INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Mathematics Department**

1. Subject Code: **MAN-001** Course Title: **Mathematics I**

2. Contact Hours: **L: 3** **T: 1** **P: 0**

3. Examination Duration (Hrs.): **Theory** 3 **Practical** 0

4. Relative Weightage**:** **CWS** 25 **PRS** 00 25 50 0

5. Credits**:** 4 6. Semester**: Autumn** 7. Subject Area**: BSC**

8. Pre-requisite**:** **None**

9. Objective: To provide essential knowledge of basic tools of Differential Calculus, Integral Calculus , Vector Calculus and Matrix Algebra for degree students.

10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Matrix Algebra:** Elementary operations and their use in getting the Rank, Inverse of a matrix and solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties. Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	8
2.	**Differential Calculus:** Limit, Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Error approximations. Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers	12
3.	**Integral Calculus:** Review of curve tracing and quadric surfaces, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions. Dirichlet's integral. Applications of Multiple integrals such as surface area, volumes, centre of gravity and moment of inertia..	12
4.	**Vector Calculus:** Differentiation of vectors, gradient, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl. Line and surface integrals. Green's, Gauss and Stroke's theorem and their applications.	10
	Total	42

11. Suggested Books:

S. No.	Name of Authors/ Books/Publishers	Year of Publication/Reprint
1.	E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K.	2011
2.	R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House.	2005
3.	M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education.	2008

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

1. Subject Code: **MAN-002** Course Title: **Mathematical Methods**
2. Contact Hours: **L: 3** **T: 1** **P: 0**
3. Examination Duration (Hrs.): **Theory : 3** **Practical : 0**
4. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE : 25** **ETE : 50** **PRE: 0**
5. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**
8. Pre-requisite**: Nil**
9. Objective: To provide knowledge of essential mathematical tools applied in solving ordinary and partial differential equations, initial and boundary value problems.
10. Details of Course:

S. No.	Contents	Contact Hours
1.	**Ordinary Differential Equations:** Solution of linear differential equations with constant coefficients. Euler-Cauchy equations, Solution of second order differential equations by changing dependent and independent variables. Method of variation of parameters, Introduction to series solution method.	**10**
2.	**Partial Differential Equations:** Formation of first and second order partial differential equations. Solution of first order partial differential equations: Lagrange`s equation, Four standard forms of non-linear first order equations .	**6**
3.	**Laplace Transform:** Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem, Initial and final value theorem. Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Applications of Laplace transform.	**10**
4.	**Z - Transform:** Z – transform and inverse Z-transform of elementary functions, Shifting theorems, Convolution theorem, Initial and final value theorem. Application of Z- transform to solve difference equations.	**5**
5.	**Fourier series:** Trigonometric Fourier series and its convergence. Fourier series of even and odd functions. Fourier half-range series. Parseval`s identity. Complex form of Fourier series.	**5**
6.	**Fourier Transforms:** Fourier integrals, Fourier sine and cosine integrals. Fourier transform, Fourier sine and cosine transforms and their elementary properties. Convolution theorem. Application of Fourier transforms to BVP.	**6**

Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Kreyszig, E., "Advanced Engineering Mathematics", Johan Wiley & Sons	2011
2.	Jain, R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", Narosa Publishing House	2009
3.	Amarnath, T., "An Elementary Course in Partial Differential Equations", Narosa Publishing House (II Edition)	2012
4.	Hildebrand F. B., "Methods of Applied Mathematics", Courier Dover Publications	1992
5.	Rao, K. S., "Introduction to Partial Differential Equations", PHI Learning Pvt. Ltd. (II Edition)	2010
6.	Sneddon, I. N., " Elements of Partial Differential Equations", McGraw-Hill Book Company	1988
7.	Simmons, G. F. and Krantz, S. G., Differential Equations:Theory, Technique and Practice" , Tata McGraw-Hill Edition	2007

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

6. Subject Code: **MAN-004** Course Title: **Numerical Methods**

7. Contact Hours: **L: 3** **T: 1** **P: 0**

8. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

9. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

10. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

9. Pre-requisite**: Nil**

10. Objective: To introduce various numerical methods to get approximation solutions.

11. Details of Course:

S.No.	Contents	Contact Hours
1	**Error Analysis**: Exact and approximate numbers, Rounding of numbers, Significant digits, Correct digits, various types of errors encountered in computations, Propagation of errors.	**3**
2	**Solution of system of linear equations**: (i) Direct methods: Gauss elimination method without pivoting and with pivoting, LU-decomposition method. (ii) Iterative methods: Jacobi and Gauss-Seidel methods.	**8**
3	Roots of non-linear equations: Bisection method, Regula-Falsi method, Newton-Raphson method, direct iterative method with convergence criteria, Newton-Raphson method for solution of a pair of non-linear equations.	**6**
4	Eigen values and Eigen vectors: Dominant and smallest Eigen values/Eigen vectors by power method.	**3**
5	Interpolation: Finite difference operator and their relationships, difference tables, Newton, Bessel and Stirling's interpolation formulae, Divided differences, Lagrange interpolation and Newton's divided difference interpolation.	**6**
6	Numerical differentiation: First and second order derivatives by various interpolation formulae.	**4**
7.	Numerical integration: Trapezoidal, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules with errors and their combinations, Gauss Legendre 2-points and 3-points formulae	**6**
8.	Solution of first and second order ordinary differential equations: Picard's method, Taylor's series method, Euler, Modified Euler, Runge-	**4**

	Kutta methods and Milne's method.	
9.	Case studies	**2**
	Total	**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Gerald, C. F. and Wheatly, P. O.," Applied Numerical Analysis", 6th Edition, Wesley.	2002
2	Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", New Age Pvt. Pub, New Delhi.	2000
3	Conte, S. D. and DeBoor, C., "Elementary Numerical Analysis", McGraw-Hill Publisher	1982
4	Krishnamurthy, E. V. & Sen, S. K., "Applied Numerical Analysis", East West Publication.	1998

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

11. Subject Code: **MAN-006** Course Title: **Probability and Statistics**

12. Contact Hours: **L: 3** **T: 1** **P: 0**

13. Examination Duration (Hrs.): **Theory: 3** **Practical: 0**

14. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

15. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

12. Pre-requisite**: Nil**

13. Objective: To impart techniques of Probability and Statistics.

14. Details of Course:

S.No.	Contents	Contact Hours
1	Concept of probability, random variable and distribution function: discrete and continuous, moments and moment generating functions.	**9**
2	Special distributions (discrete): Binomial, Poisson, Negative binomial, Geometric. (continuous): Uniform, Exponential, Gamma, Beta, Normal, Lognormal.	**9**
4	Bivariate random variables: joint, marginal, conditional distribution. Statistical independence, product moment.	**3**
5	Random sample, law of large numbers, central limit theorem, correlation, regression.	**7**
6	Estimation: maximum likelihood estimation, unbiasedness and efficiency, interval estimation for normal population with normal, t, χ^2 distribution.	**7**
7	Testing of Hypothesis: Simple and composite hypothesis, Type I and type II errors. Power of test. Some tests for normal population parameters based on normal, t, χ^2 distribution.	**7**
	TOTAL	**42**

11. Suggested Books:

S.No.	Title/Authors/Publishers	Year of Publication
1.	Rohatgi, V K. and Saleh , A. K. Md. Ehsanes, "An Introduction to Probability and Statistics", (John Wiley and Sons) , (2^{nd} edition)	2000
2.	Hogg, R. V. and Craig, A., "Probability and Statistical Inference", (Pearson Education), (6^{th} Edition)	2006

3.	Johnson, R. A., Miller, I. and Freund, J. E., "Miller & Freund's probability and statistics for engineers", (Prentice Hall PTR), (8^{th} edition)	2011
4.	Hines, W. W., Montgomery, D. C., Goldsman, D. M. and Borror, C. M., "Probability and Statistics in Engineering", (John Wiley & sons), (4^{th} Edition)	2003
5.	Papoulis, A. and Pillai, S. U., "Probability, Random Variables and Stochastic Processes", (Tata McGraw-Hill), (4^{th} edition)	2002

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: **Department of Mathematics**

16. Subject Code: **MAN-010** Course Title: **Optimization Techniques**

17. Contact Hours: **L: 3** **T: 1** **P: 0**

18. Examination Duration (Hrs.): **Theory: 3** **Practical : 0**

19. Relative Weightage**:** **CWS: 25** **PRS: 0** **MTE: 25** **ETE: 50** **PRE: 0**

20. Credits**: 4** 6. Semester**: Spring** 7. Subject Area**: BSC**

15. Pre-requisite**: Nil**

16. Objective: To acquaint the students with the basic concepts of Optimization.

17. Details of Course

S. No.	Contents	Contact Hours
1	Different Types of OR Models, Case studies in Engineering applications	**2**
2	Convex Sets, Graphical Method, Simplex Method, Big – M Method, Two Phase Method, Revised Simplex Method	**10**
3	Duality Theory, Dual Simplex Method, Sensitivity Analysis	**7**
4	Cutting Plane and Branch and Bound Techniques for all Integer and Mixed Integer Programming Problems, 0-1 Integer Problems, Travelling Salesman Problem, Cargo Loading Problem	**9**
5	Transportation Problems and Assignment Problems	**4**
6	Game Theory: Rectangular Games, Minmax Theorem, Graphical Solution of 2 X n and m X 2 games, Reduction to Linear Programming Problems	**5**
7	Sequencing and Scheduling: Processing of Jobs through Machines, CPM and PERT	**5**
	TOTAL	**42**

18. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1	Taha, H.A., "Operations Research: An Introduction", MacMillan Pub Co., NY, Ninth Edition (Reprint).	2013
2.	Ravindran, A., Phillips, D.T. and Solberg, J.J., "Operations Research: Principles and Practice", John Wiley and Sons, NY, Second Edition (Reprint).	2012
3.	Pant, J.C., "Introduction to Optimization", Jain Brothers,	2012
4.	Hillier, F. S. and Lieberman, G. J., "Introduction to Operations Research," 9th Edition, McGraw-Hill	2009
5.	Mittal, K.V. and Mohan, C., "Optimization Methods in System Analysis and Operations Research"	1996
6.	Mohan C. and Deep K., "Optimization Techniques"	2009