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NOTIFICATION

No. A. 12018/4/2003 - P&AR(GSW), the 12th March, 2008. In exercise of the powers conferred by the proviso to Article 309 of the Constitution of India, the Governor of Mizoram is pleased to make the following rules relating to the recruitment and conditions of service of persons appointed to the Mizoram Planning, Economic and Statistical Service.

PART - I
PRELIMINARY

1. **Short title and Commencement :**
   (1) These Rules may be called the Mizoram Planning, Economic & Statistical Service Rules, 2008,
   (2) They shall come into force on the date of publication in the official Gazette.

2. **Definitions :**
   In this rules, unless there is anything repugnant in the subject or context;
   (a) 'Commission' means the Mizoram Public Service Commission.
   (b) 'Constitution' means the Constitution of India.
   (c) 'Duty Post' means any post specified in Schedule - I & II and it includes temporary post specified in that Schedule and any other temporary post declared as duty post by the Governor.
   (d) 'Gazette' means the Mizoram Gazette.
   (e) 'Government' means Government of Mizoram.
   (f) 'Member of the Service' means a person appointed in a substantive capacity to any grade of the Mizoram Planning, Economic & Statistical Service and includes a person appointed on probation to the Mizoram Planning, Economic & Statistical Service in accordance with these rules.
   (g) 'Schedule' means a schedule appended to these Rules;

(h) 'Schedule Castes' means such Castes as are specified by the President of India under Article 341(1) of the Constitution of India and as modified by law made by Parliament from time to time in so far as the specification relates to the State of Mizoram.

(i) 'Schedule Tribes' means such tribes as are specified by the President of India under Article 342(1) of the Constitution of India as modified by law made by Parliament from time to time in so far as the specification relates to the State of Mizoram;

(j) 'Service' means the Mizoram Planning, Economic & Statistical Service;

(k) 'State' means the State of Mizoram;

(l) 'Year' means the Calendar year.

PART - II
CONSTITUTION OF THE SERVICE AND ITS CLASSIFICATION

3. Constitution of the Service :

1) There shall be constituted a Service to be known as the MIZORAM PLANNING, ECONOMIC & STATISTICAL SERVICE (MPESS)

2) They shall consist of the following persons, namely :-

(a) all persons already appointed to the existing posts as mentioned in Schedule - I appended to these rules;

(b) all persons holding ex-cadre posts in Schedule I-A appended to these rules;

(c) all persons to be appointed to the Service in accordance with these rules, after the commencement of these rules.

4. Composition and Strength of Service :

1) The Composition and strength of the service and category of posts therein shall be as may be determined by the Government from time to time.

2) At the commencement of these rules, the composition and strength of the service and the category of posts therein are shown in Schedule-I & II appended to these Rules.

5. Classification :

1) The service shall have four grades, namely :-

(a) Selection Grade

(b) Junior Adminsitrative Grade

(c) Senior Grade

(d) Junior Grade.

2) All the posts in the service shall be Mizoram Planning, Economic & Statistical Service (Group 'A') posts

PART - III
METHODS OF RECRUITMENT

6. 1) Recruitment :

Recruitment to the service after the commencement of these rules shall be by the following methods, namely :-

(a) Seventy five percent of the sanctioned posts of Junior Grade shall be filled by promotion in accordance with rule-8.

(b) Twenty five percent of the sanctioned posts of Junior Grade shall be filled by direct recruitment through competive examination in accordance with rule 9, 10 & 11.

2) **Promotion :**

(a) All posts in the Selection Grade shall be filled by promotion from Officers belonging to Junior Administrative Grade.

(b) All posts in the Junior Administrative Grade shall be filled by promotion from officers belonging to Senior Grade.

(c) All posts in the Senior Grade shall be filled from Officers belonging to Junior Grade.

All promotions (a), (b) and (c) shall be through a process of selection.

7. **Constitution of the Selection Board :**
The Board for the purpose of these rules shall be Mizoram Public Sercive Commission for all kinds of appointments and promotion to the Service.

PART - IV

8. **Recruitment by Promotions and conditions of eligibility and procedure for the selection :**
As provided for in rule 6. 1(a), Officers substantively appointed to and who have served a minimum period of eight years in the grade of Inspector of Statistics will be eligible to be considered for appointment to entry grade of the Service.

The Selection for inclusion in the selected list shall be through a process of selection.

PART - V
DIRECT RECRUITMENT AND APPOINTMENT

9. **Competitive Examination :**

(1) A competitive examination for direct recruitment to the service shall be held at such intervals as the Government may, in consultation with the Commission determine from time to time. The dates on which and the places at which the examination shall be held may be fixed by the Commission.

(2) The examination shall be in accordance with the rules and syllabus as per Schedule-III.

(3) The Commission shall prepare list of selected candidates who appeared in the examination in order of merit and send it to the Government.

10. **Procedure of Direct Recruitment :**
A candidate for direct recruitment to the service must satisfy the following conditions namely :-

(a) Nationality : He must be a citizen of India.

(b) Age : He must have attained the age of 21 years but must not have exceeded the age of 30 years on the closing date for receipt of applications from candidates.

Provided that the upper age limit may be relaxed by five years in the case of candidates belonging to Schedule Castes and Scheduled Tribes and in respect of candidates belonging to special categories of persons in accordance with any general or special order issued by the Government from time to time.

(c) Educational Qualification : The minimum educational qualification of the candidate shall be at least 2nd Class Master Degree in Statistics/Economics/Mathematics and Commerce of recognised University.

(d) Payment of Examination : He must pay the fees prescribed by the Government or the Commission as the case may be.

(e) Physical Fitness :

(i) A candidates shall be of sound health, both mental and physical and shall be free from organic disease, bodily infirmity likely to interfere with the efficient performance of his duty.

(ii) A candidate shall be required to undergo a Medical Board examination approved by the Commission before final approval for appointment to the Service.

(f) Adminission into the Examination : The decision of Commission as to the eligibility or otherwise of a candidate for admission to the examination shall be final and a candidate to whom a Certificate or Admission Card has not been issued by the Commission shall not be admitted to the examination hall.

(g) No right to appointment : The inclusion of a candidate's name in the list referred to in rule 9(3) shall confer no right to appointment unless the Governor is satisfied, after such inquiry as may be considered necessary that the candidate is suitatble in all respects for appointment to the Service and an actual offer of appointment is made.

Provided that where a candidate whose name is included in the list, is not appointed to the service, the reasons for the same shall be recorded in writing by not Government.

11. Appointment of Direct Recruit :

(1) Subject to the provisions of these rules, appointment to the Service shall be made from the candidates included in the list referred to in Rule 9(3) of these rules strictly in the order of merit and with due regard to the ratio specified in Rule 6.1(a) and (b) of these Rules :

(2) A person appointed to the Service shall join within 45 days from the date of receipt of the order of appointment, failing which, unless the Governor is otherwise pleased to extend the period, the appointment, will be cancelled.

PART - VI
APPOINTMENT, DISQUALIFICATION, PROBATION TRAINING AND CONFIRMATION

12. Appointment :

(1) All appointments to the Service shall be made to appropriate Grades of the Service and not against any specific post of the service.

(2) Appointments to the Service shall be made by the Governor and shall be notified in the Official Gazette.

13. Disqualification :

1) No person -

(a) Who has entered into or contracted a marriage with a person having a spouse living, or

(b) Who, having a spouse living has entered into or contracted a marriage with any person shall be eligible for appointment to the service.

Provided that the Governor may, if satisfied that such marriage is permissible udner the personal law applicable to such persons and to the other Party to the marriage and there are other grounds for so doing, exempt any person from the operation of these rules.

2) A person who is already in Government service or in the service of a statutory body, shall not be appointed unless a release Certificate or a 'No Objection Certificate' from that Government or statutory body, as the case may be, is furnished.

14. Probation :

1) Every person recruited to the Service in accordance with these rules shall be on probation for a period of two years.

Provided that the period of probation may, for good and sufficient reason to be recorded in writing, be extended for six months by the Governor in the individual case.

2) A Person on probation shall be liable to be discharged from the Service at any time without assigning any reason thereof during the period of probation.

Provided if he holds a lien on any permanent post under the Central Government or the State Government or Administration of Union Territory, he shall be liable to be reverted to that post.

Provided further that a person who holds a lien to any permanent post under he Central Government or the State Government of Administration of Union Territory may, it he so desires, during the period of probation have the option to revert to his parent Department after giving such notice as may be prescribed by the Governor.

15. Training :

Every probationer shall, during the period of probation, undergo such training as may be prescribed by the Government from time to time.

PART - VII

MISCELLANEOUS :

18. Time Scale of Pay :

The time scale of pay admissible to the service shall be as follows, subject to revision by the Government from time to time.

(i)	Selection Grade	:	Rs. 14,300-400-18300/-
(ii)	Junior Administrative Grade	:	Rs. 12,000-375-16500/-
(iii)	Senior Grade	:	Rs. 10,000-325-15200/-
(iv)	Junior Grade	:	Rs. 8,000-275-13500/-

19. Fixation of Initial Pay :

1) On first appointment to the service, the initial pay of member of the service shall be fixed at the minimum of the time scale of pay unless he, under the Fundamental Rules and Supplimentary Rules or any other rules governing the fixation of pay for the time being in force, is entitled to have his pay fixed at the higher stage in that time scale.

2) On Promotion/Appointment of a member from lower to higher grade in the Service, the initial pay in the time scale shall be fixed in accordance with the principles governing such fixation under the fundamental Rules and Supplimentary Rules or any other rules governing the fixation of pay in force from time to time.

20. Increment :

1) The first increment due to a member in the time scale of pay shall accrue on completion of one year service in the grade.

2) The Governor may withhold, for such time as he may direct, an increment or increments due to substantive member of the service who has failed to pass the departmental examination within such time as the Governor may, by general or special order prescribe, but withholding of such increment shall have no cumulative.

21. Promotion of Higher Grade :

1) Subject to the provision of sub-Rule below, promotion of the members of the Service to the Senior Grade, the Junior Administrative Grade and the Selection Grade shall be made in consultation with the Commission through a process of seclection.

2) A member of the Service in the Junior Grade shall be eligible for promotion to the Senior Grade after he has put in regular service in the Junior Grade for a minimum period of 5 years subject to Rule 17 and his ability, integrity and character.

3) A member of the service in the Senior Grade shall be eligible for promotion to Junior Administrative Grade after he has put in a minimum period of 5 years in the Senior Grade, or with not less than 10 years regular service calculated from the date of entry into the service out of which at least 3 years shall be in the Senior Grade on regular basis.

4) A member of the service in the Junior Administrative Grade shall be eligible for promotion to the Selection Grade after he has put in a minimum period of 5 years in the Junior Administrative Grade or with not less than 18 years of service calculated from the date of entry into the service out of which 2 years shall be in the Junior Administrative Grade on regular basis.

22. Post of Member of the Service :

1) Every member of the service shall, unless he is appointed to an ex-cadre post, or is otherwise not available for holding a duty post owing to the exigencies of public service, be posted against a duty post under the Government by the Governor.

23. Seniority :

1) The Government shall prepare a list of members to be appointed to the Service, arranged in order of seniority as determined in the manner specified below :

(a) The seniority of members of the service appointed at the initial constitution of the service in accordance with the provisions of Part IV of these Rules shall be as determined by the Government.

(b) The Inter-se-seniority of members of the service appointed after the commencement of these rules shall be determined by the Government in accordance with the principles/rules for determination as may be made by the Government from time to time.

24. Relaxation :

Where the Governor is satisfied that the operation of any of these rules causes undue hardship in any particular case, he may in consultations with the Commission relax the rule to such extent and subject to such conditions as he may consider necessary for dealing with the case in a just and equitable manner.

Provided that the case of any person shall not be dealt with in any manner less favourable to him than that provided by any of these rules.

25. Interpretation :

If any question arises relating to the interpretation of these rules, it shall be referred to the Governor whose decision thereon shall be final.

26. Repeal and Saving :

On and from the commencement of these rules, the Mizoram Planning, Economic and Statistical Service Rules, 1996 issued under Notification No.A.12018/1/82-APT(B) dated 2.2.1996 and published in the Mizoram Gazette Extra ordinary Issue No. 49 dated 7.2.1996 shall stand repealed.

Notwithstansding such repeal, any order made or action taken under any of the rules so repealed or under any general orders ancillary thereto shall be deemed to have been validly made, done or taken under the corresponding provisions of these rules.

By orders, etc.

Sd/-
C. ROPIANGA
Secretary to the Govt. of Mizoram,
Deptt. of Personnel & Adve. Reforms.

SCHEDULE - I
(Rules No. 3(2)(a)

LIST OF EXISTING POSTS HELD BY THE APPOINTEES :

		No. of posts
1.	Director, Economic & Statistics	1
2.	Adviser, Planning Board	1
3.	Dy. Adviser, Planning Board	1
4.	Joint Director, Economic & Statistics	1
5.	Chief Planning Officer, Lunglei	1
6.	Dy. Director, Economis & Statistics	4
7.	Senior Research Officer, Planning Board	3
8.	Economist, Planning Board	1
9.	Research Officer, Planning Board	6
10.	Research Officer, Economic & Statistics	6
11.	District Research Officer, one each in Aizawl, Lunglei, Saiha	3
12.	Research Officer, Agriculture	1
13.	Research Officer, AH & Vety	1
14.	Research Officer, Education	1
15.	Research Officer, Soil & Water Conservation	1
16.	Research Officer, P.W.D.	
17.	Research Officer, Environment & Forest	1
18.	Research Officer, Transport	1
19.	Research Officer, SCERT (School Education)	1
20.	Research Officer, Health Service Department	1
21.	Research Officer, Urban Development and Poverty Alleviation	1
	TOTAL	**38**

SCHEDULE - I A
List of Ex-Cadre post held by members of the service vide Rule No. 3(2)(b)

1.	Project Director, SLMC	1
2	SO/APO, SLMC (RD)	2
3.	APO (Monitoring) DRDA, Aizawl, Lunglei, Saiha, Lawngtlai, Serchhip, Champhai, Kolasib and Mamit	8
	TOTAL	**11**

SCHEDULE - II
(Rule No. 4(2)

THE AUTHORISED PERMANENT STRENGTH OF THE SERVICE AND PARTICULARS OF THE POSTS INCLUDED IN IT ARE AS FOLLOWS :

1.	Specific Posts under the Government of Mizoram	38
2.	Deputation, Training and Leave reserve	7
	TOTAL	**45**

The above figures include the following posts.

A.	**SELECTION GRADE :**		
	1.	Director, Economics & Statistics	1
	2	Adviser, Planning Board	1
		TOTAL	**2**
B.	**JUNIOR ADMINISTRATIVE GRADE**		
	1.	Deputy Adviser, State Planning Board	1
	2.	Joint Director, Economic & Statistics	1
	3.	Chief Planning Officer, Lunglei	1
		TOTAL	**3**
C.	**SENIOR GRADE**		
	1.	Senior Research Officer, State Planning Board	3
	2.	Economist, Planning Board	1
	3.	Dy. Director, Economic & Statistics	4
		TOTAL	**8**
D.	**JUNIOR GRADE**		
	1.	Research Officer, Planning Board	6
	2.	Research Officer, Economic & Statistics	6
	3.	District Research Officer, one each in Aizawl, Lunglei, Saiha	3
	4.	Research Officer, Agriculture	1
	5.	Research Officer, AH & Vety	1
	6.	Research Officer, Education	1
	7.	Research Officer, Soil & Water Conservation	1
	8.	Research Officer, P.W.D.	1
	9.	Research Officer, Environment & Forest	1
	10.	Research Officer, Transport	1
	11.	Research Officer, SCERT (School Education)	1
	12.	Research Officer, Health Service Department	1
	13.	Research Officer, Urban Development	1
		TOTAL	**25**

E.	**TOTAL OF A+B+C+D (2+3+8+25)**	**38**
F.	**RESERVATIONS :**	
	(a) Deputation @ 10%	2.5
	(b) Training @ 10%	2.5
	(c) Leave @ 10%	2.5
		7.5=7
	GRAND TOTAL 'E' + 'F' (38+7)	**45**

SCHEDULE III
(Rule No.9(2)

SYLLABUS FOR COMPETITIVE EXAMINATION FOR DIRECT RECRUITMENT TO JUNIOR GRADE OF MIZORAM PLANNING, ECONOMIC AND STATISTICAL SERVICE.

Sl.No.	**Subject**	**Time**	**Ful Marks**
1.	General English	3 hrs	100
2.	Economics I/or Statistics I or Mathematics I or, Commerce I	3 hrs	100
3.	Economics II/or Statistics II/ or, Mathematics II/or, Commerce II.	3 hrs	100
4.	General Knowledge	3 hrs.	100
5.	Viva Voce	As specified by the Commission	50
		TOTAL	**450**

Economics - I

I. Consumption and Demand: The theory of consumer's choice; utility - cardinal and ordinal approaches; optimum of the consumer; Indifference Curve, Slutsky, Revealed Preference Theory; Consumer's Surplus; Constant Elasticity Model.

II Theory of Production and Costs: The Production Function; Factor-Employment Decision; Shift in factor prices: substitution and scale effect. Derivation of short and long run cost curves; Laws of Returns and Returns to Scale. Input Demand Functions; Adding up Theorem.

III. Theory of Firm: Long run and Short-run Supply; Determinants of the Industry's Supply Function. Firm Survival and the "Zero Profit Theorem"; Monopoly Profit Maximizing Optimum; Monopoly and Economic Efficiency, Monopolistic Price Discrimination; Controlled and Administered Prices; Oligopoly - non-collusive and Collusive Models.

IV. National Income and Consumption Function: Concept, Measurement and Component Analysis of National Income; Theories of Consumption Function - Absolute, Relative, Permanent and Life-cycle Hypotheses.

V. Output and Employment: Model of Income Determination; Say's Law of Markets; Keynes' Objection to Classical Theory; The Principle of Effective Demand; Income Multiplier; Classical-Keynesian Synthesis. Theory of Investment, Autonomous and Induced Investment, Marginal Efficiency of Capital; Saving-Investment Equality.

Economics - II

I. Economic Growth and Development: Role of Government in Economic Development; Factors of Economic Growth: Capital, Labour & Technology; Classical and Neo-classical Growth Models: Harrod and Domar, Solow and Meads, Joan Robinson, Contribution of Smith, Ricardo, Malthus and J.S.Mill. Quality of Life and Holistic view of Development and Civil Society.

II. Sectoral View of Development: Role of Agriculture in Economic Development-Efficiency and Productivity in Agriculture, New Technology and Sustainable Agriculture; Globalisation and Agricultural Growth; Terms of Trade between Agriculture and Industry; The question of scale-economy; Development of Infrastructure; Labour Laws.

III. Money: Concept of High-Powered Money; Components of Supply of Money; Theories of Demand for Money - Keynesian, Portfolio Balance Approach and Friedman's Restatement; The Process of Credit Creation; Functions of Central Bank; Instruments of Credit Control; Theory of Inflation - Demand -Pull and Cost-push Inflation; Policies for Control.

IV. Public Finance: Theory of Public Goods; Market Failure in Provision of Public Goods; Voluntary Exchange Models; Pure Theory of Public Expenditure, Social Choice Theory; Wagner's Law of Increasing State Activities; Criteria for Public Investment; Benefit-Cost Analysis.
Principles of Budgeting; Planning Programming Budgeting System; Theory of incidence of Taxation, Benefit and Ability to Pay Approach; Welfare Cost of Taxation; Deficit Financing.

V. International Trade and Indian Economy: Terms of Trade, concept, their uses and limitations, International Trade as an Engine of Growth; Static and Dynamic Gains from trade; Import-substituting Industrializations, Export-led Growth; Balance of Payments, Tariff and Effective Protection; Post-GATT International Economic order; WTO and Developing countries.
Characteristics of under developed economy; Broad Demographic features of Indian population and Achievements and Goals of Population Policy; Rural-Urban Migration; Poverty and Inequality. Rationale of Internal and External Reforms; Privatisation and Disinvestments Debate; Issues in Labour Market Reforms.

Statistics - I

I. Descriptive Statistics: Collection of Data: Primary and Secondary Data; Designing a questionnaires; classification of data; Measures of Central Tendency; Arithmetic, Geometric and Harmonic Mean; Range; Mean Deviation; Standard Deviation; Moments; Skewness and Kurtosis; Lorenze Curve.

II. Correlation and Regression Analysis: Karl Pearson's Coefficient of Correlation; Correlation and Causation; Rank Correlation Coefficient; Method of Least Squares; Partial and Multiple Correlation Coefficients. Regression Equation of Y on X; Explained and Unexplained Variation; R^2; Regression in Grouped Frequency Distribution; Standard Error of Estimate and t-statistic.

III. Index Numbers Vital Satisfies: uses and problems in the construction of Index Numbers; Weighted and Un-weighted Index Numbers; Fisher's Ideal Index Numbers; Time Reversal Test; The Chain Index Numbers; Base shifting, splicing and deflating Index Numbers; Consumer Price Index Numbers and Index Numbers of Industrial Production; Crude Birth Rate; Age Specific Birth Rate; Net Reproduction Rate; Crude Death Rate; Infant Mortality Rate; Maternal Mortality Rate; Natural Growth Rates.

IV. Business Forecasting and Time Series Analysis: Methods of forecasting; Business forecasting and Time Series Analysis; Components of Time Series; Methods of Measurement - Straight line trend, freehand method; Method of Semi-Averages; Method of Least Squares; Non-Linear Trend; Method of Moving Averages; Second Degree Parabola; Logarithmic Trends; Growth Curves - Logistic and Gompertz; measurement of seasonal variations, measurement of cyclical variations and irregular variations.

V. Probability: Axiomatic definition of probability; Probability Density Function; Conditional Probability; Additional Theorem; Multiplicative Theorem; Dependent and Independent Events; Baye's Theorem; Moments and Moment Generating Functions; Properties of Binomial, Poisson and Normal Distribution.

Statistics - II

I. Methods of Sampling and Estimation: Sampling methods - Random Sampling methods, Stratified Sampling, Purposive Sampling, Cluster Sampling and Proportional Sampling; Parameter and Statistic; Sampling Distribution. Statistical Estimation; Properties of Good Estimators; Method of Maximum Likelihood; Point Estimation; Interval Estimation; Confidence Limit for Population Mean, Proportion and Difference of Two Means.

II. Sampling Distributions: Properties of t-distribution; critical values; t-test for single mean; t-test for difference of means; F-statistic; F-test for equality of population variances. Chi-square test; Yate's Correction for continuity; test of hypothesis concerning variance; Test of Independence; Test of Goodness of Fit; Test of Homogeneity.

III. Test of Hypothesis: Statistical Hypothesis - Simple and Composite; Type I and Type II Errors; Test of Hypothesis About Population mean; Test of the difference between two means, population proportions; Power of Test. Steps in Solving Testing of Hypothesis Problem. Non-parametric Test: Test for Randomness; Median Test; Sign Test; Mann-Whitney-Wilcoxton U-Test.

IV. Statistical Decision Theory: Decision Making Under Risk; Decision making under certainty; Decision making under uncertainty; Theory of Games; Two persons zero-sum Game; A Game with a Pure Strategy; A game with a Mixed Strategy; Dominance Principle, Analysis of Variance: One-way classification model and two-way classification model.

V. Regression Model: Deterministic and Undeterministic Relationship; Ordinary Least Squares (OLS) Method, Basic Assumptions of OLS Estimation; Best Linear Unbiased Estimator (BLUE); Distribution of a and b ; Covariance of a and b; Estimation of Var(a) and Var(b); Violations of Basic Assumptions: Heteroskedasticity; Auto-regressive Disturbances.

MATHEMATICS - I

1) **Real Analysis:**

Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, Integration and differentiation, the fundamental theorem of Calculus, integration of vector-valued functions, Rectifiable curves. Rearrangements of terms of a series, Riemann's theorem.

Sequences and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel's and Dirichlet's tests for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.

Functions of several variables, linear transformations, Derivatives in an open subset of R^n, Chain rule, Partial derivatives, interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobians, extremum problems with constraints, Lagrange's multiplier method, Differentiation of integrals, Partitions of unity, Differential forms, Stoke's theorem.

Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets. Integration of Non-negative functions. The General integral. Integration of Series. Reimann and Lebesgue Integrals.

The Four derivatives. Functions of Bounded variation. Lebesgue Differentiation Theorem. Differentiation and Integration. Measures and outer measures, Extension of a measure. Uniqueness of Extension. Completion of a measure. Measure spaces. Integration with respect to a measure. The L^p-spaces. Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of L^p, Convergence in Measure, Almost uniform convergence.

2) **Functional Analysis:**

Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Riesz Lemma, basic properties of finite dimensional normed linear spaces and compactness. Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, dual spaces with examples. Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems. Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.

Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces. Self-adjoint operators, Positive, projection, normal and unitary operators. Abstract variational boundary-value problem. The generalized Lax-Milgram theorem.

3) **Algebra:**

Group, subgroups, Normal subgroups, Quotient Groups, Homomorphisms, Cyclic Groups, Permutation Groups, Cayley's Theorem, Rings, Ideals, integral Domains, Fields, Polynomial Rings. Symmetric groups, alternating groups, Simple groups, Rings, Maximal ideals, Prime Ideals, Integral domains, Euclidean domains, principal Ideal domains, Unique Factorisation domains, quotient fields, Finite

fields, Algebra of Linear Transformations, Reduction of matrices to Canonical Forms, Inner product Spaces, Orthogonality, quadratic Forms, Reduction of quadration forms. Reduction of Quadratic forms. Conjugate elements and class equations of finite groups, Sylow theorem, solvable groups, Jordan Holder Theorem Direct Products, Structure Theorem for finite abellan groups, Chain conditions on Rings; Characteristic of Field, Filed extensions, Elements of Galois theory, solvability by Radicals, Ruler and compass construction.

4) **Topology:**

Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods. Interior, exterior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology. Alternate methods of defining a topology in terms of Kuratowski Closure Operator and Neighbourhood Systems. Continuous functions and homeomorphism.

First and Second Countable spaces. Lindelofs theorems. Separable spaces. Second Countability and Separability. Separation axioms T_0 T_1 T_2, T_{3ya}, T_4; their Characterizations and basic properties. Urysohn's lemma. Tietze extension theorem.

Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact sets. Local compactness and one point compactification. Stone-vech compactification. Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric spaces. Connected spaces. Connectedness on the real line. Components. Locally connected spaces.

Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff's theorem). Countability and product spaces.

Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Nets and filters. Topology and convergence of nets. Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and Compactness.

Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Paracompactness. The Smirnov metrization theorem.

The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.

5) **Statics:**

Reduction of coplanar forces; equilibrium of coplanar forces; general condition of equilibrium of any system of coplanar forces; friction: laws of statical friction; laws of limiting friction; coefficient of friction, angle of friction, cone of friction; solution of problems on equilibrium of heavy bodies (such as uniform rods, solid spheres) resting on plane surfaces.

Centre of gravity of thin uniform rod; uniform lamina, triangular lamina and lamina in the form of a parallelogram; centre of gravity of circular arcs; of uniform sector of a circle; moments and products of inertia; theorems of parallel and perpendicular axes; angular momentum of a rigid body about a fixed axis; principal axes.

6) **Particle Dynamics:**

Velocity and acceleration in Cartesian co-ordinates; rectilinear motion with variable acceleration; simple harmonic motion; collision of elastic bodies; direct and oblique impact. Projectiles; rectilinear motion in resisting media on a horizontal plane where resistance varies as (i) velocity, (ii) square of velocity, (iii) displacement; vertical motion under gravity where resistance varies as (i) velocity, (ii) square of velocity.

Tangential and normal acceleration on smooth curves; motion on a smooth plane curve such as vertical circles and cycloids; radial and transverse accelerations on smooth curves (simple problems only); work done by a force; work energy equation; potential function; conservative forces.

7) **Differential Equations:**

Preliminaries- Initial value problem and the equivalent integral equation, mth order equation in d-dimensions as a first order system, concepts of local existence, existence in the large and uniqueness of solutions with examples.

Linear Differential Equations- Linear Systems, Variation of constants, reduction to smaller systems. Basic inequalities, constant coefficients. Floquet theory. Adjoint systems, Higher order equations.

Dependence on initial conditions and parameters; Preliminaries. Continuity. Differentiability. Higher Order Differentiability.

Linear second order equations- Preliminaries. Basic facts. Theorems of Sturm. Sturm-Liouville Boundary Value Problems. Number of zeros. Nonoscillatory equations and principal solutions. Nonoscillation theorems.

Use of Implicit function and fixed point theorems- Periodic solutions. Linear equations. Nonlinear problems.

Second order Boundary value problems- Linear problems. Nonlinear problems. Aprori bounds.

8) **Complex Analysis:**

Complex integration. Cauchy-Goursat Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Maximum modulus principle. Schwarz lemma. Laurent's series. Isolated singularities. Meromorphic functions. The argument principle. Rouche's theorem Inverse function theorem.

Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, log z and z^a. Bilinear transformations, their properties and classifications. Definitions and examples of Conformal mappings.

Spaces of analytic functions. Hurwitz's theorem. Montel's theorem Riemann mapping theorem. Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection principle. Monodromy theorem and its consequences. Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet problem. Green's function.

9) **Rigid Dynamics:**

Coplanar forces: reduction of coplanar forces; equilibrium of coplanar forces; general condition of equilibrium of any system of coplanar forces; friction: laws of statical friction; laws of limiting friction; coefficient of friction, angle of friction, cone of friction; solution of problems on equilibrium of heavy bodies (such as uniform rods, solid spheres) resting on plane surfaces.

Centre of gravity of thin uniform rod; uniform lamina, triangular lamina and lamina in the form of a parallelogram; centre of gravity of circular arcs; of uniform sector of a circle; moments and products of inertia; theorems of parallel and perpendicular axes; angular momentum of a rigid body about a fixed axis; principal axes.

10) **Computer Oriented Numerical Analysis:**

Solution of Equations: Bisection, Secant, Regula Falsi, Newton's Method, Roots of Polynomials. Interpolation: Lagrange and Hermite Interpolation, Divided Differences, Difference Schemes, Interpolation Formulas using Differences.

Numerical Differentiation. Numerical Quadrature: Newton-Cote's Formulas, Gauss Quadrature Formulas, Chebychev's Formulas. Linear Equations: Direct Methods for Solving. Systems of Linear Equations (Gauss Elimination, LU Decomposition, Cholesky Decomposition), Iterative Methods (Jacobi, Gauss-Seidel, Relaxation Methods). The Algebraic Eigenvalue problem: Jacobi's Method, Givens' Method, Householder's Method, Power Method, QR Method, Lanczos' Method.

Ordinary Differential Equations: Euler Method, Single-step Methods, Runge-Kutta's Method, Multi-step Methods, Milne-Simpson Method, Methods Based on Numerical Integration, Methods Based on Numerical Differentiation, Boundary Value Problems, Eigenvalue Problems.

MATHEMATICS - II

I **PURE MATHEMATICS:**

1) **Number Theory:**

Primes and factorization. Division algorithm. Congruences and modular arithmetic. Chinese remainder theorem. Euler phi function. Primitive roots of unity. Quadratic law of reciprocity, application. Arithmetical functions. Mobius inversion formula. The Diophantine equations $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$. Farey sequences.

Riemann zeta function, functional equation, prime number theorem, arithmetical functions, mobious inversion, introduction to modular forms.

2) **Linear programming:**

Linear Programming- Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis. Game Theory-Two-Person, Zero-Sum Games. Games with Mixed Strategies. Graphical Solution. Solution by Linear Programming.

Applications to Industrial Problems- Optimal product mix and activity levels. Petroleum-refinery operations. Blending problems. Economic interpretation of dual linear programming problems. Input-output analysis. Leontief system. Indecomposable and Decomposable economies.

3) **Measure Theory:**

Measurable and measure spaces: Extension of measures, signed measures, Jordan-Hahn decomposition theorems. Integration, monotone convergence theorem, Fatou's lemma, dominated convergence theorem. Absolute continuity. Radon Nikodymtheorem, Product measures, Fubini's theorem.

4) **Graph Theory:**

Graph and multi-graphs, Sub-graphs, Degree of Vertex, paths, connectivity, Connected components, cut sets, Bridges, Traversal Multi Graphs, Matrix Representation, planner graphs, maps & regions, Eulerian and Hamiltonian Graphs, Directed Graphs, Euler's Formula, Trees. Pigeonhole principle.

5) **Algebraic Topology:**

Brouwer's fixed point theorem, fundamental theorem of algebra, vector fields on planar sets, Frobenius theorem for 3x3 matrices. Covering spaces, unique path lifting theorem, covering homotopy theorems, group of covering transformations, criterion of lifting of maps in terms of fundamental groups, universal covering, its existence, special cases of manifolds and topological groups.

Singular homology, reduced homology, Eilenberg Steenrod axioms of homology (no proof for homotopy invariance axiom, excision axiom and exact sequence axiom) and their application, relation between fundamental group and first homology.

6) **Differential Geometry:**

Local Theory of Surfaces - Parametric patches on surface. First Fundamental form and arc length. Normal curvature. Geodesic curvature and Gauss formulae. Shape operator Lp of a surface at a point. Vector field along a curve. Second and third fundamental forms of a surface. Weiengarten map. Principal curvatures. Gaussian Curvature. Mean and normal curvatures. Gauss theorem egregium. Isometry groups and the fundamental existence theorem for surfaces.

Global Theory of surfaces - Geodesic coordinate patches. Gauss-Bonnet formulae, Euler-characteristic of a surface. Index of a vector field. Spaces of constant curvature.

Intrinsic Theory of Surfaces in Riemannian Geometry - Parallel translation and connections. Cartan's structural equations and curvature. Interpretation of curvature. Geodesic curvature and Gauss-Bonnet for a 2-dimensional Riemann surface. Geodesic coordinate systems. Isometries and spaces of constant curvature and the 3-types of geometry.

7) **Mathematical Statistics:**

Random Variables: Concept, cumulative distribution function, discrete and continuous random variables, expectations, mean, variance, moment generating function. Discrete random variable: Bernoulli random variable, binomial random variable, geometric random variable, Poisson random variable. Continuous random variables: Uniform random variable, exponential random variable, Gamma random variable, normal random variable.

Conditional probability and conditional expectations, Bayes theorem, independence, computing expectation by conditioning; some applications - a list model, a random graph, Palya's urn model. Bivariate random variables: Joint distribution, joint and conditional distributions, the correlation coefficient. Functions of random variables: Sum of random variables, the law of large numbers and central limit theorem, the approximation of distributions. Uncertainty, information and entropy, conditional entropy, solution of certain logical problems by calculating information.

II APPLIED MATHEMATICS

1) Hydrostatics:

Pressure equation. Condition of equilibrium. Lines of force. Homogeneous and heterogeneous fluids. Elastic fluids. Surface of Equal pressure. Fluid at rest under action of gravity. Rotating fluids. Fluid Pressure on plane surfaces. Centre of pressure. Resultant pressure on curved surfaces.

Equilibrium of floating bodies. Curves of buoyancy. Surface of buoyancy. Stability of equilibrium of floating bodies. Meta centre. Work done in producing a displacement. Vessel containing liquid. Gas laws. Mixture of gases. Internal Energy. Adiabatic expansion. Work done in compressing a gas. Isothermal Atmosphere. Connective equilibrium.

2) Classical Mechanics:

Generalized coordinates. Holonomic and Non-holonomic systems. Scleronomic and Rheonomic sytems. Generalized potential. Lagrange's equations of first kind. Lagrange's equations of second kind. Uniqueness of solution. Energy equation for conservative fields.

Hamilton's variables. Donkin's theorem. Hamilton canonical equations. Cyclic coordinates. Routh's equations. Poisson's Bracket. Poisson's Identity. Jacobi-Poisson Theorem. Motivating problems of calculus of variations, Shortest distance. Minimum surface of revolution. Brachistochrone problem. Isoperimetric problem. Geodesic. Fundamental lemma of calculus of variations.

Hamilton's Principle. Principle of least action. Poincare Cartan Integral invariant. Whittaker's equations. Jacobi's equations. Statement of Lee Hwa Chung's theorem.

3) Mechanics of Solids

Analysis of Strain-Affine transformations. Infinite simal affine deformation. Geometrical interpretation of the components of strain. Strain quadric of Cauchy. Principal strains and invariants. General infinite simal deformation. Saint -Venant's equations of, Compatibility. Finite deformations.

Analysis of Stress-Stress tensor. Equations of equilibrium. Transformation of coordinates. Stress quadric of Cauchy. Principal stress and invariants. Maximum normal and shear stresses.

Equations of Elasticity - Generalised Hooke's law. Homogeneous isotropic media. Elasticity moduli for isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid. Strain energy function and its connection with Hooke's law. Uniqueness of solution. Beltrami-Michell compatibility equations. Saint-Venant's principle.

Two-dimensional Problems - Plane stress. Generalized plane stress. Airy stress function. General solution of Biharmonic equation. Stresses and displacements in terms of complex potentials. Simple problems. Stress function appropriate to problems of plane stress. Problems of semi-infinite solids with displacements or stresses prescribed on the plane boundary.

4) Fluid Mechanics:

Kinematics- Lagrangian and Eulerian methods. Equation of continuity. Boundary surfaces. Stream lines. Path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines.

Equations of Motion- Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Equations referred to moving axes. Impulsive actions. Stream function. Irrotational motion in two-dimensions. Complex velocity potential. Sources, sinks, doublets and their images. Conformal mapping. Milne-Thomson circle theorem.

Two-dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Kinetic energy of liquid. Stress components in a real fluid. Relations between rectangular components of stress. Connection between stresses and gradients of velocity. Dynamical similarity. Buckingham p-theorem. Reynolds number. Prandt's boundary layer. Boundary layer equations in two-dimensions. Blasius solution. Boundary layer thickness.

5) **Theory of Relativity:**

Inertial frames. Speed of light and Galilean relativity. Michelson-Morley experiment. Lorentz Fitzgerold contraction hypothesis. Relative character of space and time. Postulates of special theory of relativity. Lorentz transformation equations and its geometrical interpretation. Group properties of Lorentz transformation. Relativistic kinematics - Composition of parallel velocities. Length contraction. Time dilation.

Geometrical representation of space-time - Four dimensional Minkowskian space-time of special relativity. Time-like, light-like and space-like intervals. Null cone, Proper time. World line of a particle. Four vectors and tensors in Minkowskian space-time.

Relativistic mechanics - Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy momentum for vector. Relativistic force and Transformation equations for its components. Relativistic Lagrangian and Hamiltonian. Relativistic equations of motion of a particle. Energy momentum tensor of a continuous material distribution.

6) **Astronomy:**

Spherical triangles; formulas for spherical trigonometry; solution of spherical triangles; position of a point of a sphere; length of a small circular arc; the. celestial co-ordinates; rising and setting of stars; dip of the horizon; atmospheric refraction, twilight.

Orbital and synodic periods of a planet; direct and retrograde motions of planets; stationary points; phases of the planets and the moon; brightness of planets; Kepler's laws; apparent solar motion; signs of the zodiac, sidereal time and mean time; correction of time; equation of time; seasons, calendar; geocentric parallax, stellar parallax; effects on right ascension; declination; longitude and latitude; paralactic eclipse; aberration; eclipses.

7) **Partial Differential Equations:**

Examples of PDE, Classifications. Transport Equation - Initial value Problem, non-homogeneous Equation. Laplace's Equation - Fundamental Solution, Mean Value Formulas, Properties of Harmonic Functions, Green's Function, Energy Methods. Heat Equation - Fundamental Solution, Mean Value Formula, Properties of Solutions, Energy Methods. Wave Equation - Solution by Spherical Means, Non-homogeneous Equations, Energy Methods.

Nonlinear First Order PDE - Complete Integrals, Envelopes, Characteristics, Hamilton-Jacobi Equations (Calculus of Variations, Hamilton's ODE, Legendre Transform, Hopf-Lax Formula, Weak Solutions, Uniqueness), Conservation Laws (Shocks, Entropy Condition, Lax-Oleinik formula, Weak Solutions, Uniqueness, Riemann's Problem, Long Time Behaviour)

Representation of Solutions - Separation of Variables, Similarity Solutions (Plane and Travelling Waves, Solitons, Similarity under Scaling), Fourier and Laplace Transform, Hopf-Cole Transform, Hodograph and Legendre Transforms, Potential Functions, Asymptotics (Singular Perturbations, Laplace's Method, Geometric Optics, Stationary Phase, Homogenization), Power Series (Non-characteristic Surfaces, Real Analytic Functions, Cauchy-Kovalevskaya Theorem).

Commerce - I

1. School of Management thought: Managerial functions;
2. Organizational Behaviour; theories of Motivation; Group dynamics and Team development; Leadership; Organizational conflict; Organizational Communication; Organization Development.
3. Business Environment; Techniques of Environment Scanning; Economic, Political and Legal, Social-Cultural and International and Technological Environment- Recent trends.
4. Management Accounting: Accounting Plan; Responsibility Centres; Budgeting; Types of budgeting; Budgetary Control; Standard Costing and Variance Analysis; Marginal Costing and Break-Even Analysis; Analysis of Financial Statements; Reporting to Management.
5. Business Statistics: L Trivariate Analysis; Probability Theory; Probability Distributions; Statistical Decision Theory; Sampling and Data-Collection; Data Sources; Statistical Estimation and Testing; Correlation and Regression Analysis; Index Numbers; Statistical Quality Control
6. Entrepreneurship: Theories; Public Policies and Programmes for Entrepreneurship Development; Promotion of a Venture;
7. Marketing Management: Market Analysis and Selection; Consumer behaviour; Product decision; Pricing decision; Distribution channels and Physical distribution decisions; Promotion Decisions; Marketing Research; Marketing Organization and control; Recent Development in Marketing.
8. Financial Management: Capital Budgeting; Cost of Capital; Operating and Financial Leverage; Capital Structure Theories; Dividend Policies; Management of Working Capital.

Commerce - II

1. Computer Application in Business; Fundamentals; Local Area of Networks (LAN) Networking Topologies; Wide Area of Network & (WAN); Multimedia; Operating systems; DOS and Windows ;
2. Word Processing; Working With MS-Word in MS-Office; formatting; Working with graphics; Spreadsheets; Working with EXCEL; Working with graphics in EXCEL; Using worksheets as database in accounting marketing, finance and personal areas; Power-Point presentation; Accounting packages Tally; Statistical packages; Excel and SPSS.
3. E-Commerce: Internet Technology Concept and; Business Models of E-Commerce and Infrastructure; Business to Consumer E-Commerce; Web Page Design, Business to Business E-Commerce; E-Business; Security issues in E-Commerce; Regulatory and Legal Framework of E-Commerce; Multi-Media and E-Commerce
4. Corporate Legal Framework: The Companies Act, 1956 (With Amendment Act 2002); The Negotiable Instruments Act 1881; Legal Environment for Security Markets; SEBI Act, 1992; Consumer Protection Act, 1986; Regulatory Environment for International Business: FEMA Act, 1999; Regulatory framework of WTO.
5. Financial Institutions and Markets: Indian Financial System; Financial Markets; Role of SEE I; Recent Developments; Reserve Bank of India; Commercial Bank; Development Bank; Insurance Sector; Insurance Regulatory and Development Authority; Unit Trust of India; Non-Banking Financial Institutions; Mutual Funds; Merchant Banking; Interest Rate Structure; Foreign Investments,
6. Project Planning and Control: Identification of Investment Opportunities; Market and Demand Analysis; Technical Analysis; Cost of Project and Means of Financing; Profitability, Financial projections and Tax Considerations; appraisal Criteria and Appraisal Process; Social Cost Benefit Analysis; Network Techniques for Project Implementation, Monitoring and Control.

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