(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2026

(Fourth Semester)

Branch - **STATISTICS**

ECONOMETRICS AND PLANNING MODELS

Time: Three Hours | Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Which of the following is likely to occur when too many variables are included in the model? a) The model may become underspecified. b) The model is more precise. c) The model may become overspecified. d) The model includes unbiased terms.	K1	CO1
	2	Observations from subjects at a given point in time generates---- a) Cross sectional data b) Panel data c) Time series data d) Spatial data	K1	CO1
2	3	What should be relationship between the number of observations (n) and the number of explanatory variables(m) in a model? a) n<m b) n=m c) $n \leq m$ d) n>m	K1	CO2
	4	Which of the following is not an assumption of a Simple Linear Regression Model? a) The disturbance terms are normally distributed. b) The Explanatory variable is non Stochastic. c) The disturbance terms are uncorrelated. d) The dependent variable is non stochastic	K1	CO2
3	5	In case of multicollinearity, the confidence intervals tend to be -- a) Wider b) Narrower c) (i) or (ii) d) None of the above	K1	CO3
	6	Which of the following methods can be used to remove autocorrelation from a time series? a) Differencing b) Smoothing c) Addition of lags d) None of the above	K2	CO3
4	7	Identify the method that assumes the structural equations are exactly identified. a) OLS b) ILS c) 2SLS d) LIML	K2	CO4
	8	In 2SLS, which of the following methods is applied to the reduced form of equations? a) OLS b) ILS c) SLS d) LIML	K2	CO4
5	9	State the models where Marginal saving rate is treated as an endogenous variable. a) Harrod-Domar Model b) Mahalonobis Model c) Chakrobarty model d) Keynesian Model	K2	CO4
	10	The two sectors considered in the two sector model of Mahalonobis were _____. a) Consumer Goods and Investments Goods sector. b) Imports sector and Exports sector c) Consumer Goods and Export sector. d) Investment and Imports sector	K2	CO4

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Write the reasons for the poor forecasting performance of a model. Illustrate.	K3	CO1
		(OR)		
	11.b.	Describe the statistical criteria used to evaluate whether the estimates of the parameters of the model are meaningful.		
2	12.a.	Write a simple Linear regression model and prove that the dependent variable $follows\ N(\beta_0 + \beta_1 X_i, \sigma^2)$	K4	CO2
		(OR)		
	12.b.	Prove that the least square estimator of β_1 is a linear function of Y_i.		
3	13.a.	Discuss the role of VIF in detecting multicollinearity.	K4	CO3
		(OR)		
	13.b.	What are the consequences of autocorrelation.? Elaborate.		
4	14.a.	Brief the properties of 2SLS estimators.	K5	CO4
		(OR)		
	14.b.	Examine the identifiability of the first equation in following model. $y_1 = 3y_2 - 2x_1 + x_2 + u_1$ $y_2 = y_3 + x_3 + u_2$ $y_3 = y_1 - y_2 - 2x_3 + u_3$		
5	15.a.	Compare Harrod Domar Model and Mahalonobis model.	K5	CO4
		(OR)		
	15.b.	Describe the Mahalonobis two sector model. How it plays a role in Indian Planning		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	State and explain the types of data used in Econometric analysis.	K3	CO1
2	17	Write the assumptions of a Classical Linear regression Model and derive the model with two explanatory valubles.	K5	CO2
3	18	Explain the role of Durbin Watson test in detecting multicollinearity.	K4	CO3
4	19	Estimate the parameters using ILS method. $Demand\ Function: Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 X_t + u_{1t}$ $Supply\ Function: Q_t = \beta_0 + \beta_1 P_t + u_{2t}$ Where Q-Quantity, P-Price, X = Income.	K5	CO4
5	20	Explain the fundamental equation and the equation for warranted growth in Harrod Model.	K5	CO4

Z-Z-Z END

(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2026

(Fourth Semester)

Branch - **STATISTICS**

TIME SERIES AND FORECASTING

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Question	K Level	CO
1	What are the main components of a time series? a) Trend, Seasonality, Cyclic, and Irregular b) Mean, Variance, Standard Deviation, and Mode c) Linear, Exponential, Logarithmic, and Quadratic d) Independent, Dependent, Correlated, and Uncorrelated	K1	CO1
2	Which of the following best describes an additive model in time series? a) $Yt=Tt+St+Rt+Yt$ b) $Yt=Tt\times St\times Rt\times Yt$ c) $Yt=Tt-St-Rt-Yt$ d) $Yt=Tt\div St\div Rt\div Yt$	K2	CO1
3	A simple moving average is best suited for which type of time series data? a) Data with a linear trend b) Data with seasonality c) Data with irregular fluctuations d) Data with an exponential trend	K1	CO2
4	In Exponential Smoothing, what does the smoothing constant (α) represent? a) The weight given to the most recent observation b) The number of past observations considered c) The length of the moving average window d) The seasonal adjustment factor	K1	CO2
5	What is the difference between an AR(1) and an AR(2) model? a) AR(1) has one lag term, while AR(2) has two lag terms b) AR(2) is a non-stationary model, while AR(1) is always stationary c) AR(1) includes moving averages, while AR(2) does not d) AR(2) has no auto regressive component	K2	CO3
6	The Partial Auto Correlation Function (PACF) helps in identifying: a) The number of lagged values in an AR model b) The seasonality in a time series c) The presence of a trend component d) The moving average order	K1	CO3
7	What is the purpose of the Augmented Dickey-Fuller (ADF) test? a) To test for stationarity in a time series b) To calculate the auto correlation of a time series c) To determine the best lag order for an AR model d) To detect seasonal components in a time series	K1	CO4
8	How does an ARIMA model differ from an ARMA model? a) ARIMA includes a differencing step to handle non-stationarity b) ARIMA can only model seasonal data c) ARMA is a special case of ARIMA with an integrated order of 1 d) ARIMA requires a larger dataset compared to ARMA	K1	CO4
9	Which of the following is a qualitative forecasting method? a) Delphi Method b) ARIMA Model c) Moving Averages d) Exponential Smoothing	K1	CO5
10	Identify the main purpose of Akaike Information Criterion (AIC) a) To compare different time series models and select the best one b) To measure the stationarity of a dataset c) To find the optimal smoothing parameter for Exponential Smoothing d) To calculate the auto correlation coefficient	K1	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	Explain the components of time series with suitable examples.	K3	CO1
	(OR)		
11.b.	Compare Additive and Multiplicative Models in time series analysis.		
12.a.	What is Moving Average Smoothing? Explain different types of moving averages.	K3	CO2
	(OR)		
12.b.	Describe Holt and Winter's Models for time series smoothing.		
13.a.	Define Auto-Regressive (AR) and Moving Average (MA) models with examples.	K3	CO3
	(OR)		
13.b.	Explain the importance of ACF and PACF in time series analysis.		
14.a.	Describe the concept of Non-Stationary and the methods to test it.	K3	CO4
	(OR)		
14.b.	Discuss the Dickey-Fuller Test and its role in time series analysis.		
15.a.	Describe the steps involved in stochastic model building.	K4	CO5
	(OR)		
15.b.	Compare AIC, BIC, and Schwartz's Bayesian Criterion in model selection.	K3	

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	Explain Auto-covariance and Auto correlation Functions in time series analysis.	K4	CO1
17	Discuss in detail Single and Double Exponential Smoothing with examples.	K4	CO2
18	Elaborate ARMA and ARIMA models along with their statistical properties.	K4	CO3
19	What is Random Walk? Explain Random Walk with Drift with a real-world example.	K4	CO4
20	Bring out the nature and uses of forecasting and compare qualitative vs quantitative forecasting methods.	K4	CO5

Z-Z-Z END

(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2026

(Fourth Semester)

Branch - **STATISTICS**

MAJOR ELECTIVE COURSE – II DATA MINING AND WAREHOUSING

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	OLAP stands for (a) Online Analytical Processing (b) Online Analysis Processing (c) Online Transaction Processing (d) Online Aggregation Processing	K1	CO1
	2	Metadata is a ———— (a) Data about mining (b) Data about query (c) Data about data (d) Data about no data	K2	CO1
2	3	The synonym for data mining is (a) data warehouse (b) knowledge discovery in database (c) ETL (d) Business intelligence	K1	CO2
	4	An itemset whose support is greater than or equal to a minimum support threshold is _____ (a) Itemset (b) Frequent Itemset (c) Infrequent items (d) Threshold values	K2	CO2
3	5	Which of the following is a randomized algorithm? (a) CLARANS (b)BIRCH (c)AGES (d)CLARA	K1	CO3
	6	Decision tree is a ———— model. (a) predictive (b) descriptive (c) learning (d) both (a) and (b)	K2	CO3
4	7	What is the basic building block of a neural network? (a) Layer (b) Weight (c) Node (d) Neuron	K1	CO4
	8	In which type of neural network, the data is grouped based on its distance from a center point? (a) Convolution Neural Network (b) Recurrent Neural Network (c) Modular Neural Network (d) Radial Basis Functions Neural Network	K2	CO4
5	9	A _____ technique is used to crawl through various web sources to collect required information, which enables a individual or company to promote business. (a) Text mining (b) Web mining (c) Spatial mining (d) Time series mining	K1	CO5
	10	Text mining is the process of: (a) Extracting information from images (b) Analyzing structured data (c) Analyzing unstructured text data (d) Identifying relationships between variables	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Identify the problems in designing data warehouse schemas.	K3	CO1
		(OR)		
	11.b.	Identify the significant features of a data warehouse.		
2	12.a.	Classify Data Mining techniques.	K4	CO2
		(OR)		
	12.b.	Examine the application of data mining in Science data.		
3	13.a.	Compare CLARANS with CLARA.	K4	CO3
		(OR)		
	13.b.	Analyze the difficulties which arise when one uses a decision tree in a real-life situation.		
4	14.a.	Explain the principles and applications of rough set theory in data mining.	K4	CO4
		(OR)		
	14.b.	Discuss the learning techniques of MLP and RBF.		
5	15.a.	Explain Web Structure Mining.	K3	CO5
		(OR)		
	15.b.	Explain temporal data mining.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Explain the different models of data warehouse servers.	K4	CO1
2	17	Discover Association Rules from market-basket data.	K4	CO2
3	18	Construct a decision tree using classical algorithms.	K4	CO3
4	19	Outline a case study to illustrate the potential application of NN for Data Mining.C	K4	CO4
5	20	List out the significant features that are extracted to convert unstructured text to structured form.	K4	CO5

Z-Z-Z END

MSc DEGREE EXAMINATION MAY 2026

(Fourth Semester)

Branch – **STATISTICS**

STATISTICAL QUALITY CONTROL

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Which of the following is an example of common cause variation? a) A machine tool gradually wearing out b) A sudden power failure stopping production c) A new operator making frequent mistakes d) A batch of defective raw material	K1	CO1
	2	The np-chart differs from the p-chart because it a) monitors the proportion of defects instead of count b) requires a fixed sample size c) uses variable sample size d) tracts the number of defects per unit	K2	CO1
2	3	The moving average control chart is most suitable for which type of process? a) highly variable process with unpredictable changes b) stable process with gradual shifts c) process with frequent special causes of variation d) process with only attribute data	K1	CO1
	4	Recall the main advantage of a CUSUM control chart over a Shewhart $\bar{X}$– chart a) it reacts faster to small process shifts b) it require fewer data points c) it only detects large variation in data d) it does not require control limits	K2	CO1
3	5	When is a double sampling plan most beneficial? a) when inspection costs are low b) when quick decisions are required in all cases c) when sampling and inspection costs are high d) when all items must be checked	K1	CO1
	6	In a CSP-1 plan,when is 100% inspection required? a) always b) at the start of the production or after detecting a defect c) only when a lot is rejected d) when the customer requests it	K2	CO2
4	7	Identify the table in MIL-STD 414 that helps to determine the appropriate sample size? a) Table I b) Table II c) Table III d) Table IV	K1	CO2
	8	In MIL-STD 414 table ,the focal point (AQL) ranges from a) 0.03 to 12% b) 0.04 to 15% c) 0.05 to 20% d) 0.06 to 10%	K2	CO2
5	9	The hazard rate or failure rate function h(t) of the distribution function F is defined as a) $h(t)=\frac{f(t)}{1-F(t)}$ b) $h(t)=\frac{1-F(t)}{f(t)}$ c) $h(t)=\frac{1-f(t)}{F(t)}$ d) $h(t)=\frac{f(t)}{F(t)}$	K1	CO4
	10	In a system with two independent components in parallel having reliability of 0.7 and 0.6 , what is the system reliability? a) 0.42 b) 0.1 c) 1.3 d) 0.88	K2	CO4

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Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Explain the meaning and the scope of Statistical Quality Control.	K2	CO1
		(OR)		
	11.b.	Describe the construction of σ- chart and what situation it is used?		
2	12.a.	Elaborate how the control charts for moving averages are constructed.	K3	CO1
		(OR)		
	12.b.	Describe the V-mask control scheme.		
3	13.a.	State the situations in which acceptance sampling is preferable and also mention its advantages.	K3	CO2
		(OR)		
	13.b.	Write the assumptions clearly and the operating procedure of CSP-II.		
4	14.a.	Explain how will you obtain n and k for a variable sampling plan with known sigma.	K4	CO3
		(OR)		
	14.b.	Mention the five points to draw OC curve for sequential sampling plan and construct the curve.		
5	15.a.	If a system has one component with Weibull distribution , derive the failure rate of the system.	K5	CO4
		(OR)		
	15.b.	Elaborate IFR, DFR and its role in bath tub curve.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Bring out the procedure for construction of $\bar{X}$ and R charts.	K3	CO1
2	17	Desire the construction of two-sided CUSUM control charts.	K3	CO1
3	18	Obtain the expression for OC and AOQ for attribute single sampling plan.	K4	CO3
4	19	Derive one sided unknown sigma variable sampling plan.	K4	CO3
5	20	Estimate the parameter using MLE of exponential distribution and its reliability.	K5	CO4

Z-Z-Z END

(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2026

(Second Semester)

Branch – **STATISTICS**

ESTIMATION THEORY

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	An estimator whose expected value equals the true parameter is called _____ (i) consistent estimator (ii) efficient estimator (iii) unbiased estimator (iv) sufficient estimator	K1	CO1
	2	The Factorization Theorem is used to identify_____ (i) completeness (ii) sufficiency (iii) efficiency (iv) consistency	K2	CO1
2	3	Recall the outcome of the Cramer–Rao inequality. (i) upper bound for variance (ii) lower bound for variance (iii) mean squared error (iv) confidence interval	K1	CO2
	4	The Rao–Blackwell theorem helps in obtaining _____ (i) biased (ii) minimum variance unbiased estimator (iii) maximum likelihood estimator (iv) consistent estimator	K2	CO2
3	5	In the Method of Moments, parameters are estimated by equating ____ (i) variances (ii) sample moments with population moments (iii) likelihood functions (iv) derivatives	K1	CO3
	6	The estimator obtained by maximizing the likelihood function is called _____ (i) Bayes estimator (ii) Method of Moments estimator (iii) Maximum Likelihood estimator (iv) Efficient estimator	K2	CO3
4	7	A family of distributions written in exponential form is called _____ (i) Normal family (ii) Scale family (iii) Exponential family (iv) Location family	K1	CO4
	8	A Bayes estimator is obtained by minimizing _____ (i) likelihood (ii) posterior risk (iii) variance (iv) bias	K2	CO4
5	9	A confidence interval constructed using small sample theory for variance follows _____ (i) Normal distribution (ii) t-distribution (iii) Chi-square distribution (iv) F-distribution	K1	CO5
	10	The degrees of freedom for confidence interval of ratio of variances are _____ (i) $n_1 + n_2 - 2$ (ii) $n_1 - 1, n_2 - 1$ (iii) n_1, n_2 (iv) $n_1 - n_2$	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks $(5 \times 7 = 35)$

Module No.	Question No.	Question	K Level	CO
1	11.a.	Explain the concepts of unbiasedness and consistency of an estimator. Illustrate with suitable examples.	K3	CO1
		(OR)		
	11.b.	Let $X_1, X_2, \ldots, X_n$ be a random sample from a distribution with mean μ and variance σ^2. (a) Show that the sample mean $\bar{X}$ is an unbiased estimator of μ. (b) Prove that $\bar{X}$ is consistent.		
2	12.a.	State the Cramér–Rao inequality and Explain the conditions under which equality holds.	K3	CO2
		(OR)		
	12.b.	Let $X_1, \ldots, X_n \sim N(\mu, \sigma^2)$, where σ^2 is known. (a) Find the Fisher information for μ. (b) Obtain the Cramér–Rao lower bound. (c) Verify whether $\bar{X}$ is efficient.		
3	13.a.	Let $X_1, X_2, \ldots, X_n$ be a random sample from an exponential distribution with pdf: $f(x;\theta) = \frac{1}{\theta} e^{-x/\theta}, x > 0$ (a) Obtain the Maximum Likelihood Estimator of θ. (b) Show whether the estimator is unbiased or biased.	K3	CO3
		(OR)		
	13.b.	Compare Minimum chi – square and Modified Minimum chi – square method.		
4	14.a.	Define an Exponential Family of distributions. Explain how sufficiency arises naturally.	K3	CO4
		(OR)		
	14.b.	Let $X \sim \text{Binomial}(n, p)$ and assume prior $p \sim \text{Beta}(\alpha, \beta)$. (a) Obtain the posterior distribution of p. (b) Find the Bayes estimator of p under squared error loss.		
5	15.a.	Explain the concept of confidence interval and confidence bounds. What is a uniformly most accurate confidence bound?	K3	CO5
		(OR)		
	15.b.	Let $X_1, X_2, \ldots, X_n \sim N(\mu, \sigma^2)$, where σ^2 is known. (a) Construct a $100(1-\alpha)\%$ confidence interval for μ. (b) Obtain the length of the interval.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks $(3 \times 10 = 30)$

Module No.	Question No.	Question	K Level	CO
1	16	Let $X_1, X_2, \ldots, X_n$ be a random sample from exponential distribution: $f(x;\theta) = \theta e^{-\theta x}, x > 0$ (a) Obtain a sufficient statistic for θ. (b) Show that it is complete. (c) Hence derive the UMVUE of θ.	K4	CO1
2	17	State and Prove the Rao–Blackwell Theorem. Explain its practical significance.	K5	CO2
3	18	Let $X_1, \ldots, X_n \sim N(\mu, \sigma^2)$, where both parameters are unknown. Obtain the MLEs of μ and σ^2.	K4	CO3
4	19	Let $X_1, \ldots, X_n \sim \text{Binomial}(n, p)$ with Beta prior. (a) Obtain the posterior distribution. (b) Derive the Bayes estimator under squared error loss. (c) Compare with MLE.	K5	CO4
5	20	Obtain $100(1-\alpha)\%$ confidence limits (large samples) for the parameters 'λ' of the Poisson distribution.	K4	CO5

Z-Z-Z END

MSc DEGREE EXAMINATION MAY 2026

(Second Semester)

Branch - **STATISTICS**

LINEAR MODELS AND DESIGN OF EXPERIMENTS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks $(10 \times 1 = 10)$

Module No.	Question No.	Question	K Level	CO
1	1	What is the defining characteristic of the Best Linear Unbiased Estimator (BLUE)? (i) It has the minimum variance among all linear unbiased estimators. (ii) It is the estimator with the minimum variance among all possible unbiased estimators. (iii) It is the linear estimator that is most robust to outliers in the dataset. (iv) It minimizes the bias for any given linear combination of parameters.	K1	CO1
	2	In the general linear model $Y=X\beta+\varepsilon$, the error vector ε is assumed to have (i) Mean β (ii) Mean 1 (iii) Mean 0 (iv) Mean $X\beta$	K2	CO1
2	3	Confounding occurs when (i) Treatments are replicated (ii) Treatments are randomized (iii) Treatment effects are mixed with block effects (iv) Blocks are eliminated	K1	CO2
	4	Which of the following best describes an asymmetrical (or mixed-level) factorial design? (i) A design where the number of replicates is unequal across treatment groups. (ii) An experiment where the factors involved do not all have the same number of levels. (iii) A design where only a fraction of the full treatment combinations are run. (iv) An experiment where blocks have varying sizes.	K2	CO2
3	5	In Resolution III designs, main effects are aliased with (i) Main effects (ii)Two-factor interactions (iii) Three-factor interactions only (iv) Error	K1	CO3
	6	Recall the purpose of ANCOVA _____ (i) Increase bias (ii) Eliminate treatments (iii) Adjust treatment means using covariates (iv) Remove replication	K2	CO3
4	7	Identify the fundamental relation in BIBD (i) $\lambda(v-1) = r(k-1)$ (ii) $\lambda v = rk$ (iii) $r = v$ (iv) $b = k$	K1	CO4
	8	In PBIBD, treatment pairs are (i) Occurring together equal number of times (ii) Not occurring together (iii) Occurring together in different frequencies (iv) Always independent	K2	CO4
5	9	Mention the use of Response surface methodology (i) Optimization problems (ii) Eliminating error (iii) Avoiding interactions (iv) Complete randomization only	K1	CO5
	10	Bio-assay is mainly used to (i) Estimate variance (ii) Measure potency of a substance (iii) Reduce error (iv) Increase replication	K2	CO5

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SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	What is a general linear model? State the Gauss–Markov assumptions.	K3	CO1
		(OR)		
	11.b.	Define BLUE. Show that the least squares estimator is linear and unbiased.		
2	12.a.	Derive the model for a 2^3 factorial experiment and describe the estimation of main and interaction effects.	K4	CO2
		(OR)		
	12.b.	What is confounding in factorial experiments? Explain complete and partial confounding with suitable examples.		
3	13.a.	Explain the construction and analysis of a half replicate in a 2^3 factorial experiment.	K4	CO3
		(OR)		
	13.b.	Describe the analysis of Split – plot design. Illustrate.		
4	14.a.	Write a note on Youden Square & Lattice Designs.	K5	CO4
		(OR)		
	14.b.	Define a Partially Balanced Incomplete Block Design (PBIBD). Explain the properties of its parameters.		
5	15.a.	Define bio-assay. Distinguish between direct and indirect bio-assay methods.	K5	CO5
		(OR)		
	15.b.	Explain the concept of cross-over design. Illustrate		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Describe the general linear model. Derive the least squares estimator and prove that it is the Best Linear Unbiased Estimator (BLUE) under Gauss–Markov assumptions.	K4	CO1
2	17	Construct 2^4 factorial experiment by confounding higher order interaction and Test its significance with Anova table.	K5	CO2
3	18	Define nested design. Derive the statistical model for a two-way nested design and explain the F-tests used in analysis.	K5	CO3
4	19	Define a Balanced Incomplete Block Design (BIBD). Derive the relationships among its parameters and explain its properties.	K5	CO4
5	20	Delineate about response surface design and derive the design.	K5	CO5

Z-Z-Z END

MSc DEGREE EXAMINATION MAY 2026

(Second Semester)

Branch - **STATISTICS**

DISTRIBUTION THEORY

Time: Three Hours | Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	If X and Y are independent normal variables, the distribution of X− Y is a) Normal b) t c) χ^2 d) Poisson	K1	CO1
	2	If $Y=X^2$and X has pdf f(x), the pdf of Y is obtained using a) Transformation method b) Convolution theorem c) Bayes rule d) Taylor expansion	K2	CO1
2	3	For a sample of size 'n', the largest order statistic is a) $X_{(1)}$ b) $X_{(n)}$ c) $X_{(n-1)}$ d) Mean	K1	CO2
	4	When the t-distribution becomes normal a) $n \rightarrow 1$ b) $n \rightarrow \infty$ c) $n = 2$ d) variance = 0	K2	CO2
3	5	A p-dimensional normal distribution is characterized by a) p means b) covariance matrix c) mean vector and covariance matrix d) variance	K1	CO3
	6	The covariance matrix of MVN distribution is a) symmetric b) skew symmetric c) diagonal always d) triangular	K2	CO3
4	7	Wishart distribution is defined for a) scalar variables b) matrices c) vectors only d) constants	K1	CO4
	8	Recall the usage of Hotelling T^2 statistic its test _____ a) mean vector b) variance c) correlation d) regression	K2	CO4
5	9	State the use of Discriminant analysis a) classification of observations b) regression c) clustering d) sampling	K1	CO5
	10	Principal Component Analysis converts correlated variables into _____ a) dependent variables b) orthogonal components c) identical variables d) random variables	K2	CO5

Cont...

Module No.	Question No.	Question	K Level	CO
1	11.a.	Delineate about distribution function. State its properties.	K3	CO1
		(OR)		
	11.b.	Explain the distribution of the product of two random variables.		
2	12.a.	Derive the pdf of r^{th} Order statistics.	K4	CO2
		(OR)		
	12.b.	Describe t distribution with its assumptions and conditions. Illustrate any one application.		
3	13.a.	Obtain the characteristic function of multivariate normal distribution.	K5	CO3
		(OR)		
	13.b.	Bring out the distribution of Quadrate functions in normal variables.		
4	14.a.	Define Wishart distribution. State any two properties of Wishart distribution.	K4	CO4
		(OR)		
	14.b.	Briefly explain the concept of Mahalanobis D^2 distribution.		
5	15.a.	What is canonical correlations? Mention the purpose of canonical correlation analysis.	K4	CO5
		(OR)		
	15.b.	Write a note on Discriminant Analysis & Cluster Analysis.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks $(3 \times 10 = 30)$

Module No.	Question No.	Question	K Level	CO
1	16	Derive the probability mass function of Binomial distribution truncated at $x = 0$. Obtain its mean and variance.	K3	CO1
2	17	Derive non – central Chi-square distribution.	K4	CO2
3	18	Estimate the mean vector and the covariance matrix of a multivariate normal distribution.	K5	CO3
4	19	Bring out the test procedure for Mahalanobis D^2 statistic and its comparison with T^2. State the significance of Mahalanobis D^2.	K5	CO4
5	20	Let X be a p – variate random variable with covariance matrix Σ. Derive the first principal component of X.	K5	CO5

Z-Z-Z END

MSc DEGREE EXAMINATIONS MAY 2026
(First Semester)

Branch- **STATISTICS**

APPLIED OPERATIONS RESEARCH

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Post-optimality analysis studies a) Changes in demand b) Sensitivity of optimal solution c) Simulation methods d) ABC classification	K1	CO1
	2	A Pure Integer Programming problem means a) Some variables are integers, some continuous b) All decision variables are integers c) No variables are integers d) Only binary values allowed	K2	CO1
2	3	In EOQ model, the trade-off is between a) Ordering cost and holding cost b) Demand and lead time c) Purchase cost and shortage cost d) Ordering cost and purchase cost	K1	CO2
	4	In probabilistic inventory models, demand is a) Always constant b) Always zero c) Variable and uncertain d) Infinite	K2	CO2
3	5	In queuing notation (M/M/C), 'C' denotes: a) Capacity of system b) Number of servers c) Number of customers d) Service discipline	K1	CO3
	6	The most common discipline in queuing is a) LCFS b) FCFS c) SIRO d) Priority service	K2	CO3
4	7	In PERT, activity times are assumed to follow a) Normal distribution b) Exponential distribution c) Beta distribution d) Poisson distribution	K1	CO4
	8	Monte Carlo method is used for a) Linear programming b) Simulation of random processes c) Critical path calculation d) ABC analysis	K2	CO4
5	9	Quadratic programming deals with a) Linear objective & linear constraints b) Quadratic objective & linear constraints c) Non-linear objective & non-linear constraints d) Simulation-based optimization	K1	CO5
	10	Constraints in goal programming are expressed as a) Probabilities b) Goals and priorities c) Integer values only d) Random variables	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Explain the steps involved in the Dual Simplex Method.	K4	CO1
		(OR)		
	11.b.	Using Integer Programming problem solve the following Maximize $Z=4x_1+3x_2$ subject to $x_1+2x_2 \leq 5$, $x_1, x_2 \geq 0$and integers.		
2	12.a.	Explain the concept of ABC Analysis.	K2	CO2
		(OR)		
	12.b.	Derive the EOQ formula for a deterministic model without shortage.		
3	13.a.	Explain the M/M/1 queueing model.	K4	CO3
		(OR)		
	13.b.	Explain the main performance measures in queuing models.		
4	14.a.	Explain the following (i) Resource allocation (ii) Resource Levelling	K5	CO4
		(OR)		
	14.b.	Explain Monte Carlo Simulation.		
5	15.a.	Explain Non-linear Programming Problem (NLPP).	K5	CO5
		(OR)		
	15.b.	Explain Goal Programming with a simple example.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Write short notes on Post Optimal Analysis in Linear Programming.	K2	CO1
2	17	Explain Probabilistic Inventory Models.	K4	CO2
3	18	Explain the classification of queuing models with examples.	K4	CO3
4	19	Explain in detail Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) with differences.	K5	CO4
5	20	Explain the Kuhn–Tucker conditions and their role in solving Non-linear Programming Problems.	K5	CO5

Z-Z-Z END

MSc DEGREE EXAMINATION MAY 2026

(First Semester)

Branch – STATISTICS

SAMPLING THEORY AND METHODS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	Stratified sampling comes under the category of (i) unrestricted sampling (ii) subjective sampling (iii) purposive sampling (iv) restricted sampling	K1	CO1
	2	Which of the following statements does not hold good in case of stratified sampling? (i) stratified sampling is convenient (ii) stratified sampling is always good (iii) enables to gather information about different stratum separately (iv) reduces error for fixed cost	K1	CO1
2	3	Systematic sampling means (i) selection of n contiguous units (ii) selection of n units situated at equal (iii) selection n largest units (iv) selection of n middle units in a sequence	K1	CO2
	4	Selected units of a systematics sample are (i) not easily locatable (ii) easily locatable (iii) not in whole population (iv) all the above	K1	CO2
3	5	A population is divided into clusters and it has been found that all items within a cluster are alike. Which of the following sampling procedures would you adopt? (i) simple random sampling (ii) cluster sampling (iii) systematics sampling (iv) stratified sampling	K1	CO3
	6	Supposing that, in cluster sampling s_w^2 represents the variance within the clusters and s_b^2 between clusters. what is the relation between s_b^2 and s_w^2? (i) $s_w^2 = s_b^2$ (ii) $s_w^2 \geq s_b^2$ (iii) $s_w^2 \leq s_b^2$ (iv) $s_w^2 \neq s_b^2$	K2	CO3
4	7	Two stage sampling design is more efficient than single stage sampling if the correlation between units in the first stage is (i) negative (ii) positive (iii) zero (iv) none of the above	K1	CO4
	8	Double sampling is also known as (i) two-stage sampling (ii) two-phase sampling (iii) two-directional sampling (iv) all the above	K2	CO4
5	9	If the mean of the sampling distribution is equal to the parameters then estimators will be (i) biased (ii) consistent (iii) sufficient (iv) unbiased	K1	CO5
	10	To find sample size we must have estimate of (i) mean (ii) variance (iii) frequency (iv) none of the above	K2	CO5

Cont...

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	If $\bar{y}_{st}$ is an unbiased estimator of the population mean $\bar{Y}_N$, then prove that $E(\bar{y}_{st}) = \bar{Y}_N$.	K5	CO1
		(OR)		
	11.b.	Explain the advantages of stratified random sampling with illustration.	K2	CO1
2	12.a.	Prove that the variance of systematic sampling $Var(\bar{y}_{sys}) = \frac{(k-1)}{nk} S^2_{wst}[1 + (n-1)P_{wst}]$.	K5	CO2
		(OR)		
	12.b.	Obtain the relative efficiency of systematic sampling when compared to simple random sampling.	K2	CO2
3	13.a.	Prove that mean and variance of cluster sampling method.	K5	CO3
		(OR)		
	13.b.	Estimate the mean and variance of unequal cluster sampling method.	K2	CO3
4	14.a.	Estimate the mean and variance of two stage sampling with unequal first stage units.	K5	CO4
		(OR)		
	14.b.	Explain three stage probability proportional size sampling method with an example.	K2	CO4
5	15.a.	Distinguish between ratio and regression estimator with mean per unit.	K2	CO5
		(OR)		
	15.b.	Estimate the variance of difference estimator.	K5	CO5

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Prove that the inequality $V_{opt}(\bar{Y}) \leq V_{prop}(\bar{Y}) \leq V_{ran}(\bar{Y})$.	K5	CO1
2	17	If the population consists of a systematic liner trend, $Y_i = i; i = 1,2,\ldots,k$ then prove that $V(\bar{y}_{st}) \leq V(\bar{y}_{sys}) \leq V(\bar{y}_n)_R$.	K6	CO2
3	18	State Hurwitz – Thompson estimator and derive the variance.	K5	CO3
4	19	Explain the two stage sampling methods with equal number of second stage units.	K2	CO4
5	20	Prove that the variance of ratio estimator in simple random sampling without replacement technique.	K5	CO5

Z-Z-Z END

(AUTONOMOUS)

MSc DEGREE EXAMINATION MAY 2026

(First Semester)

Branch- **STATISTICS**

REAL ANALYSIS AND LINEAR ALGEBRA

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Question	K Level	CO
1	The infimum of the set $\{1/n : n \in N\}$ is: (a) 0 (b) 1 (c) ∞ (d) –1	K1	CO1
2	Every convergent sequence is: (a) Bounded (b) Divergent (c) Monotonic (d) not monotonic	K2	CO1
3	If $f(x) = \sin x$, then $f'(x) = ?$ (a) $\cos x$ (b) $-\cos x$ (c) $-\sin x$ (d) 1	K1	CO2
4	A function f(x) is continuous at x = a if: (a) f(a) = 0 (b) lim f(x) = f(a) (c) $f(x) \to \infty$ (d) f(x) = 0	K2	CO2
5	The Riemann integral of f(x)=1 on [0,1] is: (a) 0 (b) ½ (c) 1 (d) ∞	K1	CO3
6	If $f(x) = x^2$, then the Riemann integral of f(x) over [0,2] is: (a) 2 (b) 8/3 (c) 4 (d) 2/3	K2	CO3
7	The null space of a linear transformation T consists of all vectors: (a) Mapped to zero (b) Mapped to identity c) Mapped to non-zero (d) mapped to one	K1	CO4
8	The Gram-Schmidt process is used to: (a) Find determinant (b) Orthogonalize vectors c) Find eigenvalues (d) Invert matrix	K2	CO4
9	If A is a 2X2 matrix with determinant $\neq 0$, then A is: (a) Not invertible (b) Invertible c) Singular (d) Nilpotent	K1	CO5
10	A quadratic form is positive definite if: (a) All eigenvalues positive (b) All eigenvalues negative c) At least one eigenvalue zero (d) both positive & negative	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	State and prove the Bolzano–Weierstrass theorem.	K2	CO1
	(OR)		
11.b.	Explain the properties of uniform convergence.		
12.a.	State and prove Mean Value Theorem for differentiable functions.	K3	CO2
	(OR)		
12.b.	Find local maxima and minima of $f(x,y) = x^2 + y^2 - 4x - 2y + 6$.		
13.a.	Explain Riemann integral. Also state its properties.	K5	CO3
	(OR)		
13.b.	Explain the properties of Riemann – Stieltjes integral.		
14.a.	Apply Gram–Schmidt process to orthogonalize {(1,1,1), (1,1,–1)} in $\mathbb{R}^3$.	K3	CO4
	(OR)		
14.b.	Define vector space. Show that the set of all 2×2 matrices forms a vector space under matrix addition and scalar multiplication.		
15.a.	Determine the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 4 & 1 \\ 3 & 2 \end{bmatrix}$.	K5	CO5
	(OR)		
15.b.	State the properties of G-inverse.		

SECTION –C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	Explain point-wise and uniform convergence of a sequence of functions. Also prove that uniform limit of continuous functions is continuous.	K2	CO1
17	State and prove the Mean Value Theorem for two variables and illustrate with an example.	K3	CO2
18	State and prove the Fundamental Theorem of Integral Calculus.	K4	CO3
19	Explain linear transformation. Find the matrix linear transformation $T:R^2 \rightarrow R^2$ given by T(x,y) = (X+2y, 3x+y).	K5	CO4
20	Reduce the quadratic form $2x_1^2 + x_2^2 + x_3^2 + 2x_1x_2 - 2x_1x_3 - 4x_2x_3$ to canonical form through an orthogonal transformation.	K5	CO5

Z-Z-Z END