**Template 6 : Course Learning Syllabus**

**Course Learning Syllabus** *( // includes Learning Outcomes & Learning Plan & Assessment Plan )*

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| **Course Code** | 18MAB101T | **Course Name** | CALCULUS AND LINEAR ALGEBRA | **Course Category** | *BS* | *Basic Sciences* | L | T | P | C |
| 3 | 1 | 0 | 4 |

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| **Pre-requisite Courses** | *Nil* | | **Co-requisite Courses** | *NIl* | | **Progressive Courses** | *Nil* |
| **Course Offering Department** | | *Mathematics* | | | **Data Book / Codes/Standards** | *nil* | |

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| **Course Learning Rationale (CLR):** | | | *The purpose of learning this course is to:* |  | **Learning** | | |  | **Program Learning Outcomes (PLO)** | | | | | | | | | | | | | | |
| **CLR-1 :** | *Application of Matrices in problems of Science and Engineering* | | |  | 1 | 2 | 3 |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **CLR-2 :** | *To apply the concept of Taylor series, Maxima minima, composite function and Jacobian in problems of science and Engineering* | | |  | Level of Thinking (Bloom) | Expected Proficiency (%) | Expected Attainment (%) |  | Engineering Knowledge | Problem Analysis | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethics | Individual & Team Work | Communication | Project Mgt. & Finance | Life Long Learning | PSO - 1 | PSO - 2 | PSO - 3 |
| **CLR-3 :** | *To Apply the concept of Differential Equations in problems of Science and Engineering* | | |  |  |
| **CLR-4 :** | *To apply the concepts of radius of curvature, evolute, envelope in problems of Science and Engineering* | | |  |  |
| **CLR-5 :** | *Application of Sequences and Series in all problems involving Science and Engineering* | | |  |  |
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| **Course Learning Outcomes (CLO):** | | | *At the end of this course, learners will be able to:* | |  |
| **CLO-1 :** | *Apply the Knowledge of Matrices, Eigenvalues and Eigen Vectors Reduce to Quadratics form in problems involving Science and Engineering* | | | | 2 | 85 | 80 |  | L |  | L |  |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-2 :** | *Gain familiarity in the knowledge of Maxima and Minima, Jacobian, and Taylor series and apply them tn the problems involving Science and Engineering* | | | | 2 | 85 | 80 |  | L |  |  | M | M |  |  |  |  |  |  |  |  |  |  |
| **CLO-3 :** | *Gain knowledge in solution of Differential Equations and Its applications in engineering problems* | | | | 2 | 85 | 80 |  |  | M |  |  |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-4 :** | *To gain the knowledge of Radius, Centre, envelopre and Circle of of curvature and apply them in the problems involving Science and Engineering* | | | | 2 | 85 | 80 |  | L | M |  | M |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-5 :** | *Gain the knowledge of convergence and divergence of series using different test and apply sequences and Series in the problems involving Science and Engineering* | | | | 2 | 85 | 80 |  |  | M | L |  |  |  |  |  | M |  |  | H |  |  |  |
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|  | | **Learning Unit / Module 1** | **Learning Unit / Module 2** | **Learning Unit / Module 3** | **Learning Unit / Module 4** | **Learning Unit / Module 5** |
| Duration (hour) | | **12** | **12** | **12** | **12** | **12** |
| **S-1** | SLO-1 | Characteristic equation | Function of two variables – Partial derivatives | Linear equations of second order with constant coefficients when PI=0 or exponential | Radius of Curvature – Cartesian coordinates | Series of Five terms – Test of Convergence- |
| SLO-2 | Eigen values of a real matrix | Total differential | Linear equations of second order with constant coefficients when PI=sinax or cosax | Radius of Curvature – Cartesian coordinates | Comparison test – Integral test- |
| **S-2** | SLO-1 | Eigen vectors of a real matrix | Total differential | Linear equations of second order with constant coefficients when PI=polynomial | Radius of Curvature – Polar coordinates | Comparison test – Integral test- |
| SLO-2 | Eigen vectors of a real matrix | Taylor’s expansion with two variables up to second order terms | Linear equations of second order with constant coefficients when PI=exponential with sinax or Cosax | Radius of Curvature – Polar coordinates | Comparison test – Integral test-. |
| **S-3** | SLO-1 | Properties of Eigen values | Taylor’s expansion with two variables up to third order terms | Linear equations of second order with constant coefficients when PI= exponential with polynomial | Circle of curvature | D’Alemberts Ratio test, |
| SLO-2 | Cayley – Hamilton theorem | Maxima and Minima | Linear equations of second order with constant coefficients when PI=polynomial with sinhax or coshax | Circle of curvature | D’Alemberts Ratio test, |
| **S-4** | SLO-1 | Problem solving using tutorial sheet 1 | Problem solving using tutorial sheet 4 | Problem solving using tutorial sheet 6 | Problem solving using tutorial sheet 11 | Problem solving using tutorial sheet 14 |
| SLO-2 | Problem solving using tutorial sheet 1 | Problem solving using tutorial sheet 4 | Problem solving using tutorial sheet 6 | Applications of Radius of curvature in engineering | Problem solving using tutorial sheet 14 |
| **S-5** | SLO-1 | Finding A inverse using Cayley – Hamilton theorem | Maxima and Minima | Linear equations of second order variable coefficients | Centre of curvature | Raabe’s root test. |
| SLO-2 | Finging higher powers of A using Cayley – Hamilton theorem | Maxima and Minima | Linear equations of second order variable coefficients | Centre of curvature | Raabe’s root test. |
| **S-6** | SLO-1 | orthogonal reduction of a symmetric matrix to diagonal form | Maxima and Minima | Homogeneous equation of Euler type | Centre of curvature | Covergent of Exponential Series |
| SLO-2 | orthogonal reduction of a symmetric matrix to diagonal form | Constrained Maxima and Minima by Lagrangian Multiplier  method | Homogeneous equation of Legendre’s Type | Evolute of a parabola | Cauchy’s Root test |
| **S-7** | SLO-1 | orthogonal reduction of a symmetric matrix to diagonal form | Constrained Maxima and Minima by Lagrangian Multiplier  method | Homogeneous equation of Legendre’s Type | Evolute of an ellipse | Log test |
| SLO-2 | orthogonal reduction of a symmetric matrix to diagonal form | Constrained Maxima and Minima by Lagrangian Multiplier  method | Equations reducible to homogeneous form | Envelope of standard curves | Log test |
| **S-8** | SLO-1 | Problem solving using tutorial sheet 2 | Problem solving using tutorial sheet 5 | Problem solving using tutorial sheet 9 | Problem solving using tutorial sheet 12 | Problem solving using tutorial sheet 15 |
| SLO-2 | Problem solving using tutorial sheet 2 | Problem solving using tutorial sheet 5 | Problem solving using tutorial sheet 9 | Applications of Curvature in engineering | Problem solving using tutorial sheet 15 |
| **S-9** | SLO-1 | Reduction of Quadratic form to canonical | Jacobians of two Variables | Equations reducible to homogeneous form | Beta Gamma Functions | Alternating Series: Leibnitz test |
| SLO-2 | Quadratic form to canonical form by orthogonal transformations | Jacobians of Three variables | Variation of parameters | Beta Gamma Functions and Their Properties | Alternating Series: Leibnitz test |
| **S-10** | SLO-1 | Quadratic form to canonical form by orthogonal transformations | Jacobians problems | Variation of parameters | Sequences – Definition and Examples | Series of positive and Negative terms. |
| SLO-2 | Orthogonal matrices | Jacobians Problems | Simultaneous first order with constant co-efficient. | Series – Types of Convergence | Series of positive and Negative terms. |
| **S-11** | SLO-1 | Reduction of quadratic form to canonical form | Properties of Jacobians and Problems | Simultaneous first order with constant co-efficient. | Series of Five terms – Test of Convergence- | Absolute Convergence |
| SLO-2 | Reduction of quadratic form to canonical form | Properties of Jacobians and problems | Simultaneous first order with constant co-efficient. | Comparison test – Integral test- | Conditional Convergence |
| **S-12** | SLO-1 | Problem solving using tutorial sheet 3 | Application of Taylor’s series Maxima Minima Jacobians in Engineering | Problem solving using tutorial sheet 10 | Problem solving using tutorial sheet 13 | Problem solving using tutorial sheet 13 |
| SLO-2 | Applications of Matrices in Engineering | Application of Taylor’s series Maxima Minima Jacobians in Engineering | Applications of Differential Equation in engineering | Problem solving using tutorial sheet 13 | Applications Convergence of series in engineering |
|  |  |  |  |  |  |
| **Learning**  **Resources** | | 1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006. 2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010. 3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008 4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010 5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002 6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008 | | | | |
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|  | **Level of Thinking** | **Continuous Assessment** | | | **Final Examination (40%)** |
| **CA – 1 (20%)** | **CA – 2 (20%)** | **CA – 3 (20%) #** |
| **Level 1** | **Remember** | **40 %** | **30 %** | **30 %** | **30 %** |
| **Understand** |
| **Level 2** | **Apply** | **40 %** | **40 %** | **40 %** | **40 %** |
| **Analyze** |
| **Level 3** | **Evaluate** | **20 %** | **30 %** | **30 %** | **30 %** |
| **Create** |

**# CA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,**

**SLO – Session Learning Outcome**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Designers** | | | | | | | |
| **(a) Experts from Industry** | | | | | | | |
| **1** | *Mr.V.Maheshwaran* | *CTS, Chennai* | *maheshwaranv@yahoo.com* |  |  |  |  |
| (b) Experts from Higher Technical Institutions | | | | | | | |
| **3** | *Dr.K.C.Sivakumar* | *IIT, Madras* | *kcskumar@iitm.ac.in* | 4 | *Dr.Nanjundan* | *Bangalore University* | *nanzundan@gmail.com* |
| (b) Internal Experts | | | | | | | |
| **5** | *Dr.A.Govindarajan* | *SRMIST* | givindarajan.a@ktr.srmuniv.ac.in | 6 | *Dr.Srinivasan* | *SRMIST* | *srinivasan.va@srmuniv.ac.in* |

**To emerge as a World - Class University in creating and disseminating knowledge, and providing students a unique learning experience in Science, Technology, Medicine, Management and other areas of scholarship that will best serve the world and betterment of mankind.**

**MOVE UP through international alliances and collaborative initiatives to achieve global excellence.**

**ACCOMPLISH A PROCESS to advance knowledge in a rigorous academic and research environment.**

**ATTRACT AND BUILD PEOPLE in a rewarding and inspiring environment by fostering freedom, empowerment, creativity and innovation.**

**Template 6 : Course Learning Syllabus**

**Course Learning Syllabus** *( // includes Learning Outcomes & Learning Plan & Assessment Plan )*

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Code** | 18MAB102T | **Course Name** | ADVANCED CALCULUS AND COMPLEX ANALYSIS | **Course Category** | *BS* | *Basic Sciences* | L | T | P | C |
| 3 | 1 | 0 | 4 |

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| **Pre-requisite Courses** | *18MAB101T* | | **Co-requisite Courses** | *NIl* | | **Progressive Courses** | *Nil* |
| **Course Offering Department** | | *Mathematics* | | | **Data Book / Codes/Standards** | *nil* | |

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| **Course Learning Rationale (CLR):** | | | *The purpose of learning this course is to:* |  | **Learning** | | |  | **Program Learning Outcomes (PLO)** | | | | | | | | | | | | | | |
| **CLR-1 :** | *To gain knowledge in evaluation of Double and triple Integral and apply then in problems in Engineering. Industries.* | | |  | 1 | 2 | 3 |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **CLR-2 :** | *To gain knowledge in evaluation of Surface and Volume Integral are Application of Gauss theorem, Stokes and Green’s theorem all Engineering fields* | | |  | Level of Thinking (Bloom) | Expected Proficiency (%) | Expected Attainment (%) |  | Engineering Knowledge | Problem Analysis | Design & Development | Analysis, Design, Research | Modern Tool Usage | Society & Culture | Environment & Sustainability | Ethics | Individual & Team Work | Communication | Project Mgt. & Finance | Life Long Learning | PSO - 1 | PSO - 2 | PSO - 3 |
| **CLR-3 :** | *To know the techniques of Laplace Transforms and inverse transform and apply them in the problems of Science and Engineering* | | |  |  |
| **CLR-4 :** | *To know the properties of Complex functions and apply them in the all Engineering fields* | | |  |  |
| **CLR-5 :** | *To gain knowledge of evaluation of improper integrals involving complex functions using Residue theorem and apply them in Engineering fields* | | |  |  |
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| **Course Learning Outcomes (CLO):** | | | *At the end of this course, learners will be able to:* | |  |
| **CLO-1 :** | *Gain familiarity in evaluation of multiple integrals using change of variables,* | | | | 2 | 85 | 80 |  | L |  | M |  |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-2 :** | *Gain knowledge in applying the techniques of vector calculus in problems involving Science and Engineering*  *In solving ODE* | | | | 2 | 85 | 80 |  | L |  |  | M | M |  |  |  |  |  |  |  |  |  |  |
| **CLO-3 :** | *Many Engineering problems can be transformed in to problems involving ODE, PDE and integrals. Laplace transform method and complex analytic methods can be used for solving them* | | | | 2 | 85 | 80 |  |  | M |  |  |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-4 :** | *Gain knowledge in Fundamentals of complex analytic functions and its properties* | | | | 2 | 85 | 80 |  | L | M |  | L |  |  |  |  | M |  |  | H |  |  |  |
| **CLO-5 :** | *Gain knowledge in evaluating improper integrals using Residue theorem involving problems in Science and Engineering* | | | | 2 | 85 | 80 |  |  | M | M |  |  |  |  |  | M |  |  | H |  |  |  |
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| --- | --- | --- | --- | --- | --- | --- |
|  | | **Learning Unit / Module 1** | **Learning Unit / Module 2** | **Learning Unit / Module 3** | **Learning Unit / Module 4** | **Learning Unit / Module 5** |
| Duration (hour) | | **12** | **12** | **12** | **12** | **12** |
| **S-1** | SLO-1 | Evaluation of double integration Cartesian and plane polar coordinates | Review of vectors in 2,3 dimensions , | Laplace Transforms of standard functions | Definition of Analytic Function – Cauchy Riemann equations | Cauchy’s integral formulae - Problems |
| SLO-2 | Evaluation of double integration of plane polar coordinates | Gradient, divergence, | Transforms properties | Cauchy Riemann equations | Cauchy’s integral formulae- Problems |
| **S-2** | SLO-1 | Evaluation of double integration of plane polar coordinates | curl – Solenoidal | Transforms of  Derivatives and Integrals | Properties of analytic function functions | Cauchy’s integral formulae- Problems |
| SLO-2 | Evaluation of double integration of plane polar coordinates | Irrotational fields | Transform of derivatives and integrals | Determination of analytic function using – Milne-Thomson’s method | Taylor’s expansions with simple problems |
| **S-3** | SLO-1 | Evaluation of double integral by changing of order of integration | Vector identities  (without proof) – Directional derivatives | Initial value theorems (without proof) and verification for some problems | Determination of analytic function using – Milne-Thomson’s method | Taylor’s expansions with simple problems |
| SLO-2 | Evaluation of double integral by changing of order of integration | Line integrals | Final value theorems (without proof) and verification for some problems | Determination of analytic function using – Milne-Thomson’s method | Laurent’s expansions with simple problems |
| **S-4** | SLO-1 | Problem solving using tutorial sheet 1 | Problem solving using tutorial sheet 4 | Problem solving using tutorial sheet  7 | Problem solving using tutorial sheet 10 | Problem solving using tutorial sheet 13 |
| SLO-2 | Problem solving using tutorial sheet 1 | Problem solving using tutorial sheet 4 | Problem solving using tutorial sheet 7 | Problem solving using tutorial sheet 10 | Problem solving using tutorial sheet 13 |
| **S-5** | SLO-1 | Evaluation of double integral by changing of order of integration | Line integrals | Inverse Laplace transforms using partial fractions | Conformal mappings: magnification | Laurent’s expansions with simple problems |
| SLO-2 | Area as a double integral (Cartesian) | Surface integrals | Inverse Laplace transforms sing Partial fractions | Conformal mappings: rotation | Singularities |
| **S-6** | SLO-1 | Area as a double integral (Cartesian) | Surface integrals | Inverse Laplace transforms section shifting theorem | Conformal mappings: inversion | Types of Poles and Residues |
| SLO-2 | Area as a double integral ( polar) | *Volume Integrals* | LT using Convolution theorem -problems only | Conformal mappings: inversion | Types of Poles and Residues |
| **S-7** | SLO-1 | Area as a double integral ( polar) | Green’s theorem (without proof), | LT using Convolution theorem -problems only | Conformal mappings: reflection | Cauchy’s residue theorem (without proof)- |
| SLO-2 | Triple integration in Cartesian coordinates | Green’s theorem (without proof), | ILT using Convolution theorem -problems only | Conformal mappings: reflection | Contour integration: Unit circle. |
| **S-8** | SLO-1 | Problem solving using tutorial sheet 2 | Problem solving using tutorial sheet 5 | Problem solving using tutorial sheet 8 | Problem solving using tutorial sheet 11 | Problem solving using tutorial sheet 14 |
| SLO-2 | Problem solving using tutorial sheet 2 | Problem solving using tutorial sheet 5 | Problem solving using tutorial sheet 8 | Problem solving using tutorial sheet 11 | Problem solving using tutorial sheet 14 |
| **S-9** | SLO-1 | Conversion from Cartesian to polar in double integrals | Gauss divergence theorem (without proof), verification | LT of periodic functions -problems only | bilinear transformation | Contour integration: Unit circle. |
| SLO-2 | Conversion from Cartesian to polar in double integrals | Gauss divergence theorem (without proof) applications to cubes. | LT of periodic functions -problems only | bilinear transformation | Contour integration: Unit circle |
| **S-10** | SLO-1 | Triple integration in Cartesian coordinates | Gauss divergence theorem (without proof applications to parallelepiped. | Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficient only | bilinear transformation | Contour integration: semicircular contour. |
| SLO-2 | Triple integration in Cartesian coordinates | Stoke’s theorems (without proof) – Verification | Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficient only | bilinear transformation | Contour integration: semicircular contour. |
| **S-11** | SLO-1 | Triple integration in Cartesian coordinates | Stoke’s theorems (without proof) – Applications to cubes | Solution of Integral equation and integral equation involving convolution type | Cauchy’s integral theorem (without proof) | Contour integration: semicircular contour. |
| SLO-2 | Area of triple Integral | Stoke’s theorems (without proof) – Applications to parallelepiped only. | Solution of Integral equation and integral equation involving convolution type | Cauchy’s integral theorem applications | Contour integration: semicircular contour. |
| **S-12** | SLO-1 | Problem solving using tutorial sheet 3 | Problem solving using tutorial sheet 6 | Problem solving using tutorial sheet 9 | Problem solving using tutorial sheet 12 | Problem solving using tutorial sheet 15 |
| SLO-2 | Application of Multiple integral in engineering | Application of Line and Volume Integrals in engineering | Application of Laplace Transform in engineering | Application of Bilinear Transformation and Cauchy Integral in engineering | Application Contour integration in engineering |
|  |  |  |  |  |  |
| **Learning**  **Resources** | | 1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.  2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.  3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008  4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010  5. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002  6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008 | | | | |

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|  | **Level of Thinking** | **Continuous Assessment** | | | **Final Examination (40%)** |
| **CA – 1 (20%)** | **CA – 2 (20%)** | **CA – 3 (20%) #** |
| **Level 1** | **Remember** | **40 %** | **30 %** | **30 %** | **30 %** |
| **Understand** |
| **Level 2** | **Apply** | **40 %** | **40 %** | **40 %** | **40 %** |
| **Analyze** |
| **Level 3** | **Evaluate** | **20 %** | **30 %** | **30 %** | **30 %** |
| **Create** |

**# CA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,**

**SLO – Session Learning Outcome**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Designers** | | | | | | | |
| **(a) Experts from Industry** | | | | | | | |
| **1** | *Mr.V.Maheswaran* | *CTS, Chennai* | *maheswaran@yahoo.com* | 2 |  |  |  |
| (b) Experts from Higher Technical Institutions | | | | | | | |
| **3** | *Dr.K.C.SivaKumar* | *IIT, Chennai* | *kcskumar@iitm.ac.in* | 4 | *Dr.nanjundan* | *Bangalore University* | *nanzandan@gmail.com* |
| (b) Internal Experts | | | | | | | |
| **5** | *Dr.A.Govindarajan* | *SRMIST* | givindarajan.a@ktr.srmuniv.ac.in | 6 | *Dr.sundarammal kesavan* | *SRMIST* | *Sundarammal.k@srmuniv.ac.in* |

**To emerge as a World - Class University in creating and disseminating knowledge, and providing students a unique learning experience in Science, Technology, Medicine, Management and other areas of scholarship that will best serve the world and betterment of mankind.**

**MOVE UP through international alliances and collaborative initiatives to achieve global excellence.**

**ACCOMPLISH A PROCESS to advance knowledge in a rigorous academic and research environment.**

**ATTRACT AND BUILD PEOPLE in a rewarding and inspiring environment by fostering freedom, empowerment, creativity and innovation.**