limitation and its effectiveness in Indian conditions-Workers participation in management; philosophy, rationale, present day state of affairs and its future prospects.

Prevention and settlement of industrial disputes in India :

Preventive measures, settlement machinery and other measures in practice-Industrial relations in public enterprises- Absenteeism and labour turn-over in Indian industries-Relative wages and wage differentials; wage policy in India- the Bonus issue-International Labour Organisation and India-Role of personnel department in the organisation-Executive development, personnel policies, personnel audit and personnel research.

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MF&AS Competitive Examination Syllabus

ECONOMICS

PAPER I

1. The framework of an Economy : National Income Accounting.
2. Economic choice : Consumer behaviour and market forms.
3. Investment decisions and determination of income and employment. Macro-economic models of income, distribution and growth
4. Banking, Objectives and instruments of Central Banking and Credit policies in a planned developing economy.
5. Types of taxes and their impacts on the economy. The impacts of the size and the content of budgets. Objectives and Instruments of budgetary and fiscal policy in a planned developing economy.
6. International trade. Tariffs. The rate of exchange. The balance of payment. International monetary and banking institutions.

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ECONOMICS

PAPER II

1. The Indian Economy : Guiding principles of Indian economic policy - Planned growth and distributive justice -

Eradication of poverty : The institutional framework of the Indian economy. Federal governmental structure-Agriculture and industrial sectors - Public and private sectors. National income- its sectoral and regional distribution. Extent and incidence of poverty.

2. Agricultural Production : Agricultural Policy : Land Reforms, Technological change. Relationship with the Industrial Sector.

3. Industrial Production : Industrial Policy : Public and private sectors. Regional distribution. Control of monopolies and monopolistic practices.

4. Pricing Policies for agricultural and industrial outputs Procurement and public Distribution.

5. Budgetary trends and fiscal policy.

6. Monetary and credit trends and policy - Banking and other financial institutions.

7. Foreign trade and the balance of payments.

8. Indian Planning : Objectives, strategy, experience and problems.

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EDUCATION

**PAPER I :
HUMAN DEVELOPMENT AND EDUCATION**

1. Education and Psychology:

Nature, Scope and Relationship between Education & Psychology;
Role of Educational Psychology in the field of Education.

2. Growth and Development :

Meaning of Growth Development and maturation; Principles of Growth and Development and their Educational Implications; Physical, Emotional, Social, Language and Intellectual Development at various stages with special emphasis on Adolescence period; Piaget's Stages of Cognitive Development -

3. Intelligence and Creativity :

Meaning and Nature of Intelligence and Creativity; Spearman's and Thurstone's theories of Intelligence; Role of Education in the Development of creativity.

4. Equality of Educational Opportunities :

Policy measures and status; Education as an instrument of social change and modernisation; Role of Education in value Development.

5. Learning and Motivation :

Nature of Learning and Motivation; Learning theories of Pavlov, Skinner and Tolman; Transfer of Learning; Role of Motivation in Learning.

6. Personality and Mental Health :

Concepts of Personality and Mental Health; Type and Trait approaches to personality; Techniques of personality assessment; Adjustment Mechanisms, Role of Guidance and Counselling in the improvement Mechanisms, Role of Guidance and Counselling in the improvement of Maladjustment.

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EDUCATION

PAPER II EDUCATIONAL THOUGHT AND SYSTEMS

1. Legal and Constitutional provision of Education, Role of local bodies, state and centre in providing education.
2. Contributions to Education of Dewey, Gandhi, Tagore and Montessori;
3. Modern Trends and practices in Education, Educational Technology and Mass Media, International Cooperation in Education, Distance Education and Open Learning Systems, Environmental Education, National Literacy Mission (NLM).
4. Need and Importance of Educational Aims; Immediate and Ultimate aims of Education, Process of Educational planning Budgetting, accounting and auditing in Education.
5. (a) Objectives and Curriculum, Organisational set-up Finances and Resource Mobilisation recommended by
 - (i) Kothari Commission (1964-66)
 - (ii) New Education Policy (1986) and its revised version (1992)
 - (b) (i) School without burden (Yash Pal Committee)
 - (ii) Education for all (Delhi summit)
 - (c) Education in the North-East with special reference to

- (i) Special cultural and organisational features of tribal communities.
- (ii) Problems and Issues
- (iii) Role of Education in the Modernisation of Tribal Communities.

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ENGLISH

PAPER I 100 marks

A detailed literary study of the Victorian Era with special reference to the works of the following writers :-

1. Alfred Lord Tennyson
2. Robert Browning
3. Matthew Arnold
4. Rosetti
5. Swinburne
6. Thackeray
7. George Elliot

8. Thomas Hardy
9. John Ruskin
- 10 Thomas Carlyle
11. John Stuart Mill
12. Walter Pater.

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ENGLISH

PAPER - II 100 marks.

First-hand reading of the following texts to test critical ability:

1. Shakespeare Twelfth Night
King Lear
The Tempest
2. Milton Samson Agonistes
3. Jane Austen Pride and Prejudice

4. Wordsworth Lyrical Ballads
5. Charles Dickens Oliver Twist
6. George Elliot Adam Bede
7. Thomas Hardy The Return of the Native
8. Yeats Easter 1916
Sailing to Bysantium
The Tower
The Winding Stair
9. T.S.Elliot The Wasteland
10. D.H.Lawrence Sons and Lovers.

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MF&AS Competitive Examination Syllabus

FORESTRY

PAPER I

NOTE : (Candidates will be required to answer 6 questions. There will be 10 questions in Paper I. The candidates will be required to attempt one compulsory question and five from the rest, selecting at least one

question each from section A, B, and C).

Section A. Silviculture

General Silvicultural principles; ecological and physiological factors influencing vegetation; natural and artificial regeneration of forests; nursery techniques; seed technology collection, storage, pretreatment and germination; establishment and tendings. Silvicultural systems: Clear felling uniform, shelterwood selection, coppice and conversion systems. Silviculture of some of the economically important species of India such as *Cedrus deodara*, *Pinus roxburghii*, *Acacia catechu*, *Acacia auriculiformis*, *Acacia nilotica*, *Albizia* spp., *Artocarpus* spp., *Bambusa* spp., *Casuarina equisetifolia*, *Dalbergia* spp., *Anogeissus* spp., *Dipterocarpus* spp., *Eucalyptus* spp. *Gmelina arborea*, *Lager stroemia* spp., *Populus* spp., *Salmalia/malabarica*, *Shorea robusta*. *Tectona grandis*, *Terminalia* spp. Social Forestry objectives, scope, necessity, agro forestry; extension forestry; recreation forestry, peoples participation.

Section B. Forest Mensuration and Management

Method of measuring diameter, girth, height and volume of trees; form factor volume estimation of stand; sampling methods; yield calculation; current annual increment; mean annual increment; sample plots; yield and stand tables; scope and objectives of forest inventory; (aerial survey and remote sensing techniques). Forest management objectives and principles; techniques; sustained yield relation normal forest, growing stock; regulation of yield methods and application, working plans preparation and control.

Section C. Forest Utilisation

Logging and extraction techniques and principles; transport, storage and sale. Minor forest product definition and scope, gums; resins, oleosins, fibres, oil seeds, nuts rubber, canes, bamboo, medicinal plants, charcoal, apiary, sericulture lac and shellac, tassar silk, Katha and Bidi Leaf. Collection, Processing and disposal of minor forest products. Wood technology; anatomical, physical and mechanical properties of wood; defects and abnormalities; composite and other wood products, pulp paper and rayon. Saw milling, wood seasoning and preservation.

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FORESTRY

PAPER II

(Note : Candidates will be required to answer 6 questions. There will be 10 questions in Paper II. The candidates will be required to attempt one compulsory and one question each from sections A,B,C,D & E).

Section A. Forest Protection

Injuries to forest abiotic and biotic; insect, pests and diseases; General forest protection against fire, insect, pests and diseases; biological and chemical controls.

Section B. Forest Ecology and Forest Biology

Biotic and abiotic components of forest ecology; forest ecosystems; forest community concepts; vegetation concepts; ecological succession and climax; primary productivity; nutrient cycling and water relation; physiology in stress environments (drought, water logging, alkalinity and salinity); composition of forest types in India, species composition and associations; dendrology, taxonomic classifications, identification of species principles and establishment of herbaria and arboreta. Principles and concepts of tree improvement; methods and techniques; exotic. Ecology and biology of Wildlife; principles and techniques of managements; endangered species; wildlife conservation.

Section C. Forest Economics, Policies and Legislation

Fundamental principles of forest economics, costs benefits analyses, estimation of demand and supply; assessment and projection of market structures; role of corporate Financing; socio-economic analyses of forest productivity and attitudes. History of forest development; Indian forest policy of 1894,1952; and 1988 National Commission on Agriculture report on forestry; Constitution of Wasteland Development Board, Indian Council of Forestry Research and Education. Forest laws; necessity, general principles; Indian Forest Act, 1927; Forest Conservation Act, 1980, Wildlife (Protection) Act. 1972.

Section D. Forest Surveying and Engineering

Different methods of survey chain, prismatic, compass, planetable and

topographic surveys; area calculation, maps and map reading. Basic principles of forest engineering. Building materials, and construction, Road objects and classification general principles; construction. Bridges general principles; objects types, simple design and construction of timber bridges.

Section E. Forest Soils and Soil Conservation.

Forest soils : Classification; factors affecting soil formation; physical and chemical properties.

Soil Conservation definitional causes of erosion; types wind and water erosion; conservation and management of eroded areas; windbreaks, shelter belts, fixation of sand dunes; reclamation of alkaline, saline, water logged and other waste land.

Watershed management objective and methods.

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GEOGRAPHY

PAPER I Principles of Geography.

Section A. Physical Geography

1. Geomorphology - Origin and evolution of the earth's crust: earth movements and plate tectonics; volcanism; rocks; weathering and erosion; cycle of erosion- Davis and Penok fluvial, glacial and marine and karst land forms; rejuvenated and polycyclic land-forms.
2. Climatology -The atmosphere, its structure and composition; temperature, humidity, precipitation pressure and winds; jet stream; air masses and fronts; cyclones and related phenomena; climatic classification. Koeppen and Thorthwalt; groundwater and hydrological cycle.
3. Soils and Vegetation - Soil genesis, classification and distribution; Biotic successions and major biotic regions of the world with special reference to ecological aspects of savanna and monsoon forest biomes.

4. Oceanography-Ocean bottom relief:salinity, currents and tides; ocean deposits and coral reefs, marine resource-biotic mineral, and energy resources and their utilisation.

5. Ecosystem - Ecosystem concept, interrelations of energy flows, water circulation, geomorphic processes, biotic communities and soils; land capability; Man's impact on the ecosystem, global ecological imbalances.

Section B : Human and Economic Geography.

1. Development of Geographical Thought - Contributions of European and Arab Geographers. Determinism and possibilism; regional concept; system approach, models and theory; quantitative and behavioural revolutions in geography.

2. Human Geography - Emergence of man and races of mankind; cultural evolution of man; Major cultural relays of the world; international migrations, past and present, world population distribution and growth, demographic transition and world population problems.

3. Settlements Geography - Concepts of rural and urban settlements; Origin of urbanization; Rural settlement pattern; central place theory; ranksize and primate city distributions; city classifications; urban spheres of influence and the rural urban fringe; the internal structure of cities-theories and cross cultural comparisions, problems of urban growth in the world.

4. Political Geography - Concepts of nation and state; frontiers boundaries and buffer zones; concept of hearthland and rainland; federalism; political regions of the world; world geopolitics; resources, development and international politics.

5. Economic Geography - World economic development - measurement and problems; world resources, their distribution and global problems; world energy crisis; the limits to growth; world agriculture-typology and world agricultural regions theory of agricultural location, diffusion of innovation and agricultural efficiency; world food and nutrition problems; world industry-theory of location of industries, world industrial patterns and problems; world of trade-theory and world patterns.

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GEOGRAPHY

PAPER II GEOGRAPHY OF INDIA

Physical Aspects - Geological history, physiography and drainage systems; origin and mechanism of the Indian monsoon, identification and distribution of drought and flood prone areas; soils and vegetation; land capability; schemes of natural physiographic drainage and climate regionalisation.

Human Aspects - Genesis ethnic/racial diversities; tribal areas and their problems; and role of language, religion and culture in the formation of regions; historical perspectives and unity and diversity; population distribution, density, and growth, population problems and policies.

Resources Conservation and utilisation of land mineral, water, boiltic and marine resources; man and environment-ecological problems and their management.

Agriculture- The infrastructure, irrigation, power fertilizers, and seeds; institutional factors-land holdings, tenure, consolidation and land reforms; agricultural efficiency and productivity; intensity of cropping, crop combinations and agricultural regionalisation, green revolution, dra zone agriculture and agricultural land use policy; food and nutrition; Rural economy, animal husbandry, social forestry and household industry.

Industry- History industrial development factors of localisation; study of mineral based,. agro-based and forest based industries, industrial decentralization and industrial policy; industrial complexes and industrial regionalisation, identification of backward areas and rual industrialisation.

Transport and Trade - Study of the network of roadways, railways, airways and waterways, competition and complimentarily in regional context; passenger and commodity flows, intra and interregional trade and the role of rural market centres.

Settlements - Rural settlement patterns; urban development in India; Census concepts of urban areas, functional and their archical patterns of Indian cities, city regions and the rural-urban fringe; internal structure of Indian cities; town planning slums and urban housing; national urbanisation policy.

Regional Development and Planning - Regional policies in Indian Five Years Plan; experience of regional planning in India, multi-level planning state, district and block level planning, Centre-State relations and the Constitutional framework for multi-level planning.

Regionalisation for planning for metropolitan regions; tribal and hill areas, drought prone areas command areas and river basins; regional disparities in development in India.

Political Aspects - Geographical basis of Indian federalism, state reorganisation; regional consciousness and national integration; the international boundary of India and related issues; India an geopolitics of the Indian Ocean area.

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GEOLOGY

PAPER - I

**(General Geology, Geomorphology, Structural Geology,
Palaeontology and Stratigraphy)**

1. General Geology :

Energy in relation to Geo-dynamic activities, Origin and interior of the Earth, Dating of rocks by various methods and age of the Earth, Volcanoes - causes and products; volcanic belts. Earthquakes causes, geological effect and distribution; relation to volcanic belts.

Geosynclines and their classification. Island arcs, deep sea trenches and mid-ocean ridges, sea-floor spreading and plate tectonics, Isostracy Mountains-types and origin. Brief ideas about continental drift, Origin of continents and oceans. Radioactivity and its application to geological problems.

2. Geomorphology :

Basic concepts and significance. Geomorphic processes and parameters. Geomorphic cycles and their interpretation. Relief features; topography and its relation to structures and lithology. Major landforms Drainage systems, Geomorphic features of Indian sub-continent.

3. Structural Geology:

Stress and strain ellipsoid, and rock deformation. Mechanics of folding and faulting. Linear and planar structures and their genetic significance. Petrofabric analysis, its graphic representation and

application to geological problems. Tectonics frame-work of India.

4. Palaeontology :

Micro, and Macro-fossils, Modes of preservation and utility of fossils
General Idea about classification and nomenclature. Organic evolution
and the bearing of Palaeontological studies on it.

Morphology, classification and geological history including
evolutionary trends of brachiopods, bivalves, gartropods, ammonoids,
trilobites, echinoids and corals.

Principal groups of vertebrates and their main morphological
characters, Vertebrates life through ages; dinosaurs, Siwalik
vertebrates. Detailed study of horses, elephants and man, Gondwana
flora and its importance.

Types of microfossils and their significance with special reference to
petroleum exploration.

5. Stratigraphy :

Principles of Stratigraphy. Stratigraphic classification and
nomenclature. Standard stratigraphical scale, Detailed study of various
geological systems of Indian sub-continent Boundary problems in
Stratigraphy. Correlation of the major Indian formation with their
world equivalents. An outline of the Stratigraphy of various geological
system in their type areas. Brief study of climates and igneous
activities in Indian sub-continent during geological past. Paleographic
reconstructions.

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GEOLOGY

PAPER II

(Crystallography, Mineralogy, Petrology and Economic Geology).

1. Crystallography :

Crystalline and non-crystalline substances. Special groups. Lattice symmetry. Classification of crystals into 32 classes of symmetry. International system of crystallographic notation. Use of stereographic projections to represent crystal symmetry. Twinning and twin laws. Crystal, irregularities. Application of X-Rays for crystal studies.

2. Optical Mineralogy :

General principles of optics Isotropism and anisotropism; concepts of optical indicatrix. Pleochroism; interference colours and extinction. Optic orientation in crystals. Dispersion, optical accessories.

3. Mineralogy :

Elements of crystal chemistry-types of bondings, Ionic radii coordination number Isomorphism polymorphism & pseudomorphism. Structural classification of silicates. Detailed study of rockforming mineral, their physical, chemical and optical properties, and uses, if any-Study of the alteration products of these minerals.

4. Petrology :

Magma, Its generation, nature and composition. Simple phase diagrams of binary and ternary systems, and their significance, Bowen's Reaction Principle. Magmatic differentiation, assimilation.

Textures and structures and their petrogenetic significance. Classification of igneous rocks. Petrography and Petrogenesis of important rock-types of India; granites and gneisses charnockites. Deccan basalts. Processes of formation of sedimentary rock. Diagenesis and lithification. Textures and structures and their significance classification of Sedimentary rocks, classic and non-classic. Heavy mineral and their significance. Elementary concept of depositional environments, sedimentary facies and provenance. Petrography of common rock types.

Variable of metamorphism. Types of metamorphism. Metamorphic grade, zones and facies ACE AKE and AEM diagrams. Textures, structures and nomenclature of metamorphic rocks. Petrography and petrogenesis of important rock type.

5. Economic Geology :

Concept of ore, ore mineral and gangue; tenor of ores. Processes of formation of mineral deposits. Common forms and structures of ore deposits. Classification of ore deposits. Control of ore deposition. Metallogenic epochs. Study of important metallic and non-metallic deposits, oil and natural gas fields, and coal fields of India. Mineral wealth of India Mineral economics. National Mineral Policy. Conservation and utilisation of minerals.

6. Applied Geology :

Essentials of prospecting and exploration techniques.

Principal methods of mining, sampling, ore-dressing and beneficiation. Application of Geology in Engineering works. Elements of soil and groundwater geology and geochemistry. Use of aerial photographs in geological investigations.

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MF&AS Competitive Examination Syllabus

HISTORY

PAPER I

SECTION A :
History of India (Down to A.D.750)

1. The Indus Civilisation

Origins : Extent : characteristic features; Major cities. Trade and contacts, causes of decline Survival and continuity.

2. The Vedic Age

Vedic Literature. Geographical area known to Vedic Texts. Differences and similarities between Indus Civilisation and Vedic Culture Political, Social and Economic patterns. Major Religious ideas and rituals.

3. The Pre-Maurya Period

Religious movements (Jainism, Buddhism, and other sects). Social and Economic Conditions Republic and growth of Magadha Imperialism.

4. The Maurya Empire

Sources, rise, extent and fall of the empire, Administration, Social Economic Conditions, Ashoka's Policy and reforms. Art.

5. The Post-Maurya Period (200 B.C. - 300 A.D.)

Principal dynasties in Northern and Southern India. Economy and Society: Sanskrit, Prakrit and Tamil Religion (Rise of Mahayana and their stick cults). Art (Gandhara, Mathura and other schools). Contacts with Central Asia.

6. The Gupta Age

Rise and fall of the Gupta Empire, the Vakatakas. Administration Society, Economy, Literature, Art and Religion. Contacts with South East Asia.

7. Post-Gupta Period (B.C. 500-750 A.D.)

Pushyabhytis, The Mukharis. The later Guptas. Harshvardhana and his times. Chalukyas of Badami. The Pallavas, Society, Administration and art. The Arab conquest.

8. General review of Science and Technology, Education and Learning.

SECTION B

MEDIEVAL INDIA (750 A.D. TO A.D.) INDIAN : 750 A.D. TO 1200 A.D.

1. Land structure, and its impact on Society.
2. Trade and Commerce.
3. Art, Religion and Philosophy; Sankarachrya.
4. Maritime Activities; contacts with the Arabs, Mutual, Cultural impacts.
5. Rashtrakutas, their role in History-Contribution to Art and Culture. The Chola Empire Local Self-Government, features of the Indian Village System; Society, Economy, Art and Learning in the South.
6. Indian Society on the eve of Mahmud of Ghazni's Campaigns; Al-Biruni's Observations.

INDIAN : 1200-1765

7. Foundation of the Delhi Sultanate in Northern India; causes and Circumstances; its impact on the Indian Society.
8. Khilji Imperialism, significance and Implications, Administrative and Economic regulations and their impact on State and the people.
9. New Orientation of State Policies and Administrative Principles under Muhammad bin Tughlag : Religious Policy and Public works of Firoz Shah.
10. Disintegration of the Delhi Sultanate : Causes and its effects on the Indian Policy and Society.
11. Nature and character of State ; Political ideas and institutions. Agrarian structure and relations, growth of Urban Centres, Trade and Commerce, Conditions of artisans and peasants, new Crafts, Industry and Technology. Indian Medicines.

12. Influence of Islam on Indian Culture. Muslim mystic movements; nature and significance of Bhakti saints. Maharashtra Dharma, role of the Vaisnave Revivakist Movement; Social and Religious Significance of the Chaitanya Movement, impact of Hindu Society on Muslim Social life.

13. The Vijayanagar Empire : its origin and growth; contribution to art, literature and culture, social and economic conditions; system of administration; break-up of the Vijayanagar Empire.

14. Sources of History: important Chronicles. Inscriptions and Travellers Accounts.

15. Establishment of Mughal Empire in Northern India : political and social conditions in Hindustan on the eve of the Babur's invasion: Babur and Humayun. Establishment of the Portuguese control in the Indian ocean, its political and economic consequences.

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16. Expansion of the Mughal Empire under Akbar: political unification; new concept of monarchy under Akbar : Akbar's religio-political outlook; Relations with the non-Muslims.

17. Growth of regional languages and literature during the medieval period. Development of art and architecture.

18. Political ideas and institutions; Nature of the Mughal State, Land Revenue administration; The Mansabdari and the jagirdari systems, the land structure and the role of Zamindars, agrarian relations, the military organisation.

19. Aurangzeb's religious policy, expansion of the Mughal Empire in Deccan; Revolts against Aurangzeb-Character and consequences.

20. Growth of urban centres ; industrial; economy-urban and rural: Foreign Trade and Commerce. The Mughals and the European trading companies.

21. Hindu Muslim relations; trends of integration; composite culture (16th to 18th centuries).

22. Rise of Shivaji : his conflict with the Mughals; administration of

Shivaji: expansion of the Maratha power under the Peshwas (1707-1761). Maratha political structure under the first three Peshwas, Chauth and Sardeshmukhi, Third Battle of Panipat, cause and effects; emergence of the Maratha confederacy, its structure and role.

23. Disintegration of the Mughal Empire, Emergence of the new Regional States.

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HISTORY

PAPER II

SECTION `A' MODERN INDIA (1757-1947)

1. Historical Forces and Factors which led to the British conquest of India with special reference to Bengal, Maharashtra and Sind; Resistance of Indian powers and causes of their failure.
2. Evolution of British Paramountcy over princely States.
3. Stages of colonialism and changes in Administrative structure and policies. Revenue, Judicial and Social and Educational and their linkages with British colonial interests.

4. British economic policies and their impact. Commercialisation of agriculture, Rural indebtedness, Growth of agricultural labour, Destruction of handicraft industries, Drain of Wealth, Growth of modern industry and rise of a capitalist class. Activities of the Christian Missions.

5. Efforts at regeneration of Indian society-Socio-religious movements, Social, religious, political and economic ideas of the reformers and their vision of future; nature and limitation of 19th century "Renaissance", caste movements in general with special reference to South India and Maharastra; tribal revolts, specially in Central and Eastern India.

6. Civil rebellions, Revolt of 1857, Civil Rebellions and peasant Revolts with special reference to Indigo revolt, Deccan riots and Mapplia Uprising.

7. Rise and growth of Indian National Movement. Social basis of Indian nationalism policies, Programme of the early nationalists and militant nationalists, militant revolutionary group terrorists. Rise and Growth of communalism. Emergence of Gandhiji in Indian politics and his techniques of mass mobilisation : Non-cooperation, Civil Disobedience and Quit India Movement; Trade Union and preasant movements State(s) people movements Rise and growth of Left-wing within the Congress- The Congress Socialists and communists; British official response to National Movement Attitude of the congress to constitutional changes 1909-1935. Indian National army Naval mutiny of 1946. The particition of India and Achievement of Freedom.

SECTION B WORLD HISTORY (1500-1950)

A. Geographical Discoveries-decline of feudalism, Beginning of Capitalism.Renaissance and reformation in Europe.

The New absolute monarchies-Emergence of the Nation State.

Commercial Revolution in Western Europe-Mercantilism.

Growth of Parliamentary institutions in England. The Thirty Years' war.

Its significance in European History ascendancy of France.

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B. The emergence of a scientific view of the World. The age of Enlightenment.

The American revolution-its significance.

The French revolution and Napoleonic Era (1789-1815)

Socialist and Labour Movements in Europe.

C Consolidation of Large Nation States. The Unification of Italy. The founding of the German Empire.

The American Civil War.

Colonialism and imperialism in Asia and Africa in the 19th and 20 th centuries.

China and the Western Powers.

Modernisation of Japan and its emergence as a great power.

The European Powers and the Ottaman Empire (1815-1914)

The first World War-The Economic and Social impact of the War-The Peace of Paris 1919.

D The Russian Revolution,1917-economic and Social Reconstruction in Soviet Union.

Rise of Nationalist Movements in Indonesia, China and Indo - China. Rise and establishment of Communism in China.

Awakening in the Arab World Struggle for freedom and reform in Egypt-Emergence of Modern Turkey under Kamalaturk.The Rise of Arab nationalism.

World Depression of 1929-32.

The New Deal of Franklin D.Roosevelt. Totalitarianism in Europe-Fascism in Italy, Nazism in Germany.

Rise of Militarism in Japan

Origins and impact of Second World War.

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MF&AS Competitive Examination Syllabus

HOME SCIENCE

PAPER - I

A. Meaning, importance and processes of Home Management

B. Resources - Human and Non-Human

(i) Time

(a) Time as resource

(b) Time Plans

(c) Time demands during different stages of family life.

(ii) Energy

(a) Energy as a resource

(b) Energy demands during different stages of family life.

(c) Fatigue-Physiological and Psychological.

(iii) Money as a resource

(a) Sources of income

(b) Types of income

(c) Methods of handling family income

(d) Budgeting- Types, preparation, Account keeping, savings and investments.

(iv) Objectives and principles of work simplification.

C. Consumer Economics :

(a) Consumer goods-classification, brands, advertisements.

(b) Consumer Protection-Quality control and Labelling.

D. Home Furnishing and Interior decoration :

(a) Objectives and principles of home furnishing

(b) Flower arrangement, principles and types

(c) Accessories.

II. CLOTHING & TEXTILES :

A. i) A study and classification of textile fibres.

ii) Properties of :-

a) Cellulose fibres

b) Protein fibres

c) Thermoplastic fibres

d) Mineral fibres

B. Yarn:

i) Yarn making, different types of yarns.

ii) Fabric construction.

(a) Weaving, different kinds of weaves - Plain, Twill, Datin, Dateen, pile, jacquard.

(b) Court of cloth

(c) Knitting

C. Finishes:

1) Objectives of Finishes

2) Kinds of Finishes.

D. Dyeing and printing of textiles.

1) Study of different indigenous and chemical dyes.

2) Printing - Block, screen, discharge, Resist.

E. Dry cleaning - Use of absorbents and solvents.

F. Clothing :

1) Importance of clothing

2) Sociological and psychological aspects of clothing

3) Clothing in relation to family budget.

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MF&AS Competitive Examination Syllabus

HOME SCIENCE

PAPER - II

1. Foods and Nutrition :

A. Review of Essential nutrients, their food sources, requirements and deficiency diseases.

- 1) Carbohydrates
- 2) Proteins
- 3) Fats
- 4) Vitamins
- 5) Minerals.

B. Balanced diet:

- 1) Definition
- 2) Factors to be considered while planning a balanced diet.

C. Malnutrition, and optimum Nutrition :

- 1) Definition
- 2) Protein-Calorie Malnutrition
- 3) Kwashiorkar
- 4) Marasmus
- 5) Obesity.

D. Diet Therapy :

- 1) Principles of therapeutic diets
- 2) Types of therapeutic diets-Liquid, Semisolid, bland, and low sodium diet
- 3) Diets in diseases-peptic ulcer, Diabetic mellitus Hypertension, Anaemia.

E. Food preservation :

- 1) Importance and principles of food preservation
- 2) Different methods of food preservation - drying, smoking, dehydration, refrigeration, pasteurisation, canning.

2. CHILD DEVELOPMENT :

A. Meaning and principles of child development.

B. Growth and Development

- 1) Introduction
- 2) Factors affecting growth and development :
- 3) Types of growth and development :
 - a) Physical
 - b) Social
 - c) Emotional
 - d) Language.
 - e) Mental.

C. Stages of development and characteristics of each stages:

- 1) Infancy
- 2) Pre-School
- 3) Childhood
- 4) Adolescence

D. Prenatal care and development.

- a) Diagnosis, signs and symptoms of Pregnancy

- b) Physical and psychological care of the mother
- c) Stages of prenatal growth and development
- d) Post natal care of mother
- e) Care of new born baby.

E. Breast feeding and bottle feeding

- 1) Advantages and disadvantages of each
- 2) Weaning.

F. Child Psychology :

Definition, Meaning and scope.

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LAW**PAPER I****1. CONSTITUTIONAL LAW OF INDIA**

1. Nature of the Indian constitution: The distinctive features its federal character.
2. Fundamental Rights: Directive Principles and their relationship with Fundamental Rights : Fundamental Duties.
3. Right to Equality.
4. Right to Freedom of Speech and Expression.
5. Right to Life and Personal Liberty.
6. Religions, Cultural and Educational Rights.
7. Constitutional position of the President and relationship with Council of Ministers.
8. Governor and his powers.
9. Supreme Court and High Courts, their power and jurisdiction.
- 10 Union Public Service Commission and State Public Service Commission : their powers and functions.
11. Principles of Natural Justice.
12. Distribution of Legislative powers between the Union and the States.
13. Delegated legislation : its constitutionality, judicial and legislative controls.
14. Administrative and Financial Relations between the Union and the State.
15. Trade & Commerce and Intercourse in India.
16. Emergency provisions.
17. Constitutional safeguards to Civil Servants.
18. Parliamentary privileges and immunities.

19. Amendment of the Constitution.

II INTERNATIONAL LAW

1. Nature of International Law.

2. Source : Treaty Custom.General Principles of Law recognised by civilised nations, subsidiary means for the determination of law, Resolution of International organs and regulations of Specialized Agencies.

3. Relationship between International Law and Municipal Law.

4. State Recognition and State Succession.

5. Territory of State: modes of acquisition, boundaries, International Rivers.

6. Sea: Inland Waters, Territorial Sea, Contiguous Zone,Continental Shelf, Exclusive Economic Zone and ocean beyond national jurisdiction.

7. Air - space and aerial navigation.

8. Outer-space : Exploration and use of Outer Space.

9. Individuals, nationality, Statelessness; Human Rights and procedures available for their enforcement.

10. Jurisdiction of state: bases of jurisdiction, immunity from jurisdiction.

11. Extradition and Asylum.

12. Diplomatic Missions and Consular Posts.

13. Treaties : Formation, application and termination.

14. State responsibility.

15. United nations : its principal organs, powers and functions.

16. Peaceful settlement of disputes.
17. Lawful recourse to force; aggression, self defence, intervention.
18. Legality of the use of nuclear weapons; ban on testing of nuclear weapons; Nuclear Non-Proliferation Treaty.

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LAW

PAPER II

I. LAW OF CRIMES AND TORTS :

LAW OF CRIMES

1. Concept of Crimes; actus reus means ream mens rea in statutory offences, punishments, mandatory sentences, preparation and attempt.
2. Indian Penal Code:

- a) Application of the Code.
 - b) General exceptions
 - c) Joint and constructive liability.
 - d) Abetment.
 - e) Criminal conspiracy.
 - f) Offences against the State
 - g) Offences against Public tranquility
 - h) Offences by or relating to public servants
 - i) Offences against human body
 - j) Offences against property
 - k) Offences relating to marriage : Cruelty by husband or his relatives to wife.
 - l) Defamation.
3. Protection of Civil Rights Act, 1955.
 4. Dowry Prohibition Act, 1961.
 5. Prevention of Food Adulteration Act, 1954.

LAW OF TORTS

1. Nature of tortious liability
2. Liability based upon fault and strict liability
3. Statutory liability
4. Vicarious liability
5. Joint Tort-feasors
6. Remedies.
7. Negligence
8. Occupier's liability and liability in respect of structures.

9. Detinue and conversion

10. Defamation

11. Nuisance

12. Conspiracy

13. False imprisonment and malicious prosecution.

II. LAW OF CONTRACTS AND MERCANTILE LAW

1. Formation of contract

2. Factors vitiating consent

3. Void, voidable, illegal and unenforceable agreements,

4. Performance of contracts.

5. Dissolution of contractual obligations frustration of contracts.

6. Quasi-Contracts

7. Remedies for breach of contract

8. Sale of goods and hire purchase

9. Agency

10. Formation and dissolution of Partnership

11. Negotiable Instruments.

12. The Banker-Customer relationship

13. Government control over private Companies.

14. The Monopolies and Restrictive Trade Practices Act, 1969.

15. The Consumer Protection Act, 1986

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MIZO ELECTIVE

PAPER-I

1. Mizo Elective Paper I Part A Poetry carries 60 marks. This will be a brief introduction to the critical study of Mizo poetry from Pre-British period to the present day

2. The Second part of this paper will be part B-Crama and carries 40 marks. There are two dramas one of which is Mizo origin and the other one is translation. This part of the paper requires the students to learn characteristics of drama with special reference to the two dramas.

The second paper namely, A- Prose and B-Fiction will be critical study of Prose and fiction of Mizo Origin.

PAPER I 100 Marks

A-Poetry 60 Marks

B- Drama 40 Marks

A. POETRY

(a) Kum 1900 hmalam hlate

1) Salulam Zai - Chang 5

2) Chawngchen Zai - Chang 5

3) Chai hla - Chang 5

4) Laltheri Zai - Chang 5

5) Saikuti Zai - Chang 5

6) Hrangchhawni Zai - Chang 5

7) Awithangpa Zai - Chang 5

(b) Kum 1900-1920 chung hlate

1) Tlangthim chhak lam kei ka en ang - Zosaphluia (D.E.Jones)

2) Thlalera ka vahvaih chung hian - Liangkhaia

3) Ka lungchhia hi man pek kha hriain - Zosaphara (E.Rolands)

(c) Kum 1920 - 1940 chung hlate :

1) Pialral ka ngai - Chang 5

2) Lei Lal puan ropui - C.Z.Huala

3) Tlang a dang lung a leng - Saihnuna

(d) Kum 1940-1965 chung hlate

1) Ramthar Zai - Chang 5

2) Chunnu lungmawl, ka di parte - (Kaihlek hla)

3) Hmangaihna - Vankhama

4) Leng dun ila - Lalzuithanga

5) Vanhnuai khuavel sakhming chhiarin - Rokunga

(e) Kum 1965 hnulam hlate

- 1) Kan hun tawng zingah - Suakliana
- 2) Ka pianna Zawlkhawpui - Rokunga
- 3) Ram ngaih hla - F.Rokima
- 4) Tho la, ding ta che - V.Thangzama

B. DRAMA/LEMCHAN

- 1) Liandova te Unau - Lalthangfala Sailo
- 2) Doctor Faustus - Christopher Marlowe

TEXT BOOK :

- 1) Rimawi Ram (Compiled & edited by Lalthangfala Sailo for CTBEB)
- 2) Doctor Faustus - Lettu - C.Laltlankima
- 3) Liandova te Unau - Lalthangfala Sailo

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MIZO ELECTIVE

PAPER-II

PAPER II 100 Marks

A- Prose 60 Marks

B- Fiction 40 Marks

A. PROSE/THU

1. Thlirtu - Kaphleia
2. Zofaten kawng kan bove - Zikpuii Pa
3. Harsatna - J.Malsawma
4. Rihdil leh Mizoram - Siamkima Khawlhiring
5. Huaisen - Darchhawna
6. Khuailui ral - Lalzuia Colney
7. Mizo tlawmngaihna a sir lehlam - Sangzuala pa

B. FICTION/THAWNTHU PHUAH

1. Sialton Official - C.Thuamluaia
2. Phira leh Ngurthanpari - Lalzuithanga
3. Pangpar bawm (Lehlin) - Rokhuma, Rev.

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MATHEMATICS

PAPER I

Any five questions may be attempted out of 12 questions to be set in the paper.

LINEAR ALGEBRA

Vector space, bases, dimension of a finitely generated space, Linear transformations, Rank and nullity of a linear transformation, Cayley Hamilton theorem, Eigen-values and Eigen-vectors.

Matrix of a linear transformation. Row and Column reduction. Echelon form. Equivalence, Congruence and similarity. Reduction to conical forms.

Orthogonal, symmetrical, skew-symmetrical, unitary, Hermitian and skew-Hermitian matrices-their Eigen-values, orthogonal and unitary reduction of quadratic and Hermitian forms. Positive definite quadratic forms. Simultaneous reduction.

Calculus

Real numbers, limits, continuity, differentiability. Mean-value theorem, Taylor's theorem, indeterminate forms, maxima and Minima. Curve Tracing.

Asymptotes

Functions of several variable, partial derivatives, maxima and minima

Jacobian, Definite and indefinite integrals, Double and triple integrals (techniques only). Application to Beta and Gamma Functions.

Areas, Volumes, centre of gravity.

Analytic Geometry of two and three dimensions.

First and second degree equations in two dimensions in cartesian and polar coordinates. Plane, sphere paraboloid, Ellipsoid, hyperboloid of one and two sheets and their elementary properties. Curves in space, curvature and torsion, Frenot's formulae.

Differential Equations.

Order and Degree of differential equation; differential equation of first order and first degree. Variables separate. Homogeneous. Linear, and exact differential equations. Differential equations with constant coefficients. The complementary function and the particular integral of

ax , ax , ax , m , ax , Bx , ax , Bx ,
 e , \cos , \sin , x , e , \cos . e , \sin

Vector, Tensor, Statics Dynamics and Hydrostatics.

(i) Vector Analysis - Vector Algebra, Differentiation of vector function of a scalar variable, Gradient, divergence and curl in cartesian, cylindrical and spherical coordinates and their physical interpretation. Higher order derivatives. Vector identities and Vector equations, Gauss and Stokes Theorems.

(ii) Tensor Analysis - Definition of a Tensor, Transformation of coordinates contravariant and covariant tensors. Addition and multiplication of tensors, contraction of tensors. Inner product, fundamental tensor, christoffel symbols, covariant differential curl and divergence in tensor notation.

(iii) Statics - Equilibrium of a system of particles; work and potential energy Friction, Common Catenary, Principle of Virtual work.

Stability of equilibrium. Equilibrium of forces in three dimensions.

(iv) Dynamics - Degree of freedom and constraints. Rectilinear motion. Simple harmonic motion. Motion in a plane, Projectiles. Constrained motion. Work and energy. Motion under impulsive forces. Kepler's laws. Orbits under central forces motion of varying mass. Motion under resistance.

(v) Hydrostatics - Pressure of heavy fluid, Equilibrium of fluids under given system of forces. Centre of Pressure. Thrust of curved surfaces. Equilibrium of floating bodies. Stability of equilibrium and Pressure of gases, problems relating to atmosphere.

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MATHEMATICS

PAPER II

This paper will be in two sections. Each section will contain eight questions. Candidates will have to answer any five questions.

SECTION A

Algebra, Real Analysis, Complex Analysis, Partial Differential equations.

ALGEBRA

Groups, subgroups, normal subgroups, homomorphism of groups, quotient groups. Basic isomorphism theorems. Sylow theorems. Permutation Groups. Cayley's theorem. Rings and Ideals. Principal Ideal domains, unique factorizations and Euclidean domains. Field Extensions. Finite fields.

REAL ANALYSIS

Metric spaces, their topology with special reference to sequence in a metric space, Cauchy sequence. Completeness. Completion, Continuous functions. Uniforms.

Properties of continuous functions on Compact sets. Riemann Stieltjes Integral. Improper integrals and their conditions of existence. Differentiation of functions of several variables. Implicit function theorem, maxima and minima, Absolute and conditional Convergence of series of real and Complex terms, Re-arrangement of series, Uniform convergence, infinite products, Continuity, differentiability and integrability for series, Multiple integrals.

COMPLEX ANALYSIS

Analytic functions, Cauchy's theorem, Cauchy's integral formula, power series. Taylor's series, singularities, Cauchy's Residue theorem and Contour integration.

PARTIAL DIFFERENTIAL EQUATIONS.

Formation of partial differential equations, Types of integrals of partial differential equations of first order, Charbits method, partial differential equation with constant, co-efficients.

SECTION B
Mechanics, Hydrodynamics, Numerical Analysis, Statistics
including probability operation Research.

MECHANICS

Generalised Coordinates, Constraints holonomic and non-holonomic systems. D'Alembert's principle and Langranges' equations. Moment of Inertia, Motion of rigid bodies in two dimension.

HYDRODYNAMICS

Equation of continuity, momentum and energy. Inviscid Flow Theory:- Two dimensional motion, Streaming motion, Sources and Sinks.

NUMERICAL ANALYSIS

Transcendental and Polynomial Equations, Methods of tabulation, bisection, regulataisi, secants and Newton-Raphson and order of its convergence.

INTERPOLATION AND NUMERICAL DIFFERENTIATION :-

Polynomial interpolation with equal or unequal step size. Spline interpolation Cubic Splines. Numerical differentiation formulae with error terms.

NUMERICAL INTEGRATION :-

Problems of approximate quadrative, quadrature formulae with equispaced arguments, caussion quadrature Convergence.

ORDINARY DIFFERENTIAL EQUATIONS :-

Eular's method, multisteppepredictore Corrector method - Adam's and Milne's method, convergence and stability, Runge Kutta Method. Probability and statistics.

1. Statistical methods :- Concept of statistical population and random sample, Collection and presentation of data. Measure of location and presentation of data/Moment and shepard's corrections.

Comulants Measures of Skewness and Kurtosis

Curve fitting by least squares Regression, correlation and correlation ratio. Rank correlation. Partial correlation Co-efficient and Multiple correlation co-efficient.

2. Probability :- Discrete sample space, Events, their union and intersection etc. Probability Classical relative frequency and axiomatic approaches, Probability in continuum, probability space, Conditional probability and independence. Basic laws of Probability, Probability of combination events, Bayes, theorem, Random variable Probability function, Probability density function. Distributions function. Mathematical expectation. Marginal and conditional expectation.

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3. Probability distributions :- Binomial, Poisson, Normal, a, a. Beta, Cauchy, Multinomial, Hypergeometric, Negative Binomial, Chebychev's lemma, (weak) law of large numbers, Central limit theorem for independent and identical varieties. Standard errors, Sampling distribution of I, F and Chi-Square and their uses in tests of significance. Large sample, tests for mean and proportion.

OPERATIONAL RESEARCH

Mathematical Programming : Definition and some elementary properties of convex sets, simplex methods, degeneracy, quality and sensitivity analysis, rectangular games and their solutions, Transportation and assignment problems, Kuha Tucker condition for non-linear programming. Bell man's optimality principle and some elementary applications of dynamic programming.

Theory of Queues :- Analysis of steady state and transient solutions for queueing system with Poisson arrivals and exponential service time.

Deterministic replacement models. Sequencing problems with two machines, n jobs 3 machines, n jobs (Special case) and n machines 2 jobs.

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POLITICAL SCIENCE AND INTERNATIONAL RELATIONS

PAPER I

**SECTION A
POLITICAL THEORY**

1. Main features of ancient Indian Political thought; Manu and Kautilya: Ancient Greek thought, Plato, Aristotle; General Characteristics of European Medieval political thought; St. Thomas Aquinas, Marsiglio of Padua; Machavelli; Hobbes, Locke, Montesquieu, Rousseau, Bentham, J.S.Mill, T.H.Green, Hegel, Marx, Lenin, and Mao-tse-Tung.
2. Nature and scope of Political Science : Growth of political Science as a discipline Traditional vs. contemporary approaches : Behaviourism and post behavioural developments; systems theory and other recent approaches to political analysis, Marxist approach to political analysis.
3. The emergence and nature of the modern State : Sovereignty; Monistic and Pluralistic analysis of sovereignty; Power Authority and Legitimacy.
4. Political obligation : Resistance and Revolution; Rights, Liberty, Equality, Justice.

5. Theory of Democracy.

6. Liberalism, Evolutionary Socialism (Democratic and Fabian): Marxian-Socialism; Fascism.

**SECTION B
GOVERNMENT AND POLITICS WITH SPECIAL
REFERENCE TO INDIA**

1. Approaches to the study of Comparative Politics : Traditional Structural-Functional approach.

2. Political Institution : The Legislature, Executive and Judiciary; Parties and Pressure-Groups; Theories of Party system; Lenin, Michels and Duverger; Electoral System; Bureaucracy Weber's view and modern critiques of Weber.

3. Political Process : Political Socialization, modernization and Communication; the nature of the non-western political process; A general study of the constitutional and political problems affecting Afro-Asian Societies.

4. Indian Political System :

(a) The Roots; Colonialism and nationalism in India; A general study of modern Indian social and political thought; Raja Ram Mohan Roy, Dadabhai Nauroji, Gokhale, Tilak, Sri Aurobindo, Iqbal, Jinnah, Gandhi, B.R. Ambedkar, M.N. Roy and Nehru.

(b) The structure : Indian constitution, Fundamental Rights and Directive Principles; Union Government; Parliament, Cabinet, Supreme Court and Judicial Review; Indian Federalism Centre State relations; State Government, Role of the Governor, Panchayati Raj.

(c) The functioning - Class and Caste in Indian Politics, politics of regionalism, linguism and communalism. Problems of secularisation of the policy and national integration Political, elites, the changing composition; Political parties and political participation; Planning and Developmental Administration; Socio-economic changes and its impact on Indian democracy.

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MF&AS Competitive Examination Syllabus

POLITICAL SCIENCE AND INTERNATIONAL RELATIONS

PAPER II

PART I

1. The nature and functioning of the Sovereign nation state system.
2. Concepts of International politics; Power, National interest; Balance of Power, "Power Vacuum".
3. Theories of International politics; The Realist theory; Systems theory; Decision making.

4. Determinants of foreign policy : National Interest; Ideology; Elements of National Power (Including nature of domestic socio-political institution).
 5. Foreign Policy Choices - Imperialism; Balance of Power: Allegiances; Isolationism; Nationalistic Universalism (Pax Britannica, Pax Americana, Pax-Sovietica): The " Middle Kingdom" Complex of China; Non-alignment.
 6. The Cold War : Origin, evaluation and its impact on international relations : Defence and its impact; a new Cold War?
 7. Non-alignment : Meaning, Bases (National and International) the non-alignment Movement and its role in international relations.
 8. De-colonization and expansion of the international community; Neo-colonialism and racialism their impact on international relations : Asian-African resurgence.
 9. The present International economic order Aid, trade and economic development; the struggle for the New International Economic Order; Sovereignty over natural resources; the crisis in energy resources.
 10. The Role and International law in International relations; The international court of justice.
 11. Origin and Development of International Organisations : The United Nation and Specialized Agencies; their roles in international relations.
 12. Regional Organisation : OAS, OAU, the Arab League, the ASEAN, the EEC, their role in international relations.
 13. Arms race disarmament and arms control; Conventional and nuclear arms, the Arms Trade; its impact on Third world role in international relations.
 14. Diplomatic theory and practice.
 15. External intervention: ideological, political and economic, "culture imperialism" Covert intervention by the major powers.
-

PART II

1. The uses and mis-uses of nuclear energy; the impact of nuclear weapons in international relations; the Partial Test-ban Treaty; the Nuclear Non-Proliferations.
2. The problems and prospects of the Indian Ocean being made a peace zone.
3. The conflict situation in West Asia.
4. Conflict and co-operation in South Asia.
5. The (Post War) foreign policies of the major powers: United States, Soviet Union, China.
6. The Third World in international relations : the North-South "Dialogue" in the United Nations and Outside.
7. The India's foreign policy and relations; India and the Super Powers; India and its neighbour; India and South-east-Asia; Indian and African problems; India's economic diplomacy India and the question of nuclear weapons.

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MF&AS Competitive Examination Syllabus

PHILOSOPHY

PAPER I

Metaphysics and Epistemology

Candidates will be expected to be familiar with theories and types of Epistemology and Metaphysics - Indian and Western - with Special reference to the following :-

(a) Western - Idealism, Realism, Absolutism, Empiricism, Rationalism; Logical 'I' Positivism; Analysis; Phenomenology; Existentialism and Pragmatism.

(b) Indian - Paramans and Paramanys ; Theories of truth and error; Philosophy of Language of meaning; Theories of reality with reference to main system (Orthodox and Heterodox) of Philosophy.

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**Syllabus for Limited Departmental Examinations of Upper Division
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MF&AS Competitive Examination Syllabus

6.1 Concepts of developmental Anthropological perspective. Models of development. Critiques of classical developmental theories. Concepts of planning and planned development. Concepts of participator development. Culture ecology and sustainable development. Displacement and rehabilitation.

7.1 Concept of research in anthropology, subjectivity and reflexivity in terms of gender class, ideology and ethics. Distinction between methodology, methods and techniques. Nature and explanation in anthropological research. Positivistics and non-positivistic approaches. Comparative methods; nature, purpose and methods of comparison in social and cultural anthropology. Basic techniques of data collection. Interview, participant and other forms of observation, schedules, questionnaire, case-study methods, extended cases study methods, life histories and secondary sources, oral history, genealogical method, participatory, learning and assessment (PLA). Participatory Rapid Assessment (PRA). Analysis, interpretation and presentation of data.

8.1 Concept, scope and major branches of human genetics. Its relationship with other branches of science and medicine.

8.2 Method for study of genetic principles in man-family study (pedigree analysis, twin study, foster child, co-twin method, cytogenetic method, chromosomal and karyotype analysis), biochemical methods, immunological methods, D.N.A. technology and recombinant technologies.

8.3 Twin study method-zygosity, heritability estimates, present status of the twin study method and its applications.

8.4 Mendelian genetics in man-family study, single factor, multifactor, lethal, sub-lethal and polygenic inheritance in man.

8.5 Concept of genetic polymorphism and selection, Mendelian population, Hardy-Weinberg law. Causes and changes which bring down frequency-mutation, isolation, migration, selection, in-breeding and genetic drift. Consanguineous and non-consanguineous mating, genetic load, genetic effect of consanguineous and cousin marriages (statistical and probability methods for study of human genetics).

8.6 Chromosomes and chromosomal-aberrations in man, methodology.

a) Numerical and structural aberrations (disorders).

b) Sex chromosomal aberrations Klinefelter (XXY), Turner (XO), Super female (XXX), intersex, and other syndromic disorders.

c) Autosomal aberrations-Down syndrome, Patau, Edward and Cri-du-chat syndromes.

d) Genetic imprints in human disease, genetic screening, genetic counselling, human DNA profiling, gene mapping and genome study.

8.7 Concept of race in historical and biological perspective. Race and racism, biological basis of morphological variation of non-metric and metric characters. Racial criteria, racial traits in relation to heredity and environment; biological basis of racial classification, racial differentiation and race-crossing in man.

8.8 Ethnic groups of mankind: characteristics and distribution in world, racial classification of human groups. Principal living peoples of world. Their distribution and characteristics.

8.9 Age, sex and population variation in genetic marker-ABO, Rh blood groups, HLA, Hp, transferrin, Gm, blood enzymes. Physiological characteristics-Hb level, body fat, pulse rate, respiratory functions and sensory perceptions in different cultural and socio-economic groups. Impact of smoking air pollutions, alcoholism, drugs and occupational hazards on health.

9.1 Concepts and Methods of Ecological Anthropology. Adaptation-

social and cultural Deterministic theories-a critique. Resources-biological, non-biological and sustainable development. Biological adaptation-climatic environmental, nutritional and genetic.

10.1 Relevance in understanding of contemporary society. Dynamics of ethnicity at rural, tribal, urban and international levels. Ethnic conflicts and political developments. Concept of ethnic boundaries. Ethnicity and concept of nation state.

11.1 Concept of human growth and development-stages of growth-prenatal, natal, infant, childhood, adolescence, maturity, senescence.

Factors affecting growth and development genetic, environmental, biochemical, nutritional, cultural and socio-economic.

Ageing and senescence. Theories and observations biological and chronological longevity. Human physique and somato-types. Methodologies for growth studies.

12.1 Reproductive biology, demography and population study. Reproductive physiology of male and female. Biological aspects of human fertility. Relevance of menarche, menopause and other bioevents to fertility. Fertility patterns and differentials.,

12.2 Demographic theories-biological, social and cultural.

12.3 Demographic methods-census, registration system, sample methods, duct reporting system.

12.4 Demographic rates and ratios, life table structure and utility.

12.5 Biological and socio-ecological factors influencing fecundity, fertility, natality and mortality.

12.6 Methods of studying population growth.

12.7 Biological consequences of population control and family welfare.

13.1 Anthropology of sports.

13.2 Nutritional Anthropology.

13.3 Anthropology in designing of defence and other equipments.

13.4 Forensic Anthropology.

13.5 Methods and principles of personal identification and reconstruction.

MF&AS Competitive Examination Syllabus

13.6 Applied human genetics-Paternity diagnosis genetic counselling and eugenics.

13.7 DNA technology-prevention and cure of diseases.

13.8 Anthro-po-genetics in medicine.

13.9 Serogenetics and cytogenetics in reproductive biology.

13.10 Application of statistical principles in human genetics and Physical Anthropology.

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ANTHROPOLOGY

PAPER II

1. Evolution of the Indian Culture and Civilization. Pre-historic (Paleolithic, Mesolithic and Neolithic), Protohistoric (Indus Civilization). Vedic and Post-Vedic beginnings. Contributions of the tribal cultures.
2. Demographic profile of India. Ethnic and linguistic elements in the Indian population and their distribution. Indian population, factors influencing its structure and growth.
3. The basic structure and nature of traditional Indian social system - a critique. Varnasharam, Purushartha, Karma, Rina and Rebirth. Theories on the origin of caste system, Jajmani system. Structural basis of inequality in traditional Indian society. Impact of Buddhism, Jainism, Islam and Christianity on Indian society.
4. Emergence, growth and development of anthropology in India-contributions of the 19th Century and early 20th Century scholar-administrators. Contributions of the Indian anthropologists to tribal and caste studies. Contemporary nature of anthropological studies in India.
5. Approaches to the study of Indian society and culture - traditional and contemporary.
 - 5.1 Aspects of Indian village. Social organisations of agriculture, impact of market economy on Indian villages.
 - 5.2 Linguistic and religious minorities - social, political and economic status.
6. Tribal situation in India-biogenetic variability, linguistic and socio-economic characteristics of the tribal populations and their distribution. Problems of the tribal Communities-land alienation, poverty indebtedness, low literacy, poor educational facilities, unemployment, underemployment, health and nutrition. Developmental projects - tribal displacement and problems of rehabilitation;

7. Problems of exploitation and deprivation of Scheduled Castes/Scheduled Tribes and Other Backward Classes. Constitutional safeguards for Scheduled Tribes and Scheduled Castes. Social change and contemporary tribal societies; impact of modern democratic institutions, development programmes and welfare measures on tribals and weaker sections. Emergence of ethnicity, tribal movements and quest for identity. Pseudo-tribalism.

8. Social change among the tribes during colonial and post - Independent India.

8.1 Impact of Hinduism, Christianity, Islam and other religious on tribal societies.

8.2 Tribe and nation state - a comparative study of tribal communities in India and other countries.

9. History of administration of tribal areas, tribal policies, plans, programmes of tribal development and their implementation. Role of N.G.Os.

9.2 Contributions of anthropology to the understanding of regionalism, communalism and ethnic and political movements.

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MF&AS Competitive Examination Syllabus

AGRICULTURE

PAPER - I

Ecology and its relevance to man, natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. Climatic elements as factors of crop growth, impact of changing environments. Environmental pollution and associated hazards to crops, animals and humans. Cropping patterns in different agro-climatic zones of the country, impact of high-yielding and short-duration varieties on shifts in cropping pattern. Concepts of multiple cropping, multistorey, relay and inter-cropping, and their importance in relation to food production. Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops grown during Kharif and Rabi seasons in different regions of the country.

Weeds, their characteristics, dissemination and association with

various crops; their multiplications; cultural, biological, and chemical control of weeds.

Soil-physical, chemical and biological properties. Processes and factors of soil formation. Modern classification of Indian soils, mineral and organic constituents of soils and their role in maintaining soil productivity. Essential plant nutrients and other beneficial elements in soils and plants. Principles of soil fertility and its evaluation for judicious fertiliser use, integrated nutrient management. Losses of nitrogen in soil, nitrogen fixation in soils. Fixation of phosphorus and potassium in soils and the scope for their efficient use. Problem soils and their reclamation methods.

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

Water-use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Drip and sprinkler irrigation. Drainage of water-logged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution.

Farm management, scope, important characteristics, farm planning. Optimum resources use and budgeting. Economics of different types of farming systems. Marketing and pricing of agriculture inputs and outputs, price fluctuations and their cost; role of co-operatives in agricultural economy; types and systems of farming and factors affecting them.

Agricultural extension, its importance and role, methods of evaluation of extension programmes, socio-economic survey and status of big, small, and marginal farmers and landless agricultural labourers; farm mechanization and its role in agricultural production and rural employment. Training programmes for extension workers; lab-to-land programmes.

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AGRICULTURE

PAPER - II

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

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

Seed technology, its importance. Different kinds of seeds and their seed production and processing techniques. Role of public and private sectors in seeds production, processing and marketing in India.

Physiology and its significance in agriculture. Imbibition, surface tension, diffusion and osmosis. Absorption and translocation of water, transpiration and water economy.

Enzymes and plants pigments; photosynthesis modern concepts and factors affecting the process, aerobic and non-aerobic respiration; C₃ and CAM mechanisms. Carbohydrate, protein ;and fat metabolism.

Growth and development; photoperiodism and vernalization. Auxins, hormones, and other plant regulators and their mechanism of action and importance agriculture. Physiology of seed development and germination, dormancy.

Climatic requirements and cultivation of major fruits, plants, vegetable crops and flower plants, the package of practices and their scientific basis. Handling and marketing problems of fruit and vegetables. Principal methods of preservation of important fruits and vegetable products, processing techniques and equipment. Role of fruits and vegetables in human nutrition. Raising of ornamental plants, and design and layout of lawns and gardens.

Diseases and pests of field vegetables, orchard and plantation crops of India. Causes and classification of plants pests and diseases. Integrated pest and disease management. Epidemiology and forecasting. Pesticides, their formulations and modes of action., Compatibility with rhizobial inoculants. Microbial toxins. Storage pests and diseases of cereals land pulses, and their control.

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

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MF&AS Competitive Examination Syllabus

CIVIL ENGINEERING

PAPER _ I

PART-A : ENGINEERING MECHANICS, STRENGTH OF MATERIALS AND STRUCTURAL ANALYSIS

ENGINEERING MECHANICS:

Units and Dimensions, SI Units, Vectors, concept of Force, Concept of particle and rigid body. Concurrent, Non-concurrent and parallel forces in a plane, moment of force and Varignon's theorem. First and Second Moment of area, Mass moment of inertia.

Static Friction, Inclined Plane and bearings. Kinematics and Kinetics: Kinematics in Cartesian and Polar Co-ordinates, motion under uniform and non-uniform acceleration, motion under gravity.

Kinetics of particle: Momentum and Energy principles, `D'Alembert's Principle, Collision of elastic bodies, rotation of rigid bodies, simple harmonic motion, Flywheel.

STRENGTH OF MATERIALS:

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

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

STRUCTURAL ANALYSIS:

Castigliano's theorems I and II, unit load method of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution, Kani's method of analysis and column Analogy method applied to indeterminate beams and rigid frames.

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

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

Matrix methods of analysis: Force method and displacement method of analysis of indeterminate beams and rigid frames. Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, statical method, Mechanism method.

Unsymmetrical bending: Moment of inertia, product of inertia, position of Neutral Axis and Principal axes, calculation of bending stresses.

PART-B: DESIGN OF STRUCTURES: STEEL, CONCRETE AND MASONRY STRUCTURES, STRUCTURAL STEEL DESIGN:

Structural Steel: Factors of safety and load factors. Riveted, bolted and welded joints and connections. Design of tension and compression member, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings, slab and gusseted

column bases. Design of highway and railway bridges: Through and deck type plate girder, Warren girder, Pratt truss.

DESIGN OF CONCRETE AND MASONRY STRUCTURES:

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

Cantilever and Counterfort type retaining walls.

Water tanks: Design requirements for Rectangular and circular tanks resting on ground.

Prestressed concrete: Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress. Design of brick masonry as per I.S. Codes. Design of masonry retaining walls.

PART-C: FLUID MECHANICS, OPEN CHANNEL FLOW AND HYDRAULIC MACHINES

Fluid Mechanics: Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curved surfaces.

Kinematics and Dynamics of Fluid flow: Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions, flownet, methods of drawing flownet, sources and sinks, flow separation, free and forced vortices.

Control volume equation, continuity, momentum, energy and moment of momentum equations from control volume equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, plane, curved, stationary and moving vanes, sluice gates, weirs, orifice meters and Venturi meters.

Dimensional Analysis and Similitude: Buckingham's Pi-theorem, dimensionless parameters, similitude theory, model laws, undistorted and distorted models.

Laminar Flow: Laminar flow between parallel, stationary and moving plates, flow through tube.

Boundary layer: Laminar and turbulent boundary layer on a flat plate, laminar sub-layer, smooth and rough boundaries, drag and lift.

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

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

(C) HYDRAULIC MACHINES AND HYDRO POWER:

Centrifugal pumps-Types, characteristics, Net Positive Suction Height (NPSH), specific speed. Pumps in parallel.

Reciprocating pumps, Air vessels, Hydraulic ram, efficiency parameters, Rotary and positive displacement pumps, diaphragm and jet pumps.

Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed.

Principles of hydropower development. Type, layouts and Component works. Surge tanks, types and choice. Flow duration curves and dependable flow. Storage and pondage. Pumped storage plants. Special features of mini, micro-hydel plants.

PART-D: GEO-TECHNICAL ENGINEERING

Types of soil, phase relationships, consistency limits particles size distribution, classifications of soil, structure and clay mineralogy.

Capillary water and structural water, effective stress and pore water pressure, Darcy's Law, factors affecting permeability, determination of permeability, permeability of stratified soil deposits. Seepage pressure, quick sand condition, compressibility and consolidation,

Terzaghi's theory of one dimensional consolidation, consolidation test. Compaction of soil, field control of compaction. Total stress and effective stress parameters, pore pressure coefficients. Shear strength

of soils, Mohr Coulomb failure theory, Shear tests.

Earth pressure at rest, active and passive pressures. Rankine's theory, Coulomb's wedge theory, earth pressure on retaining wall, sheetpile walls, Braced excavation. Flooring capacity, Terzaghi and other important theories, net and gross bearing pressure.

Immediate and consolidation settlement. Stability of slope, Total Stress and Effective Stress methods, Conventional methods of stress, stability number.

Subsurface exploration, methods of boring, sampling, penetration tests, pressure meter tests.

Essential features of foundation, types of foundation, design criteria, choice of type of foundation, design criteria, choice of type of foundation, stress distribution in soils, Boussinesq's theory, Newmark's chart, pressure bulb, contact pressure, applicability of different bearing capacity theories, evaluation of bearing capacity from field tests, allowable bearing capacity, Settlement analysis, allowable settlement.

Proportioning of footing, isolated and combined footings, rafts, buoyancy rafts, Pile foundation, types of piles, pile capacity, static and dynamic analysis, design of pile groups, pile load test, settlement of piles, lateral capacity. Foundation for Bridges. Ground improvement techniques - preloading, sand drains, stone column, grouting, soil stabilisation.

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MF&AS Competitive Examination Syllabus

CIVIL ENGINEERING

PAPER-II

**PART-A: CONSTRUCTION TECHNOLOGY, EQUIPMENT,
PLANNING; LAND MANAGEMENT**

1. Construction Technology:

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

CONSTRUCTION:

Building components and their functions, Brick masonry: Bonds, jointing. Stone masonry. Design of brick masonry walls as per I.S. codes, factors of safety, serviceability and strength requirements; plastering, pointing. Types of Floors & Roofs. Ventilators, Repairs in buildings.

Functional planning of building: Building orientation, circulation, grouping of areas, privacy concept and design of energy efficient building; provisions of National Building Code. Building estimates

and specifications; Cost of works; valuation.

2. CONSTRUCTION EQUIPMENT:

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

Concreting equipments: Weight batcher, mixer, vibration, batching plant concrete pump.

Earth work equipment: Power shovel hoe, bulldozer, dumper, trailers, and tractors, rollers, sheep foot roller.

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

New work Analysis: CPM and PERT analysis, Float Times, cashing of activities, contraction of network for cost optimization, updating, cost analysis and resource allocation.

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

PART-B: SURVEY AND TRANSPORTATION ENGINEERING

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

Railways: Permanent way, sleepers, rail fastenings, ballast, points and crossings, design of turn outs, stations and yards, turn tables, signals, and interlocking, level crossing construction and maintenance of permanent ways, super elevation, creep of rail, ruling gradient, tract resistance, tractive effort, relaying of track.

Highway Engineering: Principles of highway planning, Highway alignments, Geometrical design: Cross section, camber, super

elevation, horizontal and vertical curves. Classification of roads: low cost roads, flexible pavements, rigid pavements. Design of pavements and their construction, evaluation of pavement failure and strengthening. Drainage of roads: Surface and sub-surface drainage. Traffic Engineering: Forecasting techniques, origin and destination survey, highway capacity. Channelised and unchannelised intersections, rotary design elements, markings, sign, signals, street lighting; Traffic surveys, Principle of highway financing.

PART-C: HYDROLOGY, WATER RESOURCES AND ENGINEERING:

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

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

Water Resources Engineering: Ground and surface water resource, single and multipurpose projects storage capacity of reservoirs, reservoirs losses, reservoirs sedimentation, economics of water resources projects.

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

Canals: Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining.

Water logging: causes and control, drainage system design, salinity.

Canal structures: Design of cross regulators, head regulators, canal falls, aqueducts, metering flumes and canal outlets.

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Diversion head work: Principles and design of weirs of permeable and impermeable foundation, Khosla's theory, energy dissipation, stilling basin, sediment excluders.

Storage works: Types of dams, design, principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage. Spillways: Spillway types, crest gates, energy dissipation.

River training: Objectives of river training, methods of river training.

PART-D: ENVIRONMENTAL ENGINEERING

Water Supply: Estimation of surface and subsurface water resources, predicting demand for water for water, impurities of water and their significance, physical, chemical and bacteriological analysis, water-borne diseases, standards for potable water.

Intake of water: pumping and gravity schemes. Water treatment; principles of coagulation, flocculation and sedimentation; slow; rapid; pressure; filters; chlorination, softening, removal of taste, odour and salinity.

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

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

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

Sewage treatment: Working principles, units, chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge, recycling of waste water.

Solid waste: collection and disposal in rural and urban contexts, management of long-term ill-effects.

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

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ELECTRICAL ENGINEERING

PAPER _ I

Electrical Circuits _ Theory and Applications.

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

Signals & Systems

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

E.M. Theory

Maxwell's equations, wave propagation in pounded media. Boundary conditions, refraction and refraction of plane waves.

Transmission line: Distributed parameter circuits, travelling and standing waves, impedance matching. Smith chart.

Wave guides: parallel plane guide. TE, TM and TEM waves, rectangular and cylindrical wave guides, resonator. Planar

transmission lines; stripline, microstripline.

Analog Electronics

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

Power supplies.

Digital Electronics

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

Energy Conversion:

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

Transformers:

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

Power Electronics and Electric Drives:

Semiconductor power devices: diode, transistor, thyristor triac GTO and MOSFET-static characteristics and principles of operation;

triggering circuits; phase control rectifiers, bridge converters, fully-controlled and half-controlled; principles of thyristor choppers and inverters, basic concepts of speed control of dc and ac motor drives ; applications of variable-speed drives.

Analog Communication

Random variables: continuous, discrete, probability, probability functions; Statistical averages, probability models; Random signals and noise white noise, noise equivalent bandwidth; signal transmission with noise, signal to noise ratio linear CW modulation: Amplitude modulation DSB, DSB-SC and SSB, Modulators and Demodulators; Phase and Frequency modulation, PM & FM signals, narrowband FM generation & detection of FM and PM, Deemphasis, Preemphasis. CW modulation system; Superheterodyne receivers, FM receivers, phase locked loop, SSB receiver signal to noise ratio calculation for AM and FM receivers.

Microwaves and Antenna

Electromagnetic radiation, propagation of waves, ground waves, sky wave, space wave, tropospheric scatter propagation. Extraterrestrial communications. Antenna: various types, gain, resistance, band-width, beamwidth, and polarization, effect of ground. Antenna coupling, high frequency antennas; microwave antennas; special purpose antennas.

Microwave Services: Klystron, magnetron, TWT, gun diodes, Impatt, Bipolar and FETs. Microwave integrated circuits. Microwave measurements.

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ELECTRICAL ENGINEERING

PAPER II

Control Systems

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

Electrical Engineering Materials

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

Microprocessors and microcomputers

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

Measurement and Instrumentation

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

IC Technology:

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

Power Systems: Analysis and Control

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

voltage control and power factor correction, economic operation, symmetrical and unsymmetrical faults. Concept of system stability, swing curves and equal area criterion. Static VAR system. Basic concepts of HVDC transmission; FACTS, Computer control and Automation, Introduction to energy control centres, various states of a power system; SCADA systems and RTUs. Active power control: Speed control of generator, tie-line control, frequency control. Economic dispatch.

Power system protection

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

Non-conventional Energy Sources and Energy Management

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

Digital Communication

Pulse code modulation (PCM), differential pulse code modulation (DPCM), delta modulation (DM), Digital modulation and demodulation schemes; amplitude, phase and frequency keying schemes, amplitude, phase and frequency keying schemes (ASK, PSK, FSK). Error control coding: error detection and correction, linear block codes, convolution codes. Information measure and source coding. Data networks, 7-layer architecture.

Satellite Communication, Radar and TV

Satellite Communication: General overview and technical characteristics, earth station equipment, satellite link design, CNR of Satellite system. Radar: Basic principles, Pulsed systems; CW Doppler radar, FMCW radar, Phase array radars. Television systems: Television systems and standards, Black and White and colour-TV

transmission and receiver systems.

Fibre Optic System

Multiplexing: Time division multiplexing, Frequency Division multiplexing. Optical properties of materials: Refractive index absorption and emission of light, optical fibres, lasers and optoelectronic materials fibre optic links.

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MECHANICAL ENGINEERING

PAPER -I

1. Theory of Machines

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

2. Mechanics of Solids:

Stress and strain in two dimensions. Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagrams, bending stresses and deflection of beams, shear stress distribution. Torsion of shafts, helical springs. Combined stresses. Thick and thin walled pressure vessels.

Struts and columns, strain energy concepts and theories of failure. Rotating discs. Shrink fits.

3. Engineering Materials:

Basic concepts on structure of solids, crystalline materials, defects in crystalline materials, Alloys and binary phase diagrams, structure and properties of common engineering materials. Heat treatment of steels, plastics, ceramics and composite materials, common applications of various materials.

4. Manufacturing Science:

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

5. Manufacturing Management:

Production Planning and Control, Forecasting, Moving average, exponential smoothing, operations scheduling, assembly line balancing. Product development, breakeven analysis, capacity planning PERT and CPM.

Control Operations: Inventory control-ABC analysis, EOQ model. Materials requirement planning. Job design, Job standards, work measurement, Quality management, Quality control, Operations Research: Linear programming, Geographical and Simplex methods. Transportation and assignment models, single server queuing model.

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

6. Elements of Computation:

Computer Organisation, Flow charting, Features of Common Computer Languages. FORTRAN. d Base III, Lotus 1-2-3 and elementary programming.

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MECHANICAL ENGINEERING

PAPER II

1. THERMODYNAMICS:

Basic concepts. Open and closed systems, Applications of Thermodynamic Laws, Gas equations, Clapeyron equation, Availability, Irreversibility and Tds relations.

2. I.C. Engines, Fuels and Combustion:

Spark Ignition and compression ignition engines, Four stroke engine and Two stroke engines, mechanical, thermal and volumetric efficiency, Heat balance. Combustion process in S.I. and C.I. engines, pre-ignition detonation in S.I. engine Diesel knock in C.I. engine. Choice of engine fuels, Octane and Cetane ratings, alternate fuels carburation and fuel injection, engine emissions and control, solid, liquid a gaseous fuels, stoichiometric air requirements and excess air factor, fuel gas analysis, higher and lower calorific values and their measurements.

3. HEAT TRANSFER, REFRIGERATION AND AIR CONDITIONING:

One and two dimensional heat conduction. Heat transfer from extended surfaces, heat transfer by forced and free convection. Heat exchangers. Fundamentals for diffusive and convective mass transfer, Radiation laws, heat exchange between black and non black surfaces, network analysis. Heat pump refrigeration cycles and systems, condensers, evaporators and expansion devices and controls. Properties and choice of refrigerant, Refrigeration Systems and components, psychometrics, comfort indices, cooling load calculations, solar refrigeration.

4. TURBO-MACHINES AND POWER PLANTS:

Continuity, momentum and Energy Equations. Adiabatic and Isentropic flow, Fanno lines, Rayleigh lines. Theory and design of axial flow turbines and compressors, Flow through turbo-machine blade, cascades, centrifugal compressor, dimensional analysis and modelling. Selection of site for steam, hydro, nuclear and stand-by power plants, selection base and peak load power plants, Modern High pressure, High duty boilers, Draft and dust removal equipment, fuel and cooling water systems, heat balance, station and plant heat rates, operation and maintenance of various power plants, preventive maintenance, economics of power generation.

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STATISTICS

PAPER-I

Probability:

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

Statistical Inference:

Consistency, unbiasedness, efficiency, sufficiency, minimal sufficiency, completeness, ancillary statistic, factorization theorem, exponential family of distribution and its properties, uniformly minimum variance unbiased (UMVU) estimation, Rao-Blackwell and Lehmann-Scheffe theorems, Cramer-Rao inequality for single and several-parameter family of distributions, minimum variance bound estimator and its properties, modifications and extensions of Cramer-Rao inequality; Chapman-Robbins inequality, Bhattacharyya's bounds, estimation by methods of moments, maximum likelihood, least squares, minimum chi-square and modified

minimum chi-square, properties of maximum likelihood and other estimators, idea of asymptotic efficiency, idea of prior and posterior distributions, Bayes estimators.

Non-randomised and randomised tests, critical function, MP tests, Neyman-Pearson lemma, UMP tests, monotone likelihood ratio, generalised Neyman-Pearson lemma, similar and unbiased tests, UMPU tests for single and several-parameter families of distributions, likelihood rotates and its large sample properties, chi-square goodness of fit test and its asymptotic distribution.

Confidence bounds and its relation with tests, uniformly most accurate (UMA) and UMA unbiased confidence bounds.

Kolmogorov's test for goodness of fit and its consistency, sign test and its optimality, Wilcoxon signed-ranks test and its consistency, Kolmogorov-Smirnov two sample test, run test, Wilcoxon-Mann-Whitney test and median test, their consistency and asymptotic normality.

Wald's SPRT and its properties, OC and ASN functions, Wald's fundamental identity, sequential estimation.

Linear inference and Multivariate Analysis:

Linear statistical models, theory of least squares and analysis of variance, Gauss-Markoff theory, normal equations, least squares estimates and their precision, test of significance and interval estimates based on least squares theory in one-way, two-way and three-way classified data, regression analysis, linear regression, curvilinear regression and orthogonal polynomials, multivariate normal distribution, Mahalanobis' D^2 and Hotelling's T^2 statistics and their applications and properties, discriminant analysis, canonical correlations, one-way MANOVA, principal component analysis, elements of factor analysis.

Sampling Theory and Design of Experiments

An outline of fixed-population and super-population approaches, distinctive features of finite population sampling, probability sampling designs, simple random sampling with and without replacement, stratified random sampling, systematic sampling and its efficacy for

structural populations, cluster sampling, two-stage and multi-stage sampling, ratio and regression, methods of estimation involving one or more auxiliary variables, two phase sampling, probability proportional to size sampling with and without replacement, the Hansen-Hurwitz and the Horvitz-Thompson estimators, non-negative variance estimation with reference to the Horvitz-Thompson estimators, non-sampling errors, Warner's randomised response technique for sensitive characteristics. Fixed effects model (two-way classification) random and mixed effects models (two-way classification per cell), CRD, RBD, LSD and their analyses, incomplete block designs, concepts of orthogonality and balance, BIBD, missing plot technique, factorial designs, 2^n , 3^2 , and 3^3 , confounding in factorial experiments, split-plot and simple lattice designs.

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STATISTICS

PAPER-II

1. Industrial Statistics

Process and product control, general theory of control charts, different types control charts for variables and attributes, \bar{X} , R , s , p , np and c charts, cumulative sum chart, V-mark, single, double, multiple and sequential sampling plans for attributes, OC, ASN, AOQ and ATI

curves, concepts of producer's and consumer's risks, AQL, LTPD and AOQL, sampling plans for variables, use of Dodge-Romig and Military Standard tables.

Concepts of reliability maintainability and availability, reliability of series and parallel systems and other simple configurations, renewal density and renewal function, survival models (exponential), Weibull, lognormal, Rayleigh, and bath-tub), different types of redundancy and use of redundancy in reliability improvement, problems in life-testing, censored and truncated experiments for exponential models.

II. Optimization Techniques

Different, types of models in Operational Research, their construction and general methods of solution, simulation and Monte-Carlo methods, the structure and formulation of linear programming (LP) problem, simple LP model and its graphical solution, the simplex procedure, the two-phase method and the M-technique with artificial variables, the duality theory of LP and its economic interpretation, sensitivity analysis, transportation and assignment problems, rectangular games, two person zero-sum games, methods of solution (graphical and algebraic).

Replacement of falling or deteriorating items, group and individual replacement policies, concept of scientific inventory management and analytical structure of inventory problems, simple models with deterministic and stochastic demand with and without lead time, storage models with particular reference to dam type.

Homogeneous discrete-time Markov chains, transition probability matrix, classification of states and ergodic theorems, homogeneous continuous-time Markov chains, Poisson process, elements of queuing theory, M/M/1, M/M/K, G/M/1 and M/G/1 queues.

Solution of statistical problems on computers using well known statistical software packages like SPSS.

III. Quantitative Economics and Official Statistics

Determination of trend, seasonal and cyclical components, Box-Jenkins method, tests for stationery of series, ARIMA models and determination of orders of autoregressive and moving average components, forecasting.

Commonly used Index numbers _ Laspeyre's, Paasche's and Fisher's ideal index numbers, chain-base index number, uses and limitations of index numbers, index number of wholesale prices, consumer price index numbers, index number of agricultural and industrial production, tests for index numbers like proportionality test, time-reversal test, factor-reversal test, circular test and dimensional

invariance test.

General linear model, ordinary least squares and generalised least squares methods of estimation, problem of multicollinearity, consequences and solutions of multicollinearity, autocorrelation and its consequences, heteroscedasticity of disturbances and its testing, test for independence of disturbances, Zellner's seemingly unrelated regression equation model and its estimation, concept of structure and model for simultaneous equations, problem of identification- rank and order conditions of identifiability, two stage least squares method of estimation.

Present official statistical system in India relating to population, agriculture, industrial production, trade and prices, methods of collection of official statistics, their reliability and limitation and the principal publications containing such statistics, various official agencies responsible for data collection and their main functions.

IV. Demography and Psychometry

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

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