DEPARTMENT
OF
MECHANICAL ENGINEERING

S Y L L A B U S

M. TECH (Mechanical)

2015 ONWARDS

ALIGARH MUSLIM UNIVERSITY
ALIGARH

CONTENTS

MACHINE DESIGN

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Engineering Mathematics
Course Number	**:**	AM632N
Credits	**:**	4
Course Category	**:**	PC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

To learn numerical solution of ordinary and partial differential equations integral equations, transformations and tensors

Syllabus:

Numerical solution of system of ordinary differential equations by Runge-Kutta method of order four, numerical solution of partial differential equations: Laplace Poisson, Heat conduction and wave equations. Curve fitting by least square method.

Fredholm and Volterra integral equations of the first and second kinds

Conformal mapping, linear, bilinear, reciprocal, exponential and Schwarz-Christoffel transformations.

Tensors: Contravariant and covariant tensors, inner and outer products, metric tensor. Christoffel symbols of the first and second kinds.

Course Outcomes:

1. Solve ordinary and partial differential equations numerically.
2. Solve integral equations.
3. Understand and apply transformations in engineering problems.
4. Use tensors in engineering applications.

Books:

1. Murray R. Spiegel, Vector and introduction to Tensor Analysis – Sachaum's outline Series, McGraw Hill.
2. M.K. Venkataraman, Numerical methods, National Publishing Company.
3. M.K. Venkataraman, Higher Mathematics, National Publishing Company.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	H		M	L						
2	H		M	L						
3	H		H	M						
4	M			M						

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Instrumentation and automatic control systems
Course Number	**:**	ME630
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignements, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives:

1. To make students familiar with various types measuring instruments.

2. To build the concept of feedback control algorithms, classical and optimal control problems.

3. To prepare the students for broader applications of control systems to mechanical engineering problems like active vibration control of light weight structures.

Course Outcomes:

Students who successfully complete the course will demonstrate the following outcomes

1. Understand the basic characteristics of a measurement system.
2. Ability to understand and analyse the working principle of different measuring instruments.
3. Design and performance evaluation of a measurement system.
4. Application of the basic knowledge of classical control systems to synthesize the modern feedback control algorithms for physical systems.
5. Ability to solve linear dynamic problems and implement the control laws using state space approach for dynamical problems.
6. Implementation of nonlinear control algorithms to evaluate the nonlinear dynamical problems.

Syllabus:

Safety and environment at workplace, Instrument and measurement systems, Sources of uncertainty and errors, Behavior of first order and higher order instruments, Static and dynamic characteristics of instruments, Noise in measurement systems, Filtering and signal analysis, Measurement and control of various response parameters.

Transducers and sensing elements, Mass sensing elements, Thermal detectors, thermo-couples, hydro-pneumatic sensors, electro-mechanical transformation, Piezoelectric sensors and actuators, velocity, acceleration piezoelectric& magneto-striction transducers, Optical instrumentation.

Classification and representation of control systems, open and closed-loop systems, Concept of Feedback, Review of classical control systems, control response analysis in time and frequency domain analysis, Stability analysis of control response, Modern control system design instate space, Model reduction, Concept of negative velocity feedback.

Optimal control design, Performance index, Algebraic Riccati equation, Linear Quadratic Gaussian (LQG) control, Statistical descriptions of noise, Kalman filter, Controllability and observability.

Applications of linear control system in noise and vibration reduction in instruments, Vibration control of structures and machines, Control of thermos-fluid systems, Nonlinear systems and Linearization of nonlinear systems, Solution of some nonlinear control problems, Robust control design, Implementation of control systems in MATLAB and SIMULINK.

Books:

1. J.P. Bentley, Principle of Measurement Systems, John Wiley and Sons.
2. J. P. Holman, Experimental methods for engineers, McGraw Hill.
3. J. B. Burl, Linear optimal control, Addison-Wesley.
4. K. Ogata, Modern control engineering, Pearson education.
5. J. J. E. Slotine, and W. Li, Applied Nonlinear Control, Prentice–Hall, Upper Saddle River, NJ.

Mapping of COs with POs:

PO / CO	a	b	c	d	e	f	g	h	i	j
1	x							x		
2	x		x	x	x			x		x
3	x	x		x	x			x		
4	x	x	x		x			x	X	x
5	x	x			x			x		x
6	x	x			x			x	x	x

PO / CO	a	b	c	d	e	f	g	h	i	j
1	H							H		
2	H		H	H	M			H		M
3	H	M		H	M			H		
4	H	M	H		M			M	M	H
5	H	H			M			M		H
6	H	H			M			M	M	H

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Numerical Methods
Course Number	**:**	ME640
Credits	**:**	4
Course Category	**:**	PC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignements, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. Development of an understanding the concepts of computer number representation and round-off error propagation during arithmetic operations.
2. To impart knowledge of MATLAB (basic features involving linear algebra, file handling and scientific visualization).
3. To impart knowledge of basic numerical tools like construction of polynomial interpolation (global and piecewise) on 1D and higher dimensional data sets. Awareness of practical issues in interpolation and their remedies.
4. Understanding the concepts of simple and non-simple roots of a nonlinear algebraic or transcendental equations and applications of different types of bracketing and non-bracketing methods for root estimation.
5. Development of concepts of numerical estimation of derivatives and integrals. Knowledge of basic Newton-Cotes and Gauss integration formulae and their applications. Handling improper integrals and integrand discontinuities.
6. To provide knowledge of methods of integrating Ordinary Differential Equations.
7. To impart knowledge of basic concepts in linear algebra, types of matrices, vector and matrix norms, Direct and Iterative Solution methods.
8. To provide basic concepts of parallel programming through MPI.

Course Outcomes:

1. Development of an understanding the concepts of computer number representation and round-off error propagation during arithmetic operations.
2. To impart knowledge of MATLAB (basic features involving linear algebra, file handling and scientific visualization)
3. To impart knowledge of basic numerical tools like construction of polynomial interpolation (global and piecewise) on 1D and higher dimensional data sets. Awareness of practical issues in interpolation and their remedies.
4. Understanding the concepts of simple and non-simple roots of a nonlinear algebraic or transcendental equations and applications of different types of bracketing and non-bracketing methods for root estimation.
5. Development of concepts of numerical estimation of derivatives and integrals. Knowledge of basic Newton-Cotes and Gauss integration formulae and their applications. Handling improper integrals and integrand discontinuities
6. To provide knowledge of methods of integrating Ordinary Differential Equations.
7. To impart knowledge of basic concepts in linear algebra, types of matrices, vector and matrix norms, Direct and Iterative Solution methods

Syllabus:

Number Representation: Representation of decimal numbers integers and floats, machine epsilon, Roundofferror, error propagation in arithmetic operations, Truncation error.

MATLAB: Introduction, Basic operations involving scalars, vectors and matrices, built-in functions for vectorand matrix analysis, Programming constructs, Plotting commands - XY plots, Contour plots, 3D plots
Interpolation: Global Polynomial interpolation methods, Interpolation errors, Piecewise polynomial methods - Splines. Multi-dimensional polynomial interpolation, linear and Bilinear Lagrange interpolation in 2D.

Root finding: One Dimensional models: Simple and Non-simple roots, Bracketing and non-Bracketing methods, Higher Dimensional models: Non-linear Systems of algebraic equations.

Numerical Differentiation: Finite difference approximations, central and biased schemes for first and second order derivatives, Higher order Compact Schemes, least square methods, Practical issues.

Numerical Integration: Newton-Cotes lntegration methods, Gauss Quadratures-Gauss-Legendre and GaussLaguerre methods, Practical issues- Improper integrals, Integrand discontinuities.

ODE systems: Initial and Boundary value problems, R-K methods, Multi-step methods, Stiff systems, shooting and Finite Difference methods.

Linear Algebra: Linear non-homogenous systems-Direct methods, Iterative methods - Stationary and Nonstationary methods, Jacobi's method, Gauss Siedel and SOR methods, Multi-grid acceleration, Linear homogenous systems or Eigenvalue problems-Power method, Simultaneous Iteration, QR method.

High Performance computing: Basic MPI subroutines, basic MPI commands, MPI and 2D models, Domain decomposition and classical methods for linear systems.

Mapping of COs with POs:

Program outcomes	**Course Outcome**						
	1	2	3	4	5	6	7
a	H	H	H	H	H	H	H
b	H	H	H	H	H	H	H
c		H	M		M		
d		M		M			
e		L					
f							
g	L						
h		L	L				
i	L						
j	M	M	L				H

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Mechanics of Solids
Course Number	**:**	ME631
Credits	**:**	4
Course Category	**:**	DE
Pre-Requisites (s)	**:**	Mechanics of Solids (Graduate Level)
Contact hours	**:**	4
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid-Semester Examination (1 hour) 25% End-Semester Examination (2 hours) 60%

Course Objectives:

1. To gain understanding of advanced concepts of 3D stress and strain by analysis of solids and structures.
2. To study engineering properties of materials, force-deformation, and stress-strain relationship.
3. To learn advanced principles of equilibrium, compatibility, and force-deformation relationship in different members of structures.
4. To analyze problems related to torsion of non-circular sections, stresses in different kind of beams, stresses and deflections in plates with different loading and boundary conditions.

Course Outcomes:

1. Ability to analyse three dimensional state of stress and strain including graphical method.
2. Ability to analyse the behavior of structural elements of various cross sections under torsional loading.
3. Capabiltiy to understand and analyse the asymmetric bending situation and shear flow in thick curved beams.
4. Proficiency to analyse the behavior of different structural members like beams and plates subjected to various types of loading and boundary conditions.

Syllabus:

Three dimensional stress and strains, laws of transformation from one set of axes to another, principal stresses and strains, dilation Alan, distortional components of strains, octahedral stresses and strains, three dimensional Mohr's circle, stress-strain relationships.
Torsion of non-circular cross-sections, St. Venant's theory, approximate solutions for rectangular, triangular and elliptical cross-sections, membrane analogy, torsion of hollow sections, multiple connected sections, center of twist and flexure centre.
Asymmetric bending of straight beams, shear center, bending of curved beams, deflection of curved thick bars.
Stresses and deflections in rectangular and circular plates, uniformly distributed and other axisymmetric loads, simply supported and clamped edged, circular plates with circular holes.

Books:

1. *L.S. Srinath, Advanced Mechanics of Solids, TMH Publisher, New Delhi.*
2. *E. J. Hearn, Mechanics of Materials-Vol. I and II, Pergamon Press.*

3. *S. Timoshenko, Strength of Materials Part II, Van-Nostrand Company Inc. Princeton, New Jersey.*
4. *A. R. Ragab, and S. E. Bayoumi, Engineering Soild Mechanics: Fundamentals and Applications, CRC Press.*
5. *A. J. Durelli, E. A. Philips, and C. H. Tsao, Introduction to Theoretical and Experimental Analysis of Stress & Strain, McGraw Hill.*
6. *F. B. Seely, and J. O. Smith, Advanced Mechanics of Materials, John Willey & Sons Inc.*

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	H	M		M				M		H
2	H			M				M		H
3	M	M	M					M	M	M
4	M		H					M	H	M

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advance Design of Mechanical Systems
Course Number	**:**	ME633
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME212, ME317
Contact hours	**:**	3-1-0
Type of Course	**:**	Theory
Course Assessment	**:**	Home Assignments 15% Mid-Sem Examination (1 hour) 25% End-Sem Examination (2 hours) 60%

Course Objectives:

This course is designed to help students achieve the following objectives:

1. To study advanced design concepts in order to enhance the basic design.
2. To study behaviour of mechanical components under fatigue and creep and design machines elements against fatigue, creep and fracture.
3. To design machine components subjected to thermo-mechanical loads.
4. Application of various theories of failure to design.

Course Outcomes:

After taking this course students should be able to:

1. Ability to apply concepts of mechanics in the analysis and design of machine components.
2. Ability to use theories of failure and design standards to the design of machine components and mechanical systems.
3. Ability to carry out design of machine components against fatigue and creep.
4. Capability to learn design and to include the effects of damage like cracks in the design of machine components.
5. To evaluate design alternatives based on available choices and to decide the most suitable design concept to carry out detailed design of mechanical systems.

Syllabus:

System Design approach for mechanical engineering, Constraints and creativity, Selection of Material & process in mechanical design. Concurrent Mechanical Engineering design and its implementation, Design Methodologies of Total Design, Design for quality and manufacture, Design for assembly, Recent advances in content and approaches of mechanical engineering design and new design strategies like design for X.

Review of static strength failure analysis, theories of failure including Von-Mises theory based strength on load carrying capacities of members, effect of small inelastic strains and residual stresses on load carrying capacity, theory of limit design.

High cycle and low cycle fatigue, cumulative damage theories, acoustical and thermal fatigue, Corrosion and fretting fatigue, pitting of gears, fatigue strength of joints components and structures, exercise of fatigue design of shafting and gears, Exercises of surface fatigue design of rolling contact bearings. Creep behavior, and elastic and plastic creep, rupture theory, analysis of tensile creep data, creep in high temperature low cycle fatigue, creep analysis of thick walled cylinders and rotating discs.

Design against fracture, theories of brittle fracture Yield Criteria for ductile isotropic materials under multi axial state of stress, fundamental aspects of crack growth and fractures, fatigue crack propagation fracture toughness data, stress corrosion cracking.

Books:

1. *Fatigue Design Procedures by Gasner & Shultz, Pergoman Press.*
2. *Fracture: An Advance Treatise by H. Liebawitz, Academic Press Vol. 1– 6.*
3. *Fatigue of Metals by P.G. Forest, Pergoman Press.*
4. *Mechanical Engineering Design by Joseph E. Shigley, McGraw Hill.*

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	H		M	M				M		M
2	H	M		M				M		M
3	H		L	M	M			H	M	H
4	H			M				H	M	H
5	H	M	M	M	M			H	H	H

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Dynamics
Course Number	**:**	ME638
Credits	**:**	4
Course Category	**:**	PC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-1-0
Type of Course	**:**	Theory
Course Assessment	**:**	Continuous Evaluation 15% Mid-Sem Examination (1 hour) 25% End-Sem Examination (2 hours) 60%

Course objectives:

- Development of an understanding of the concepts of vibrations and its significance in structural design.
- To be able to do mathematical modelling of complex physical systems.
- Ability to derive the governing equations using the principles of mechanics.
- Capability to obtain the solutions of governing equations using efficient solution strategies.
- To provide the knowledge of nonlinear vibration characteristics and exposure to various approximate analytical methods for the solution of non-linear governing equations.
- To provide an insight into the stability analysis of structural components undergoing large amplitude vibrations.

Course Outcomes:

1. Capability to model physical systems and to identify and handle the various sources of non-linearity.
2. Application of principles of Mechanics and mathematics to obtain the desired solution.
3. Exposure to application of approximate analytical methods for the solution of nonlinear differential equations.
4. Ability to apply graphical techniques for understanding the dynamic characteristics of structural components.
5. Ability to understand the role of non-linear vibration analysis in the efficient/optimal design of structural components

Syllabus:

Review of free and forced vibrations, vibration under arbitrary excitation, vibration isolation, systems with two degree of freedom, normal mode analysis, Stiffness, flexibility and inertia influence coefficients, orthogonality of eigen vectors, orthonormal modes, modal analysis, Hamilton's principle, generalized coordinates, Lagrange's equation and its application, principle of virtual work, self-excited vibration & stability analysis,
Introduction to nonlinear vibration; Analytical methods, Duffing equation, Jump phenomenon, Vander Pol equation. Graphical methods; phase plane representation & phase velocity method of construction of trajectories and stability criterion.

Books:

1. Nonlinear ordinary differential Equations, D.W. Jordan and P. Smith, Clarendon Press, Oxford

2. Perturbation Methods, Ali Hasan Nayfeh, John Wiley- ISBN: 9783527617609
3. Mechanical Vibration by S.S. Rao, Addison Welsely Publishing Company ISBN 0-201-59289-4, Prentice Hall; ISBN
4. Elements of Vibration Analysis by Leonard Merovitch, McGraw Hill Intnl. Edition..

Mapping of COs with POs:

PO's	**Course Outcomes**				
	1	**2**	**3**	**4**	**5**
a	**H**	**H**	**H**	**H**	**H**
b	**M**	**H**	**M**	**H**	**H**
c					**M**
d	**M**	**L**			
e	**L**		**L**		**M**
f					
g					
h			**H**	**L**	
i					**M**
j	**M**		**M**		

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Mechanisms
Course Number	**:**	ME632
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME212, ME317
Contact hours	**:**	3-1-0
Type of Course	**:**	Theory
Course Assessment	**:**	Home Assignments 15% Mid-Sem Examination (1 hour) 25% End-Sem Examination (2 hours) 60%

Course Objectives:

1. To prepare students to apply their knowledge of kinematics of machines and mechanism to study the spatial mechanisms.
2. To build the concept to explore analytical and geometrical methods to synthesize planar and spatial mechanisms.
3. To apply different techniques, skills and modern engineering tools specially to develop computer programs to analyze and synthesize various spatial mechanisms and machines.

Course Outcomes:

Students who successfully completed this course will demonstrate the following outcomes

1. Ability to apply the concept of mathematics and complex algebra to analyse force and motion analysis of planar linkages.
2. Ability to apply the concept of vector and matrix algebra to analyse various planar spatial mechanisms.
3. Ability to design linkages, planar and spatial mechanisms for a given motion or a given input/output motion or force relationship.
4. Explore the concept of displacement, velocity and acceleration profiles to synthesize planar and spatial mechanism.
5. To develop an ability to use the techniques, skills and computer programming to analyze different mechanisms.

Syllabus

Introduction, constrained motion in kinematic chain, mobility and range of movement, equivalent linkage, review of velocity and acceleration analysis in planar mechanism, acceleration analysis in complex mechanisms.
Analytical methods in kinematics, kinematics of spatial chain, matrix method, kinematics of open chain, dynamics of mechanism.
Kinematic synthesis: type, number and dimensional synthesis, body guidance, path generation and function generation, spacing of accuracy point, Chebshev polynomials, coupler curves, practical applications of mechanism in machines.

Books:

1. Kinematic Analysis & Synthesis of Mechanisms by A.K. Malik, Amitab A. Ghosh & Gunter Dittrich, CRCP London.
2. Kinematic Synthesis of Linkage by Hartenberg & Denavit, McGraw Hills.

3. Kinematic & Linkage Design by Hall Jr., Prentice Hall.
4. Theory of Mechanisms & Machines by A Ghosh & A.K. Malik, Affliated East – West Press Limited.

Mapping of COs with POs:

PO / CO	a	b	c	d	e	f	g	h	i	j
1	H							M		
2	H		L					M		M
3	H	M	M	M				H	M	H
4	H	M						H	M	H
5	H				M			H		H

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	**Finite Element Methods**
Course	:	ME637
Credits	:	4
Course Category	:	PE
Pre-Requisites(s)	:	None
Contact Hours	:	3-0-1
Type of Course	:	Theory
Course Assessment	:	Continuous evaluation 15% Mid Semester Examination 25% End Semester Examination 60%

Course objective

1. Equip the students with the Finite Element Analysis fundamentals
2. Enable the students to formulate linear and non-linear design problems into FEA
3. Enable the students to develop FE code for structural element.
4. Enable the students to perform simulations using commercial Finite Element Packages (e.g. ANSYS & Abaqus)

Course outcomes:

1. Ability to identify the mathematical model for solution of common engineering problems.
2. Capability to formulate linear and non-linear problems into finite element model.
3. Ability to solve structural problems for various loading conditions using finite element method.
4. Ability to develop a general FE code in a team work and appraise the importance of ethical issues pertaining to the utilization of commercial FE codes.

Syllabus:

Introduction to FEM. Method of weighted residuals and variational approach for solving differential equations. Galerkin and Rayleigh-Ritz methods. Element types and properties. Boundary conditions. Stress-strain determination. Solution techniques. Mesh refinement. Convergence criterion. Frames, beams and axial element. Plane stress. Plane strain.
Finite element formulation for linear elastic continuum and extended Laplace equation including inertia and dissipative terms. Plate bending and 'C' elements. Non-conforming elements and patch test. FEM analysis of plates and shells. Dynamic and nonlinear problems, Material and geometric non-linearity. Axisymmetric problems-classical solution. Finite Element solution of free vibration problems. Principles of transient dynamic analysis. Laboratory work for the solution of solid mechanics problems using FE packages.

Books:

1. Tripathi R. Chandrupatla & Ashoke D. Belegundu; Introduction to Finite Element in Engineering, Prentice Hall of India Pvt. Ltd.
2. O.C. Zienkiewiez & K. Morgan; Fnite Elements & Approximations, John Willey & Sons, New York.
3. Klaus-Jorgen Bathe; Finite Element Procedures in Engineering Analysis, Prentice Hall.
4. J.N. Reddy; An introduction to Finite Element Methods, 3rd Edition Mc Graw Hill.
5. Singiresu S. Rao; The Finite Element Method in Engineering, Elsevier Science and Technology

Mapping of COs with POs:

Program outcomes	Course outcomes			
	1	2	3	4
a	M	H	H	
b	H	L	M	
c		M	L	
d	M			
e				M
f				
g				
h				
i				H
j				L

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Computational Mechanics Lab
Course Number	**:**	ME697
Credits	**:**	03
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME212, ME317
Contact hours	**:**	0-3-0
Type of Course	**:**	Lab
Course Assessment	**:**	Laboratory Work (Continuous Class Work Evaluation) 60% End Semester Examination 40%

Course objectives:

- To give students working knowledge of commonly used softwares like ABAQUS/ANSYS, MATLAB and modelling softwares like solid works.
- To impart program writing skills in Matlab/Fortran for structural mechanics problems.
- To give working knowledge of data analysis and visualization softwares like TECPLOT, Origin, GLE etc.
- The lab course has been structured to have several tutorials and lab exercises on solving various structural problems.

Course Outcomes

1. Ability to model physical systems and identification of input parameters (material model, geometric constraints, boundary conditions, loading environment, analysis type etc.) and output parameters (Temporal and spatial distribution of displacements, stresses and strains).
2. Application of principles of Mechanics and Mathematics to obtain the governing equations and the techniques to obtain the desired solution.
3. Analyzing design alternatives for the optimal design of structural components.
4. Interpretation of the results using advance plotting softwares such as ORIGIN, GLE and TECPLOT.
5. Ability to design and analyze products independently and in groups in the form of assignments and project.
6.

Course Module:

1. Development of MATLAB codes

   i) Solution of dynamical problems of discrete systems and multi-body dynamics
   ii) Analysis of 2D and 3D frames and trusses.
   iii) Mesh generation of 1D, 2D and 3D structures using some line, plate and brick elements.
   iv) Modelling of beams bases on Euler Bernouli /Timoshenko theories (Analytical & FE solutions).

2. Development of SIMULINK blocks for dynamical systems (1 (a)) and testing the relative accuracies of the two methods.

3. Modelling and analysis of Euler Bernouli/Timoshenko beams using FE packages.
4. Fracture mechanics problems using FE packages.
5. Data interpretation and plotting.
6. Labview applications.

Mapping of COs with POs:

PO's	**Course Outcomes**				
	1	**2**	**3**	**4**	**5**
a	**H**	**H**	**H**	**M**	**H**
b	**H**	**H**	**H**	**H**	**H**
c	**M**	**H**	**H**		**M**
d			**M**	**H**	
e		**L**	**M**	**M**	**M**
f			**M**		**M**
g				**M**	
h	**M**	**M**	**H**	**L**	**M**
i	**M**	**M**	**H**	**L**	**H**
j	**H**	**H**	**M**	**L**	**H**

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Project
Course Number	**:**	ME691D
Credits	**:**	03
Course Category	**:**	DC
Pre-Requisites (s)	**:**	ME212, ME317
Contact hours	**:**	0-3-0
Type of Course	**:**	Practical
Course Assessment	**:**	Course Work (Continuous Evaluation) 60% End Semester Examination 40%

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts/data from various available sources (Journals, articles, web-based resources etc.)
2. To impart training to recognize and incorporate social, ethical and professional aspects in technological solutions.
3. To provide an exposure to the analysis / solution of a real world complex engineering problem.
4. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
5. To develop data representation and interpretation skills along with an approach of critical reasoning.
6. To develop documentation and technical report writing skills.
7. To develop overall management (technical and financial) skills required for successful completion of research and design task.
8. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Ability to identify a potential research and design problem on the basis of literature survey.
3. Modelling of Physical systems employing knowledge of mathematics, science and engineering and problem formulation.
4. Development of mathematical model, experimental facility if any and identifying the input parameters, output parameters and constraints.
5. Development of efficient solution strategies and design of experimental procedure with flexibility for incorporating technological changes. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
6. Understanding the implications of the results obtained and optimization of the procedure/process in order to cater to the financial/ economic/ environmental/ social/ ethical issues.
7. Capability to employ various data analysis (visualization and interpretation) approaches and to extract the relevant trends through logical and critical reasoning.
8. Ability to effectively communicate the research / design / analysis through technical reports.
9. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task and to inculcate ability to function effectively as a team and knowledge sharing.

Mapping of COs with POs:

Program outcomes	Course outcomes								
	1	2	3	4	5	6	7	8	9
a			H	H	H				
b	M	H	H		H				
c		M	M		M				
d				H	H		H		
e							M		H
f						H	H		H
g								H	
h	H								M
i						H		H	
j		M	H						

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Stress analysis and vibration lab
Course	:	ME796
Credits	:	03
Pre-Requisite(s)	:	None
Course Category	:	DC
Contact Hours	:	0-3-0
Type of Course	:	Practical
Course Assessment	:	Laboratory Work (Continuous Evaluation) 60% End Semester Examination 40%

Course Objectives:

1. To impart working knowledge of equipment's in the areas of advance dynamics, stress analysis and tribology.
2. To carryout experiments and extract relevant data from sophisticated equipment's in different area of machine design.
3. To inculcate knowledge of data analysis and visualization through different software's.
4. To correlate theoretical concept through experimental observation (viz. progressive buckling, mode of failure)

Course Outcomes:

1. Ability to understand the deformation behaviors of metals and composite.
2. Ability to capture the data in impact loading of projectiles, analysis the mode of deformation and energy absorption characteristic's.
3. Ability to observe and analyse pressure distribution for different bearing setup.
4. Capability to calculate and verify wear rate for different material on wear friction setup.
5. Ability to determine unbalance force and apply dynamic balancing concept through machinery fault simulator (MFS).
6. Ability to determine transmissibility ratio in forced vibration setup.

Mapping of COs with POs:

Program outcomes	**Course outcomes**				
	1	2	3	4	5
a	H	M	M	M	H
b		H			M
c		H	H		
d	M				L
e	M				
f					
g	H	H	H	H	H
h					
i					
j					

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Preliminary Dissertation
Course Number	**:**	ME781D
Credits	**:**	03
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-0-3
Type of Course	**:**	Practical
Course Assessment	**:**	Course Work (Continuous Evaluation) 60% End Semester Examination 40%

Course Objectives:

1. To assess the plan of study / work for feasibility in terms of research potential and the required infrastructural support at the Departmental level.
2. To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
3. To develop the ability for justification and defence of a research proposal.
4. To develop documentation and research proposal writing skills.
5. To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcomes:

1. Capability to carry out extensive literature review and imparting knowledge of the various fact and data sources on a specific technical topic.
2. Ability to identify a potential research and design problem on the basis of literature survey.
3. Modelling of Physical systems and design of experimental facility/procedure employing knowledge of mathematics, science and engineering.
4. Development of efficient solution strategies and design of experimental procedure with flexibility for incorporating technological changes.
5. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
6. Ability to effectively plan the work in stages and communicate the research plan through a technical report and oral presentation.
7. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

Program outcomes	**Course Outcome**						
	1	2	3	4	5	6	7
a			H	H	H		
b	M	H	H		H		
c		M	M		M		
d				H	H		
e							H
f							H
g						H	
h	H						M
i						H	
j		M	H				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Dissertation Seminar
Course Number	**:**	ME782D
Credits	**:**	02
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-0-0
Type of Course	**:**	General
Course Assessment	**:**	Course Work (Continuous Evaluation) 60% End Semester Examination 40%

Course Objectives:

- To assess the technical quality of the study / work for submission feasibility as dissertation.
- To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
- To develop the ability for justification and defense of a research proposal.
- To develop documentation and research report/dissertation writing skills.
- To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcomes:

1. Capability to carry out extensive literature review and imparting knowledge of the various fact and data sources on a specific technical topic.
2. Ability to identify a potential research and design problem on the basis of literature survey.
3. Capability to justify and defend a research work/thesis.
4. Ability to effectively communicate the research work through a technical report and oral presentation using modern audio-visual aids.
5. Ability to plan the schedule of work and employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

Program outcomes	**Course outcomes**				
	1	2	3	4	5
a	M				
b	M				
c		M			
d					
e					
f	M				H
g			H	H	
h					
i		H	M		
j	H				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Dissertation
Course Number	**:**	ME798D
Credits	**:**	10
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-0-3
Type of Course	**:**	Practical
Course Assessment	**:**	Course Work (Continuous Evaluation) 60% End Semester Examination 40%

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts/data from various available sources (Journals, articles, web-based resources etc.)
2. To impart training to recognize and incorporate social, ethical and professional aspects in technological solutions.
3. To provide an exposure to the analysis / solution of a real world complex engineering problem.
4. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
5. To develop data representation and interpretation skills along with an approach of critical reasoning.
6. To develop documentation and technical report writing skills.
7. To develop overall management (technical and financial) skills required for successful completion of research and design task.
8. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Ability to identify a potential research and design problem on the basis of literature survey.
3. Modelling of Physical systems employing knowledge of mathematics, science and engineering and problem formulation.
4. Development of mathematical model, experimental facility if any and identifying the input parameters, output parameters and constraints.
5. Development of efficient solution strategies and design of experimental procedure with flexibility for incorporating technological changes. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
6. Understanding the implications of the results obtained and optimization of the procedure/process in order to cater to the financial/ economic/ environmental/ social/ ethical issues.
7. Capability to employ various data analysis (visualization and interpretation) approaches and to extract the relevant trends through logical and critical reasoning.
8. Ability to effectively communicate the research / design / analysis through technical reports.
9. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task and to inculcate ability to function effectively as a team and knowledge sharing.

Mapping of COs with POs:

Program outcomes	Course outcomes								
	1	2	3	4	5	6	7	8	9
a			H	H	H				
b	M	H	H		H				
c		M	M		M				
d				H	H		H		
e							M		H
f						H	H		H
g								H	
h	H								M
i						H		H	
j		M	H						

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Fracture Mechanics
Course Number	**:**	ME671N
Credits	**:**	04
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. Imbibe understanding and significance of the principles of fracture mechanics.
2. Ability to employ these principles in fracture based design.
3. Application of these techniques in solving different structural problems.

Course Outcomes:

After taking this course students should be able to

1. Identify the mechanism of fracture and crack growth.
2. Classify the different type of fractures and define the near field equations to determine the stress-strain and load-displacement fields around a crack tip for linear elastic cases.
3. Understand the linear elastic and elasto-plastic fracture mechanics and formulate the stress intensity factor *K* and strain energy release rate *G* for typical crack configurations.
4. Apply the energy principles and energy release rate for the formulation of fracture toughness and crack resistance.
5. Comprehend the concept of fracture based design and apply this principle for the design of simple components.

Syllabus:

Introduction and overview, Grifith theory, linear elastic fracture mechanics, concept of strain energy release rate (*SERR*), concept of stress intensity factor (*SIF*), *SERR* and *SIF* as fracture parameters, evaluation of *SIF*, stress and displacement field near crack tip, generalised Westergaard solutions.
Elastoplastic fracture mechanics, Crack tip plastic zone and its evaluation, Dugdale model, concept of crack tip opening displacement (*CTOD*), *CTOD* as a fracture parameter, experimental technique for toughness measurement, concept of *J* integral and its evaluation, application of *J*-integral for evaluation of structural integrity, slow stable crack growth and concept of crack resistance (*C*-*R*) curve. Dynamic and time dependent fracture analysis, Elastodynamic crack-tip parameters, dynamic toughness, crack arrest, creep crack growth, viscoelastic fracture mechanics.
Application of fracture mechanics, Mixed mode crack problem, Mechanics of fatigue crack propagation, Life prediction of fatigued structures under constant and variable amplitude loading, fracture and failure of metals, ceramics, polymers and composites, Crack propagation under environmental conditions, fracture safe designing of structures and machine components, service failure analysis.

Books:

1. *T.L. Anderson, Fracture Mechanics - Fundamentals and Applications, 3rd Edition, Taylor and Francis Group, 2005.*
2. *David Brooke, Sijthoff & Noordhohh; Elementary Engineering Fracture Mechanics, Martinus Nijhoff Publisher, 1986*
3. *Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill.*
4. *K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.htm.*

Mapping of COs with POs:

PO's	CO's				
	1	2	3	4	5
a	M	L	L		H
b		M	M	H	
c					
d	L		H		
e					
f					
g					L
h			M		H
i			L	M	H
j		M	L		

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Tribology
Course Number	**:**	ME671N
Credits	**:**	04
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. Impart understanding of friction, wear and lubrication.
2. To be able to explain different types of lubrication and their application to Hydrodynamic bearings applying different types of boundary conditions.
3. To provide the concepts of governing Navier-Stokes equations and develop the generalized Reynolds's equation and its applications.
4. Familiarize the concept of hydrostatic bearings and their applications.
5. Familiarize with squeeze film bearings and their applications.
6. Apply the knowledge of mathematics, science and engineering for the analysis and design of rotor-shaft systems on journal bearings.

Course Outcomes:

1. Proficiency to describe tribology, recognize the laws of friction, and appreciate various modes of wear.
2. Ability to identify various types of lubrications and apply the design procedures to a hydrodynamic / hydrostatic lubricated bearing rotor-shaft system.
3. Ability to apply basic governing equations for the design and development of hydrodynamic / hydrostatic lubricated bearings incorporating frictional and thermal effects.
4. Ability to apply the knowledge of bearing materials and their properties for the design of a mechanical system.
5. Ability to achieve bearing optimization using improved tribological practices and capability to explore the design of tribological surfaces as well as ways to troubleshoot tribology problems.

Syllabus:

Introduction, lubricants and their properties, viscosity and its variation, types of friction, static and kinetic friction, stick-slip effects, friction measuring devices, types of lubrication, generalized Reynolds's equation and its application to one dimensional journal bearings, fixed and pivoted shoe type slider bearings, Rayleigh step bearings, lubrication of discs, Sommerfeld, half Sommerfeld, and Reynolds boundary conditions, finite bearings, lubricant supply, effects of leakage, thermal effects, dynamic effects in hydro dynamic bearings, squeeze film bearings, hydrostatic thrust and journal bearings effects of non-central loading, bearing optimization, lubrication by gases, vapours & non-Newtonian fluids, dry & marginally lubricated bearings, wear and wear types, mechanisms of wear, wear models, measurement of wear, constant and variable wear rate, damage of mechanical components due to wear, wear controlling techniques.

Books:

1. Principal of Lubrication by Cameron, Published by Longman
2. Theory of Hydrodynamic Lubrication by Pinkus & Sternkicht, McGraw Hill.
3. Fluid film Lubrication by Cross, Matsch Castelli & Wildmann, John Wiley.
4. Engineering Tribology by J.A. Williams, Oxford University.
5. Applied Tribology (Bearing Design and Lubrication), Michael M. Khonsari, E. Richard Boose, John Wiley and Sons Ltd.
6. J Halling, Principles of Tribology, The Macmillan Press Ltd, London, 1975.
7. Standard Hand Book of Lubrication Engineering by O'Conner & Boyd, McGraw Hill.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	M		L	L				L	M	
2	H		M	M				L	M	M
3	H	M		H	L			M	H	H
4		M	M	L					L	L
5	M	H	M		M			L		M

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Theory of Plates and Shells
Course Number	**:**	ME674
Credits	**:**	04
Course Category	**:**	DE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. Imparting knowledge of modelling and analysis of two dimensional plain and curved structures.
2. To build the concept of formulation for general two dimensional bending problems.
3. To prepare students to apply their knowledge for practical applications of plates and shells for complex systems.

Course Outcomes:

Students who successfully completed this course will demonstrate the following outcomes

1. Ability to apply the concept of elasticity to obtain the force and moment resultants, the extensional and bending stiffnesses.
2. Ability to identify the behaviour of plates and shells under bending moment, twisting moment and general loading.
3. Ability to develop governing equations and explore the suitable solutions in bending for various boundary boundary conditions and geometry.
4. Explore the membrane theory to obtain the solutions of simple problems of thin shells.
5. Explore the recent shear deformable theories and their effects on the bending and natural vibration of thick plates and shells.

Syllabus:

Basics relationship for rectangular isotropic plates, bending moments and curvature, equilibrium of plate element, bending and twisting moments, curvature and twist, rectangular plate under transverse loading, governing equations and boundary conditions using Hamilton's Principle.

Navier solution for all round simply supported plates, rectangular plate with non-simply supported boundary conditions, Levy's solution, Ritz's solution, bending behaviour of isotropic plates under sinusoidal, uniform and patch loading.

Circular plate under radially symmetrical loading, circular plates with circular holes, bending moments and curvatures, governing equations with different support conditions.

General equations general elastic shell, linear strain displacement relations, thin shell theory, dynamic governing equations using Hamilton's principle, membranes theory, analysis of cylindrical and spherical shells, rotationally symmetric shells, shallow shell theory assumptions.

Concept of thick plates and shells, shear deformation effects, first order and higher order shear deformation theories for plates and shells, bending behaviour of laminated and functionally graded plates and shells.

Books:

1. Theory and Analysis of Plates Classical & Numerical Methods by Szlard, R. Cliffs. Prentice Hall, Englewood, N.J. 1974.
2. Theory of Plates & Shell by Tinoshenko, S.P. & Woinowsky Krieger S. McGraw Hill.
3. Stresses in Plates and Shells by Ugural, A.C., McGraw Hill N.Y. 1981.

Mapping of COs with POs:

Program outcomes	**Course outcomes**				
	1	2	3	4	5
a	H	H	H	H	H
b			M		H
c		H			M
d	M	H		M	L
e			M		
f					
g					
h	M			H	H
i					L
j	M		M		M

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Theory of Plasticity
Course Number	**:**	ME676
Credits	**:**	04
Course Category	**:**	DE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives:

1. The main objective of this course is to give the basis of the theory of plasticity, thereby making it relatively simple to analyse and design complex structures.
2. To give the student the ability to achieve a good physical understanding of the mechanical behaviour of complex structural elements and to be able to design and make calculations on these elements.
3. Be able to model complicated structures and their individual parts of principally arbitrary type.
4. To allow students become familiar with problem formulations and solutions in elasticity and plasticity; and prepare students for future study in advanced engineering mechanics.

Course Outcomes:

After taking this course students should be able to demonstrate

1. Students will have knowledge and understanding of the theory of plasticity for large deformations and the theory's applications in non-linear analysis of structures.
2. Students will understand the various theoretical elements of plasticity and the established plasticity models for metallic materials.
3. Students will be able to derive and apply equations in the theory of plasticity for large deformations and apply established plasticity models in the analysis of structures
4. Students will also be able to identify material parameters from laboratory experiments, and be able to implement plasticity models in the finite element method for nonlinear analysis of structures
5. They will also learn to read scientific papers and to carry out literature searches, and thus be able to form an impression of where the research frontier is in the field.

Course Syllabus

1. Introduction; Review of stress strain relation in three dimensions; Mohr’s circle for three-dimensional stress system. Idealized plastic behavior; yield criteria of metals. Experimental determination of yield locus; plastic stress-strain relation including Levy, Von-Mises and Prandtl-Reuss equation, work hardening.
2. Plastic bending of beams; collapse load in beams and simple structures; combined bending and torsion; torsion of prismatic bars; plastic stress distribution; elasto-plastic torsion of circular section; plastic banding of plates; annular plates clamped at its outer edge; elasto-plastic bending of circular plates by transverse load.

3. Plane plastic strain and theory of slip line construction of slip line fields; approximate construction of slip lines and their geometric properties; velocity field; limiting lines; load bounding; the lower and upper bound theorems; applications to various processes such as indentation, extrusion and forging.

Books:

1. Theory of Plasticity for Engineers by Hoffman & Sachs, McGraw Hill.
2. Plasticity for Mechanical Engineers by Johnson & Mellor, Van Nostrand.
3. Mathematical Theory of Plasticity, Hill Oxford.
4. Plasticity Theory and Application by A. Mandelson, Mc Millon Co.

Mapping of COs with POs:

PO's	CO's				
	1	2	3	4	5
a	H	H	M	H	M
b		H	H	M	H
c					
d			L	H	L
e					
f					
g					M
h	L	M	M	H	H
i		M	M	H	
j	M	H	H	H	H

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Random Vibration
Course Number	**:**	ME677
Credits	**:**	04
Course Category	**:**	PE
Pre-Requisites (s)	**:**	Mechanical Vibration
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives:

1. Imparting knowledge of random variables and random processes.
2. Ability to model systems subjected to random forcing functions and classification of various random functions.
3. Imparting knowledge of measurement of random data and role of accuracy of measurements.
4. Ability to model and analyze complex engineering problems involving non-linear random vibrations.
5. To provide the knowledge of statistical linearization approach.

Course Outcomes:

1. Ability to identify and classify the various random phenomenon occurring in physical systems for the efficient design of aerospace and earth quake resistant structures subjected to random loads.
2. Capability to model physical problems subjected to random forcing functions.
3. Imparting understanding of measurement techniques and processing of random data.
4. Capability to solve the governing equations for the analysis of non-linear random vibration problem.
5. Impart knowledge of spectral response analysis in order to quantify the response characteristics.
6. Ability to employ statistical linearization technique for the solution of systems with stationary response.

Syllabus:

Introduction to random variables and random processes, joint probability distribution of several random variables. Correlation functions of a random process, Fourier analysis, power spectral density function, wide-band and narrow band processes, response due to stationary random excitation for single and multi-degree of freedom systems. Frequency domain approach. Brief discussion on measurement and processing of random data, accuracy of measurements. Digital spectral analysis, Exercise on methods of solution of nonlinear random vibration problems, Statistical linearization for simple system with stationary response.

Books:

1. An introduction of Random Vibrations & Spectral Analysis by D.E. Newland, John Wiley & Sons, Inc. N.Y.
2. Random Vibrations and Statistical linearization by J.B. Roberts, P.D. Spanos.
3. Random Vibrations by N.C. Nigam.

Mapping of COs with POs:

PO's	**Course Outcomes**					
	1	2	3	4	5	6
a	H	H	H	H	H	H
b	H	M	M	H	L	M
c		H	M		H	L
d			M			M
e		H				
f						
g						
h	L	H	H	L	H	M
i	H					
j		M	M	M	L	M

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Rotor Dynamics
Course Number	**:**	ME678
Credits	**:**	04
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. Impart basic understanding of the rotor dynamics phenomena with the help of simple rotor models and subsequently carry out the analysis for real life rotor systems.
2. Ability to write down the differential equations of motion for simple, geared and branched rotor bearing system under transverse and torsional vibrations.
3. Capability to find out the critical speeds using different numerical methods, balance the unbalanced system and perform the instability analysis.
4. Apply of the knowledge of mathematics, science and engineering for the analysis and design of rotor-shaft systems with different kinds of bearings.
5. To be capable to boost research in the developing area of the rotor dynamics such as identification of rotor bearing system parameters and its use in futuristic model based condition monitoring and fault diagnostic.

Course Outcomes:

1. Proficiency to analyze the various effects associated with the rotor dynamics.
2. Ability to develop the vibration models of rotor bearing systems with changing complexities for real engineering systems.
3. Ability to formulate the response due to unbalance and instability in practical rotor systems.
4. Ability to use various vibration measuring and balancing instruments.
5. Ability to identify rotor bearing system parameters and capability to carry out research in condition monitoring and fault identification in rotors.

Syllabus:

Introduction, Simple rotors with rigid bearings, Jeffcott rotor model and variant of Jeffcott rotor model, Shafts stiffness constants, Rotor-bearing interactions: Effects of rolling element bearings and fluid film bearings on rigid and flexible rotors.
Flexural and torsional vibrations; critical speeds of shafts using Rayleigh's method, matrix iteration methods, Prohal and Myklested method; equivalent discrete systems; geared and branched systems; Gyroscopic effects.
Instability of rotors mounted on fluid film bearings; rigid rotor instability; instability of a flexible rotor; instability threshhold by transfer matrix methods; internal hysteresis of shafts; instability in torsional vibrations.
Balancing of rotors and balancing criteria for rigid and flexible rotors; bearing dynamic parameters estimation; measurement & digital processing techniques; condition monitoring of rotating machineries.

Books:

1. *Rotor Dynamics Published by J.S. Rao, New AGE International (P) Ltd., New Delhi ISBN 81 – 224-0977-6*
2. *Krämer E., 1993, Dynamics of Rotors and Foundations, Springer-Verlag, New York.*
3. *Genta, G., 2005, Dynamics of Rotating Systems, Springer, New York.*
4. *Yamamoto, T., Ishida, Y., 2001, Linear and Nonlinear Rotordynamics: A Modern Treatment with Applications, Wiley, New York.*

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	M								L	
2	H	M	L	M	M			L	L	M
3	L			M					M	M
4				H	M			M		L
5	H	L	M	M	L			L		M

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Experimental Stress Analysis
Course Number	**:**	ME679
Credits	**:**	04
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives:

1. The aim of this course is to enable students establish the fundamentals of experimental stress analysis.
2. To understand the relation between the mechanics theory and experimental techniques in stress-strain determination.
3. Understand basic principles of photoelasticity, and use it as an analysis tool.
4. Understand concept of stress and strain and the principles in using strain gages.
5. To provide the tools of research necessary to design equipment and/or instrumentation schemes for directed studies.

Course Outcomes:

After taking this course students should be able to demonstrate

1. A basic understanding of experimental methods (*e.g.* strain gages, photoelasticity etc.) commonly used in experimental solid mechanics.
2. The ability of experimental techniques on theoretical/mathematical grounds.
3. The skill to apply knowledge for the determination of stresses and strains.
4. The understanding for the application of optical techniques.
5. The ability to extend the knowledge in the generation of experimental reports and present their findings in a structured, logical manner.

Syllabus:

Experimental Stress Analysis
Importance of Experimental Methods and their scope, whole field and point by point methods, static and dynamic problems.

Photoelasticity
Photoelastic effect and polarised light, permanent and temporary birefringence, optics of plane and circular polariscope, dark and light background, isoclinic and isochromatic, stress optics law for two dimensional problems, secondary principal stresses.
Photoelastic model materials, preparation of models, fringe order, compensation techniques, scoparation of principal stresses using extensometer/ incidence, shear difference and numerical integration of Laplace equation, basic elements of three dimensional photo elasticity, photoelastic stress and strain gauges.

Other Optical Methods
Surface stress determination using birefringent coating, reinforcing thickness effects of photo stress ports, Moir's method, scattered light technique in photoelasticity, advantage and scope,

scattered light polariscope, elements of holography, preparation and interpretation of holograms.

Brittle Coating Methods
Characteristics and methods of applying brittle coatings on components, factors affecting accuracy failure analysis of cracks developed in coating, refrigeration technique, calibration methods, scope of application.

Strain Gauge Technique
Review of strain gauging technique, strain rosettes, transverse sensitivity, graphical and homographic solutions for determination of principal stresses from strain results, stress gauge.

Books:

1. *Dow and Adams, "Experimental stress analysis and motion measurements", Prentice Hall.*
2. *Dally and Riley, "Experimental Stress Analysis", McGraw Hill.*
3. *Durelli, "Applied Stress Analysis", Prentice Hall.*
4. *Frocht, "Photoelasticity Vol. 1 & 2", John Wiley.*
5. *Durelli and Riley, "Introduction to Photomechanics", McGraw Hill.*

Mapping of COs with POs:

PO's	**CO's**				
	1	2	3	4	5
a	H	M		L	
b		H	M	L	
c	H				
d	L	L	H	H	
e				M	H
f					
g					
h		M	H		
i					L
j		H	L	M	

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Dynamics of Mechanical System
Course Number	**:**	ME681
Credits	**:**	04
Course Category	**:**	PE
Pre-Requisites (s)	**:**	Engineering Mechanics, Machinery Dynamics
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives

1. Development of an understanding of the general principles and laws of motion, constraints and tensorial transformation.
2. To be able to make mathematical model and analyse multi-body dynamical systems using fundamental laws of motion.
3. Ability to model and analyse gyroscopic and cam-follower systems.
4. To derive the governing dynamics of autonomous systems with holonomic/non-holonomic constraints.
5. To provide an insight into the stability analysis and control algorithm for vibration suppression.

Course Outcomes

1. Exposure to single-/multi- particle dynamics, generalized co-ordinate systems and tensorial transformations.
2. Ability to employ gyroscopic principles for the stability analysis of marine, aerospace and surface transport vehicles.
3. Capability to design cam-follower systems for specific applications.
4. Ability to develop the mathematical models of multi-body dynamical systems using Hamiltonian, Langrangian approaches.
5. Ability to apply graphical techniques such as phase-plane plots, response spectra etc. to explore the dynamic characteristics.Ability to carry out stability analysis and feedback control of mechanical systems.

Syllabus:

General Principles, fundamental laws of motion, generalized coordinates, holonomic and non-holonomic constraints, dynamics of particle and systems of particles, orthogonal transformation of coordinates, general tensor transformation, Euler's equation of motion.
System Dynamics, motion of gyroscopes, mechanical transients, phase plane representation; response of linear systems to transient forcing functions, cam dynamics; mathematical model of cam systems; response of follower by Laplace transform and phase-plane methods; jump and crossover shocks; spring surge and wind-up; principles of rocket motion.
Derivation of equations of motion using Lagrange's equation and Hamilton's principle, application of Lagrange's equation for conservative and non-conservative, autonomous systems with holonomic and non-holonomic constraints; applications to systems with small displacements and to impulsive motion.
Stability analysis using Laiapunov and Routh Hurwitz criteria for linear systems, control system dynamics, block diagram representation, response of first order and second order systems, feedback control analysis of linear systems.

Books:

1. Dynamics of Multibody Systems, Ahmad A Shabana, Cambridge University Press
2. Dynamic Analysis of Machines by Shigley, McGraw Hills.
3. The Stability of Motion by Chetayev, Pergamon Press.
4. Principles of Dynamics by Greenwood, Prentice Hall.
5. Automatic Control Engineering by Raven, McGraw Hill.

Mapping of COs with POs:

PO's	**Course Outcomes**					
	1	**2**	**3**	**4**	**5**	**6**
a	**H**	**H**	**H**	**H**	**H**	**H**
b	**L**	**M**	**H**	**M**	**H**	**M**
c			**M**		**M**	**H**
d			**M**			**M**
e			**M**			
f						
g						
h	**L**	**M**	**H**	**L**	**L**	**H**
i						
j			**M**	**M**		**M**

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Mechanics of Composite Materials
Course Number	**:**	ME682
Credits	**:**	04
Course Category	**:**	DE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25%

Course Objectives:

1. To develop an understanding of the linear elastic analysis of composite materials.
2. To build the concepts of anisotropic material behaviour, laminate mechanics and the analysis of laminated plates.
3. To build the concept to formulate and solve problems on mechanics of composite materials using classical methods.
4. To prepare students to undertake projects on the applications of fiber reinforced composites as structural members in various mechanical systems.

Course Outcomes:

Students who successfully completed this course will demonstrate the following outcomes

1. Ability to understand the manufacturing techniques of composite materials and to identify their effective mechanical properties.
2. Ability to understand the mechanics of fibrous composite materials and the ability to understand the stress and strain transformations, and the transformation of material properties.
3. Capability to understand the macro and micro mechanical behaviour of lamina and to understand the concept of finding laminate properties from the lamina.
4. Ability to understand the failure and damage mechanisms in unidirectional fiber composites.
5. Capability to formulate the linear elastic problems and to obtain their solutions for bending, buckling and vibration of composite structures.

Syllabus:

Introduction to composite materials, classification and characteristics, mechanical behavior, micro and macro mechanics, evaluation of effective elastic constants, Halpin-Tsai equation.
Fibre reinforced polymer composites, manufacturing techniques, multi-layered laminates, cross-ply and angle-ply laminates.
Failure analysis of unidirectional fibre reinforced composite, Tsi-Hill, Tsi-Wu criteria, Hoffman failure criteria.
Analysis of lamina and laminates, linear stress-strain relations, transformation of stress and strains tensors, equilibrium equations, force and moments resultants, composite lamina under longitudinal, transverse and shear loads.
Bending, buckling and free vibration of laminated beams and plates.

Books:

1. Mechanics of Composite Materials by Jones, McGraw Hill.
2. Analysis of Structural Composite Materials by Gar, et.al. Marcel Dekkar Inc. NY.
3. Behaviour of Structures Composed of Composite Materials by Vinson & Martinus Nijhoff & Sierakowski.
4. Composite Materials Vol. 1 – 8 by Bronman & Krock, Academic Press.
5. Mechanics of laminated composites plates and shells, theory and practice, JN Reddy, CRC press.

Mapping of COs with POs:

Program outcomes	**Course outcomes**				
	1	2	3	4	5
a	x	x	x	x	
b					
c					x
d	x			x	x
e					
f	x				
g					
h					x
i					x
j					x

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Computer Methods in Mechanical Design
Course Number	**:**	ME684
Credits	**:**	04
Course Category	**:**	DE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course Objectives:

1. To impart knowledge of topics addressing the impact of CAD in engineering design and analysis,
2. To develop the ability to establish the CAD techniques appropriate for mechanical engineering applications.
3. To apply knowledge of interdisciplinary nature of computer graphics, geometric modelling and engineering design in the wide variety of applications.
4. To develop knowledge of theoretical principles in optimization and artificial intelligence.

Course Outcomes:

After taking this course students should be able to:

1. Analyse and use appropriate engineering computer graphics and geometric modelling techniques for mechanical engineering applications.
2. Write programs that demonstrate geometrical transformations, computer aided analysis and synthesis of mechanisms.
3. Apply FEM techniques on basic structural analysis.
4. Develop knowledge of theoretical principles in optimization and artificial intelligence.
5. Formulate and solve basic engineering optimization problems.

Syllabus:

Introduction and overview, Need and Scope of Computer Aided Machine Design, Role of Geometric Modelling. Principles of software design, Geometric modelling, Principles of interactive computer graphics and overview of hardware available for use in CAD. Geometric transformations and Projections. Windowing and view porting. Modelling of curves, surfaces and solids. Introduction to finite element methods. One dimensional elements.

Derivation of stiffness and mass matrices for a bar, a beam and a shaft static and dynamic analysis of bars, beams and shafts. Comparison with analytical results. Case studies using FEM for design of simple element geometries such as a tapered bar, a plate with a hole and a spanner Overview of optimization methods, formulation of optimization problem. Single variable and multiple variable optimization. Applications for optimization to simple machine design problems such as design of gear spring and a shaft. Practice in using CAD packages and FEM software on other real life problems like spanners and connecting rods etc.

Books:

1. *Computer Aided Kinetics for Machine Design by Ryan, Marcel Dekker, NY.*
2. *David F. Rogers & J.A. Adam; Mathematical elements for Computer Graphics, McGraw Hills.*
2. *Principles of interactive Computer Graphics by Newman, McGraw Hills.*
3. *Fundamentals of FEM by Cook, McGraw Hills.*

PO's	CO's				
	1	2	3	4	5
a	H	M		L	
b					
c		H			M
d					H
e	L		H	M	
f					
g			M		
h		L		H	
i					L
j	M		L		

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Mechanics of Composite Materials
Course Number	**:**	ME682
Credits	**:**	04
Course Category	**:**	DE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Assignments, Quizzes 15% Mid Semester Examination 25% End Semester Examination 60%

Course objectives:

1. Introduce students to basic notion of tensor algebra and calculus.
2. To inculcate fundamental concept of stress and strain tensors related to finite deformation of continua.
3. Let the student have basic understanding of conservation of mass, momentum, energy related to continua.
4. To inculcate the knowledge of constitutive relation for variety of materials.

Course outcomes:

1. Ability to understand basic notion of tensor algebra and tensor calculus.
2. Student should be able to have the physical insight into the different measures of stress and strain.
3. Ability to identify a physical continuum mechanics problem and formulate mathematical model for it.
4. Capability to model large deformation problems for a variety of materials.
5. Student must learn mathematical modeling of materials and formulation of balance principles.

Syllabus:

Introduction to continuum concept and continuum mechanics, Algebra of Tensors, Eigen value and Eigen vectors, Transformation laws for Tensors, Gradient and Related operators, Integral Theorems.

Motion of Continuum bodies (Reference and current configuration), Displacement, velocity and acceleration fields, Material and spatial derivatives, Deformation gradient and strain tensors.

Concept of Traction vector and stress tensor, Principle and octahedral stresses, Alternative stress measures, change of observer and objective tensor fields, Objective rates: Jaumann, Green-Naghdi

Balance principles: Conservation of mass, Reynolds transport theorem, Momentum balance, Balance of Mechanical energy, Entropy inequality, Second law of thermodynamics, Clausius-Duhem inequality.

Books:

1. Nonlinear Solid Mechanics: A Continuum Approach for Engineering, *G. A. Holzaphel*.
2. Introduction to the Mechanics of a Continuous Medium, *L. E. Malvern.*
3. Continuum Mechanics for Engineers, *G. T. Mase and G. E. Mase*.
4. Elements of Continuum Mechanics, *R. C. Batra.*

Mapping of COs with POs:

Program outcomes	Course outcomes				
	1	2	3	4	5
a	H	H			M
b	M	M			
c			H	H	
d		L	M	L	H
e					
f					
g					
h					
i					
j				M	L

THERMAL SCIENCES

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Engineering Mathematics
Course Number	**:**	AM632N
Credits	**:**	4
Course Category	**:**	PC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

To learn numerical solution of ordinary and partial differential equations integral equations, transformations and tensors

Syllabus:

Numerical solution of system of ordinary differential equations by Runge-Kutta method of order four, numerical solution of partial differential equations: Laplace Poisson, Heat conduction and wave equations. Curve fitting by least square method.

Fredholm and Volterra integral equations of the first and second kinds

Conformal mapping, linear, bilinear, reciprocal, exponential and Schwarz-Christoffel transformations.

Tensors: Contravariant and covariant tensors, inner and outer products, metric tensor. Christoffel symbols of the first and second kinds.

Course Outcomes:

1. Solve ordinary and partial differential equations numerically.
2. Solve integral equations.
3. Understand and apply transformations in engineering problems.
4. Use tensors in engineering applications.

Books:

1. Murray R. Spiegel, Vector and introduction to Tensor Analysis – Sachaum's outline Series, McGraw Hill.
2. M.K. Venkataraman, Numerical methods, National Publishing Company.
3. M.K. Venkataraman, Higher Mathematics, National Publishing Company.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X		X	X						
2	X		X	X						
3	X		X	X						
4	X			X						

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Instrumentation & Automatic Control System
Course Number	**:**	ME630
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course outcomes:

After taking this course students should be able to

1. Understand the basic characteristics of a measurement system
2. Understand the working principle of different measuring instruments
3. Design a measurement system
4. Understand the basic philosophy of feedback control systems their implementation to the physical system.
5. Understand the solution of a dynamic problem and implementing the control laws using state space for dynamical problems.
6. Understand the implementation of nonlinear control algorithm to the solution of the nonlinear dynamical problems.

Syllabus:

Safety and environment at workplace, Instrument and measurement systems, Sources of uncertainty and errors, Behavior of first order and higher order instruments, Static and dynamic characteristics of instruments, Noise in measurement systems, Filtering and signal analysis, Measurement and control of various response parameters.

Transducers and sensing elements, Mass sensing elements, Thermal detectors, thermo-couples, hydro-pneumatic sensors, electro-mechanical transformation, Piezoelectric sensors and actuators, velocity, acceleration piezoelectric & magneto-striction transducers, Optical instrumentation.

Classification and representation of control systems, open and closed-loop systems, Concept of Feedback, Review of classical control systems, control response analysis in time and frequency domain analysis, Stability analysis of control response, Modern control system design in state space, Model reduction, Concept of negative velocity feedback.

Optimal control design, Performance index, Algebraic Riccati equation, Linear Quadratic Gaussian (LQG) control, Statistical descriptions of noise, Kalman filter, Controllability and observability.

Applications of linear control system in noise and vibration reduction in instruments, Vibration control of structures and machines, Control of thermos-fluid systems, Nonlinear systems and Linearization of nonlinear systems, Solution of some nonlinear control problems, Robust control design, Implementation of control systems in MATLAB and SIMULINK.

Books:

1. J.P. Bentley, Principle of Measurement Systems, John Wiley and Sons.
2. J. P. Holman, Experimental methods for engineers, McGraw Hill
3. J. B. Burl, Linear optimal control, Addison-Wesley.
4. K. Ogata, Modern control engineering, Pearson education.
5. J. J. E. Slotine, and W. Li, Applied Nonlinear Control, Prentice–Hall, Upper Saddle River, NJ.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Numerical Methods
Course Number	**:**	ME640
Credits	**:**	4
Course Category	**:**	PC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

1. Development of an understanding the concepts of computer number representation and round-off error propagation during arithmetic operations.
2. To impart knowledge of MATLAB (basic features involving linear algebra, file handling and scientific visualization).
3. To impart knowledge of basic numerical tools like construction of polynomial interpolation (global and piecewise) on 1D and higher dimensional data sets. Awareness of practical issues in interpolation and their remedies.
4. Understanding the concepts of simple and non-simple roots of a nonlinear algebraic or transcendental equations and applications of different types of bracketing and non-bracketing methods for root estimation.
5. Development of concepts of numerical estimation of derivatives and integrals. Knowledge of basic Newton-Cotes and Gauss integration formulae and their applications. Handling improper integrals and integrand discontinuities.
6. To provide knowledge of methods of integrating Ordinary Differential Equations.
7. To impart knowledge of basic concepts in linear algebra, types of matrices, vector and matrix norms, Direct and Iterative Solution methods.
8. To provide basic concepts of parallel programming through MPI.

Course Outcomes:

1. Ability to apply the knowledge of basic numerical methods in obtaining solutions of various mathematical models encountered in research, analysis and design.
2. Ability to apply the knowledge of basic numerical methods in the development of advanced numerical methods like FEM, FDM etc. for the solution of mathematical models represented by ODE's / PDE's.
3. Ability to analyze the data trends by utilizing the techniques of function representation via interpolation
4. Capability to utilize the available softwares like MATLAB and various built-in MATLAB functions for solution of mathematical models, data analysis and visualization.
5. Capability to write parallel codes using MPI.

Syllabus:

Number Representation: Representation of decimal numbers integers and floats, machine epsilon, Round-offerror, error propagation in arithmetic operations, Truncation error.

MATLAB: Introduction, Basic operations involving scalars, vectors and matrices, built-in functions for vectorand matrix analysis, Programming constructs, Plotting commands - XY plots, Contour plots, 3D plots

Interpolation: Global Polynomial interpolation methods, Interpolation errors, Piecewise polynomial methods - Splines. Multi-dimensional polynomial interpolation, linear and Bilinear Lagrange interpolation in 2D.

Root finding: One Dimensional models: Simple and Non-simple roots, Bracketing and non-Bracketing methods, Higher Dimensional models: Non-linear Systems of algebraic equations.

Numerical Differentiation: Finite difference approximations, central and biased schemes for first and second order derivatives, Higher order Compact Schemes, least square methods, Practical issues.

Numerical Integration: Newton-Cotes lntegration methods, Gauss Quadratures-Gauss-Legendre and Gauss-Laguerre methods, Practical issues- Improper integrals, Integrand discontinuities.

ODE systems: Initial and Boundary value problems, R-K methods, Multi-step methods, Stiff systems, shooting and Finite Difference methods.

Linear Algebra: Linear non-homogenous systems-Direct methods, Iterative methods - Stationary and Non-stationary methods, Jacobi's method, Gauss Siedel and SOR methods, Multi-grid acceleration, Linear homogenous systems or Eigenvalue problems-Power method, Simultaneous Iteration, QR method.

High Performance computing: Basic MPI subroutines, basic MPI commands, MPI and 2D models, Domain decomposition and classical methods for linear systems.

Books:

1. Applied Numerical Methods with MATLAB by Steven C. Chapra, Tata McGraw-Hill, 2e, 2007.
2. Applied Numerical Methods for Engineers using MATLAB and C by Robert J Schilling and Sandra L. Harries, Thomson Brooks / Cole, 2000.
3. Iterative methods for sparse linear systems, 2nd Edition, Yousef Saad, SIAM, 2003.
4. Getting Started with MATLAB 7: A quick introduction for scientists and engineers by Rudra Pratap, Oxford University Press, Indian Edition, 2006.
5. Computational Mathematics: Models, methods, and analysis with MATLAB and MPI by Robert E. White, CRC Press, 2004.
6. Using MPI by W. Gropp, E. Lusk and A. Skjellum , MIT Press, 1995.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X									
2	X	X	X							
3	X	X	X	X						
4	X	X	X							
5	X	X	X							

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Thermodynamics
Course Number	**:**	ME641
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	Basic Thermal Sciences
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

1. The purpose of this course is to familiarize the students with the application of thermodynamics as well as to provide the knowledge of thermodynamics.
2. The students shall be given a detailed understanding of thermodynamic relations, multicomponent systems, exergy, thermodynamics of special systems and statistical thermodynamics.

Course Outcomes:

The outcomes of this course may be written as:

1. The students will be able to use thermodynamic relations and different charts like compressibility, entropy, enthalpy and fugacity for solving real problems.
2. They will be able to apply the Thermodynamic aspects to chemical reaction (chemical equilibrium).
3. Students will be able to calculate Entropy generation for open and closed systems and perform exergy analysis of various systems.
4. They will be able to understand thermodynamics of special systems.
5. They will be able to acquire knowledge of statistical thermodynamics and use them in practical problems.

Syllabus:

Real gas behaviour: Review of thermodynamic relations; Real gas equations of State (Van der waals, Redlich-Kwong, Peng-Robinson, Virial etc.); Development and use of generalized charts for compressibility, enthalpy/entropy correction; Fugacity coefficient; Real gas mixtures.

Multicomponent systems: Partial molar properties; Gibbs-Duhem relation; Fugacity coefficient of a component in a real gas mixture; Chemical equilibrium, Equilibrium constant Kp and its various forms; Kp variation with temperature Simultaneous chemical reactions.

Irreversibility, availability (exergy) and entropy production: Reversible and irreversible work, Reversible work in non-flow and flow processes, Entropy balance for isolated, closed and open systems; Exergy balance, irreversibility and second law efficiency for isolated, closed/open systems and heat exchangers; Exergy destruction; Second law analysis of reacting systems; Introduction to Irreversible thermodynamics; Onsager's reciprocal relations; Thermoelectric phenomena.

Thermodynamics of Special Systems: Generalized work; Maxwell equations and Tds relations for elastic, dielectric piezoelectric systems, reversible cell and magnetic systems.

Statistical Thermodynamics: Thermodynamic probability, Entropy and probability, Degeneracy of energy levels, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein statistics, Microscopic interpretation of heat and work; Evaluation of entropy; Partition function; Determination of microscopic properties from partition function.

Books:

1. Fundamentals of Thermodynamics, Seventh Edition, by Claus Borgnakke and Richard A. Sonntag, Wiley India, Pvt. Ltd, 2008.
2. Thermodynamics, An Engineering Approach, Seventh Edition, by Yunus A. Cengel and Michael A. Boles,Tata McGraw Hill Education Pvt. Ltd, 2008.
3. Thermodynamics Principles & Practice by Michael A. Saad, Prentice-Hall Intl, 1977.
4. Fundamental of Thermodynamics, Second Edition, by E. Ratharishnan, Prentice Hall of India, Pvt. Ltd, New Delhi, 2006.
5. Thermodynamics by J.E. Lay, Prentice Hall.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X						X	X		
2	X	X						X		X
3	X	X					X	X		
4		X	X					X		X
5		X	X	X			X	X		X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Conduction and Radiation Heat Transfer
Course Number	**:**	ME643
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	Heat and Mass Transfer
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

The main focus of the course is on methods for solving conduction heat transfer problems. The emphasis will be on analytical and also on than numerical methods. In addition, the course explores the theoretical and practical aspects of radiative properties of black and non black surfaces. The course also deals with radiant exchange between surfaces with and without a participating media. The course will require the use of a mathematical software package to perform numerical evaluations of functions/solutions and to plot the solutions like high–level packages such as Mathematica, MatLab, Maple, or low–level, computer language methods (Fortran, C++).

Course Outcomes:

After taking this course students should be able to:

1) Develop an understanding of the concepts of conductivity tensor and its inhomogeneity.
2) Develop an understanding of generalized conduction equation and methods of obtaining exact solution in transient and multi-dimensional conduction problems.
3) Ability to solve numerically transient multi-dimensional conduction problems under different boundary conditions.
4) Develop an understanding of the different concepts of radiation like Spectral hemispherical emissive power and Radiation pressure
5) Ability to solve problems with radiation heat transfer between two or more surfaces using a mathematical software.
6) Ability to solve problems with radiation exchange with participating medium.

Syllabus:

Conduction:
Derivation of generalized conduction equation for an isotropic in-homogenous solids; conductivity tensor; concepts of isotropic & homogenous conductivity. Analysis and Optimization of variable cross section and circumferential fins with uniform and variable heat transfer coefficients; Extended surfaces with relative motion; wire drawing. 2-D conduction in solids with complex boundary conditions; Ablation; Numerical solutions for transient and steady conduction problems.

Fundamentals of radiation heat transfer:
Importance of thermal radiation,
Black body and its characteristics: Planck's distribution, Rayleigh-Jeans distribution.
Radiative properties of non-black surfaces
Radiation heat transfer between surfaces: Enclosure theory, View/shape factor relations

Radiation between surfaces with and without participating media,
Radiation exchange with specular surfaces. Formulation for numerical solution.

Books:

1. Heat Conduction by M.N. Ozisik, John Wiley & Sons.
2. Heat Transfer by J.P. Holman, International Edition, McGraw Hills.
3. Essentials of Radiation Heat Transfer by C. Balaji, John Wiley & Sons Ltd.
4. Radiative heat transfer, Modest M. F., Academic Prcss, London.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X						X	X		X
2	X	X	X				X			X
3		X	X				X			X
4	X									X
5	X	X	X					X		X
6		X	X				X	X		X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Combustion Engineering
Course Number	**:**	ME644
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	Basic Thermal sciences
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

1. To familiarize students the applications of combustion and to impart knowledge of basic combustion processes, conservation equations of reacting flow.
2. To teach students the calculation of flame temperature, rates of reactions, burning velocities, detonation velocities and provide them the understanding of flame structure of premixed and diffusion flames and properties estimation methods.

Course Outcomes:

1. Students can apply the knowledge of combustion to analyze the performance of engines and power plants, quantify the effect of parameters (ambient temperature, pressure etc.) on adiabatic flame temperature and use knowledge of conservation equations of reacting flows.
2. Students will be able to calculate reaction rates, their temperature dependency and understand important reaction mechanisms.
3. They can analyze the diffusion flame structure and droplet combustion.
4. 4. They will have a thorough knowledge of estimation techniques required for determining thermos- physical and transport properties of gases and liquids in high temperature, high pressure environment.

Syllabus:

Combustion fundamentals: Applications of combustion, Effect of temperature, pressure and fuels on flame temperature, Simplified conservation equations for reacting flows.

Chemical kinetics: Empirical analysis of reaction rates and their temperature dependency, chain and multistep reactions, specification of reaction mechanism, global kinetics.

Premixed flames: explosion***,*** oxidation characteristics of fuels, burning velocity, cool flames, detonation and deflagration, Rankine-Hugoniot curve.

Diffusion flames: flame structures, advanced topics in droplet combustion.

Properties estimation methods: Evaluation of thermo physical and transport properties of gases and liquids in high temperature, high pressure environment.

Books:

1. Combustion Engineering, second edition by Ragland and Bryden, McGraw Hill, 2011.
2. An introduction to Combustion, third edition by Stephen Turns, McGraw Hill, 2012.

3. Combustion, fourth edition by Irvin Glassman, Richard A.Yetter, Academic press, 2008.
4. Principles of combustion, second edition by Kenneth K. Kuo, John Wiley and Sons. 2005
6. The properties of gases and liquids. Fourth edition by R.C.Reid, J.M. Prausnitz and B.E.Poling, 1989.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X						X	X		X
2	X	X		X			X	X		
3	X	X		X			X			X
4	X	X	X	X				X		X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Fluid Dynamics
Course Number	**:**	ME645
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	Fluid Mechanics
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

1. Development of an understanding of the concepts of vorticity and its dynamics in fluid flows.
2. To impart knowledge of advanced methods of analysis of potential flows.
3. To impart knowledge of airfoil aerodynamics using thin airfoil potential flow theory.
4. To develop an understanding of Navier-Stokes equations for viscous fluid flow and methods of obtaining different exact solutions alongwith their physical interpretation.
5. To provide knowledge of similarity solutions of Boundary Layer equations subjected to pressure gradients.
6. To provide knowledge of methods of analysis of Turbulent flows and Reynolds stress concepts.
7. To provide knowledge of canonical wall bounded turbulent flows like channels and pipes.
8. To provide knowledge of Jet flows.

Course Outcomes:

1. Ability to analyze vorticity dominated flows.
2. Capability to analyze potential flow using advanced methods like panel methods with application to airfoils.
3. Capability to formulate viscous fluid flow problems together with techniques for obtaining exact solutions wherever possible.
4. Capability to formulate and analyze Turbulent flows using turbulence models (RANS approach).
5. Ability to design wall bounded turbulent flow systems like channels and pipes. Ability to design flow systems involving jet-like flows.

Syllabus:

Vorticity Dynamics
Review of Mathematical relations, Vortex line, vortex tube and vortex filament, rate of change of vorticity of fluid particle, Helmoltz theorem, rate of change of circulation on a curve and Kelvin's theorem, Velocity induced by a vortex filament, Biot-Savart Law, Decay of a line vortex in a viscous fluid.

Potential Flow
Singularity distribution, Small disturbance theory, similarity rules, K-J theorem, Methods of superposition of singular solutions, Method of images, Complex variable techniques, Conformal Mappings, Thin Airfoil theory, Glauerts & Gothered transformations.

Viscous Flow
Exact solutions of N-S Equation, Turbulence, Reynolds Equation, Turbulent Flow through pipes and over flat surfaces, Solutions of B.L. Equation. Using similarity transformations, Falkner-Skan solutions for wedge flows, Slender body theory, Subsonic and Supersonic Turbulent Jets, Active and Passive Control of Jets.

Books:

1. Principles of Ideal Fluid Aerodynamics by Krishnamurthy Karamcheti.
2. Boundary Layer Theory by H. Schlichting.
3. Fluid Dynamics by G.K. Batchler.
4. Theory of Turbulent Jets by Abramovich.
5. Fluid Dynamics Theoretical & Computational Approach by Z.U.A. Warsi.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	C	d	e	f	g	h	i	J
1	X		X							
2	X	X								
3	X	X	X							
4	X	X	X							
5	X			X						
6	X			X						

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Convective Heat Transfer
Course Number	**:**	ME646
Credits	**:**	4
Course Category	**:**	DC
Pre-Requisites (s)	**:**	Heat and Mass Transfer
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Outcomes:

1. Development of 3D unsteady (generalized) momentum, energy and mass transfer equations in the Cartesian system, representing them in tensor and vector notations, expandable to other coordinate systems.
2. Development of generalized Integral form of Momentum and energy equations, identification of the displacement, momentum, conduction and enthalpy thicknesses, solutions for variable free stream velocities over curved surface.
3. Analysis of momentum and energy boundary layers in pipe flows, identification of entrance and fully developed region during laminar flow, solution of energy differential equations for constant heat flux and constant wall temperature conditions.
4. Carrying similarity solutions for forced convection laminar velocity and thermal hydrodynamic boundary layers, Wedge Flows, Transpiration Cooling, flow over a body of arbitrary shape and for free convection.
5. Knowledge of turbulent heat convection and modifying the laminar momentum and energy equations for turbulent flows.
6. Learning the flow regimes for the forced and natural boiling, their applications and design methods. Learning the process of condensation over different surfaces, carrying modelling of film condensation for different applications.

Syllabus:

Generalized Momentum and Energy Equations

1. Navier – Stokes Equation for 3D flow
2. 3D Energy Equation
3. Tensor and Vector Notations
4. Mass Transfer Equations of Boundary layer

Momentum and Energy equations for flow over a body of revolution

1. Integral Momentum equation of the Boundary layer
2. Displacement and Momentum thickness
3. Energy Integral Equation for a body of revolution
4. Conduction and enthalpy thickness
5. Solutions for constant free stream and variable free stream velocities over a curved surface

Heat Transfer in Circular Tubes

1. Fully Developed Laminar Flow
2. Energy Differential equations
3. Fully Developed Temperature and Velocity Profiles

4. Constant Heat Flux Solutions
5. Constant Wall Temperature Solutions

Similarity Solutions

1. Similarity solutions for the laminar hydrodynamic Boundary layer
2. Similarity solutions for Wedge Flows
3. Transpiration Cooling
4. Similarity solutions for the laminar thermal Boundary layer
5. Similarity solutions for flow over a constant temperature body of arbitrary shape
6. Similarity Solutions for External Boundary layer during free convection

5. Fundamentals of Turbulent Heat Convection
6. Forced and natural boiling
7. Condensation

Books:

1. Convective Heat Transfer by W. M. Kays and M. E. Crawford; McGraw Hill inc.
2. Convective Heat Transfer by Adrian Bejan; John Wiley and Sons.
3. Convective Heat Transfer Analysis by Patrick H. Oosthuizen / David Naylor; McGraw Hill International Edition

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	J
1	X	X		X				X	X	X
2	X								X	X
3	X							X	X	X
4	X							X	X	X
5	X								X	X
6	X	X	X					X	X	X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	:	Simulation Laboratory
Course Number	:	ME695
Credits	:	3
Course Category	:	Core
Pre-Requisites(s)	:	None
Contact Hours	:	0-3-0
Type of Course	:	Laboratory
Course Assessment	:	Course Work 60 marks End Sem Examination 40 marks

Course Outcomes:

1. Understanding basics of Geometrical Modeling of physical systems in different software.
2. Applying the principles of grid generation to generate meshes in Cartesian and body fitted coordinate systems.
3. Analyzing thermo-fluid systems using simulation softwares
4. Conduct both Steady state and Transient (time dependent) fluid flow simulations
5. Understanding of visualization software.
6. Applying symbolic mathematics software to solve ODE.
7. Generate, describe, present and derive numerical data faithfully.

Syllabus:

Modeling Fundamentals: Principles, Model set up procedures including Grid Considerations and requirements, Boundary Conditions types and the user input for each boundary type, Physical properties of materials and the required user input, Turbulence modelling, solution control parameters and discretization schemes.

Case studies of Model Problems on Incompressible flows: Fluid Flow and heat transfer of a uniform flow past bodies; Modeling periodic flow and heat transfer in a channel**.**

Case studies of Model Problems on Compressible flows: Fluid Flow on a uniform flow Airfoil and other bodies.

Case studies of Model Problems on Heat Transfer: Heat Transfer analysis of conjugate gradient problems.

Case study on temperature variation in a slab using ODE solver.

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Project
Course Number	**:**	ME691T
Credits	**:**	3
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-3-0
Type of Course	**:**	Practical
Course Assessment	**:**	Course Work 60 marks End Sem Examination 40 marks

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts/data from various available sources (Journals, articles, web-based resources etc.)
2. To impart training to recognize and incorporate social, ethical and professional aspects in technological solutions.
3. To provide an exposure to the analysis / solution of a real world complex engineering problem.
4. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
5. To develop data representation and interpretation skills along with an approach of critical reasoning.
6. To develop documentation and technical report writing skills.
7. To develop overall management (technical and financial) skills required for successful completion of research and design task.
8. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Capability to identify a potential research and design problem on the basis of a literature survey.
3. Awareness of social, professional and ethical aspects associated with a given technology.
4. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
5. Capability to employ various data analysis (visualization and interpretation) approaches and to extract the relevant trends through logical and critical reasoning.
6. Ability to effectively communicate the research / design / analysis through technical reports.
7. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

	Program Outcomes									
Course Outcome	a	b	C	d	e	F	G	h	i	J
1			X					X		
2			X					X		
3										X
4	X	X	X	X						
5	X	X		X						X
6							X			
7						X				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Thermo-Fluid Lab.
Course Number	**:**	ME794
Credits	**:**	3
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-3-0
Type of Course	**:**	Laboratory
Course Assessment	**:**	Course Work 40 marks End Sem 60 Marks

Course Outcomes:

1. Evaluating aerodynamic coefficients of streamline and bluff bodies in subsonic flows.
2. Evaluating flow characteristics of Convergent-divergent nozzles in compressible flow.
3. Introducing the concept of Particle image velocimetry on bluff bodies.
4. To conduct numerical experiments on 2D bluff and streamline bodies using ANSYS

Mapping of COs with POs:

Program Outcomes/Course Outcomes	a	b	c	d	e	f	g	h	i	j
CO-1	X	X		X	X					X
CO-2	X	X		X	X					X
CO-3		X		X	X		X			
CO-4	X	X		X	X					X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Preliminary Seminar
Course Number	**:**	ME781T
Credits	**:**	3
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-0-3
Type of Course	**:**	General
Course Assessment	**:**	Course Work 60 marks Mid Sem Examination End Sem Examination 40 marks

Course Objectives:

1. To assess the plan of study / work for feasibility in terms of research potential and the required infrastructural support at the Departmental level.
2. To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
3. To develop the ability for justification and defence of a research proposal.
4. To develop documentation and research proposal writing skills.
5. To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Capability to identify a potential research and design problem on the basis of a literature survey.
3. Capability to identify proper theoretical / research methods and tools for obtaining solutions for a specific problem.
4. Ability to effectively communicate the research plan through a technical report.
5. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	J
1	X		X					X		
2	X		X							
3	X	X	X							
4			X				X			
5			X			X				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title : Dissertation Seminar.
Course Number : ME782T
Credits : 2
Course Category : DC
Pre-Requisites (s) : None
Contact hours : 0-0-0
Type of Course : General
Course Assessment : Course Work 60
Mid-Semester Examination
End-Semester Examination 40

Course Objectives:

1. To assess the study / work for submission feasibility as a thesis.
2. To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
3. To develop the ability for justification and defence of research work.
4. To develop documentation and research report/thesis writing skills.
5. To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcome:

1. Capability to justify and defend a research work/thesis.
2. Ability to effectively communicate the research work through a technical report.
3. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	J
1							X			
2							X			
3						X				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Dissertation
Course Number	**:**	ME798T
Credits	**:**	10
Course Category	**:**	DC
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0-0-3
Type of Course	**:**	General
Course Assessment	**:**	Course Work 60 Mid-Semester Examination End-Semester Examination 40

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts / data from various available sources (Journals, articles, web-based resources etc.)
2. To provide an exposure to the analysis / solution of a real world complex engineering problem.
3. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
4. To develop data representation and interpretation skills along with an approach of critical reasoning.
5. To develop documentation and technical report writing skills.
6. To develop overall management (technical and financial) skills required for successful completion of research and design task.
7. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Capability to identify a potential research and design problem on the basis of a literature survey.
3. Awareness of social, professional and ethical aspects associated with a given technology.
4. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
5. Capability to employ various data analysis (visualization and interpretation) approaches and to extract the relevant trends.
6. Ability to effectively communicate the research / design / analysis through technical reports.
7. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	J
1			X					X		
2			X		X			X		
3										X
4	X	X	X	X						
5	X	X		X						X
6					X		X			
7					X	X				

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Air Pollution Control
Course Number	**:**	ME661
Type Of Course	**:**	Theory
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Course Assessment	**:**	Home Assignment / quiz – 15% Mid-Semester Examination (1 hour) – 25% End-Semester Examination (3 hour) –60%

Course Objectives:

1. To create awareness about the effects of air pollution and its control strategies
2. To develop capability to carry out sampling and analysis of combustion generated pollutants
2. To apply modeling techniques on indoor and outdoor environments
3. To emphasize the need to compliance of various emission standards

Syllabus:

Introduction to Air Pollution (Control and Effects) , Introduction to Standard Analytical Methods, Air Pollutants Sampling & Measurement Aspects (Including interference and Corrections), Air Pollution Emission Estimates, Air Pollutant Concentration Models (Indoor and Outdoor), Formation & Control of Particulates, Oxides of Nitrogen (Thermal, Prompt and Fuel-bound), Oxides of Sulphur, Review of Air Pollutions Control Techniques, Particulates and Gaseous Pollutant Control Devices, Introduction to Air Pollution Standards.

Course Outcomes:

After studying this course, the students should be able to

1. Identify combustion generated pollutants, their major sources and effects on life and materials
2. Carry out sampling and analysis using modern online techniques
3. Understand formation and destruction mechanisms of different air pollutants
4. Predict pollution levels in indoor and outdoor environments using available modeling techniques
5. Use various techniques / devices to control combustion generated pollution

Books:

1. Air Pollution Control Engineering" by Noel de Nevers , McGraw Hill Intl. Edition
2. Air Pollution Control Theory" by Crawford, Tata McGraw Hill
3. Air Pollution" by Wark and Warner, Harper & Collins Publishers
4. Turbomachines, Basic Theory and Applications" by E Logram, Marcel Dekker Inc.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1				X		X			X	
2	X	X		X						
3	X		X	X						
4		X	X					X	X	X
5	X	X	X					X	X	X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Refrigeration and Cryogenics
Course Number	**:**	ME662
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

To impart knowledge of vapor compression, vapor absorption and various non-coventional refrigeration systems. Also their thermodynamic analysis. Performance of different Cryogenic refrigeration systems..

Syllabus:

Introduction: Thermodynamic analysis of vapour-compression refrigeration cycles, Multi-compressor and multi-evaporator systems, Thermoelectric refrigeration, Air refrigeration, Steam Jet refrigeration.Refrigerants: Primary & Secondary refrigerant, Important refrigerants used in the refrigerantindustry. Nomenclatureof refrigerants, Properties & selection of refrigerants, ODP and GWP of important refrigerants, Montreal Protocol & Kyoto Protocol, Alternatives to important CFCs, HCFCs and HFCs, Modern trends in Refrigeration and Air conditioning industry. Retrofitting, Recovery, Recycling and Reclaim. Vapour-absorption Refrigeration Systems & Binary Mixtures: Basic principle of vapour absorption refrigeration,Aqua-ammonia system, Lithium bromide-water system,Elementary properties of binary mixtures, Temperature concentration diagram, Enthalpy-concentration diagram, Steadyflowprocess with binary mixtures. Cryogenics and Liquefaction of Gases: Definition of Cryogenics, Cryogenic Engineering & Cryogenic systems, Important Applications of Cryogenic Temperatures. Ideal liquefaction system, System performance parameters, Critical components of liquefaction systems,throttling process and Joule-Thomson's effect. Adiabatic expansion process, Internal & External work methods of expansion, Linde-Hampson System, Precooled Linde-Hampson System, Linde dual pressure system, Claude System, Liquefaction of Hydrogen & Neon, Liquefaction of Helium. Separation of gases from Air. Cryogenic Refrigeration Systems: Philips Refrigerator, A.D. Little Single-volume Refrigerator, A.D. Little Double Refrigerator, Importance of Regenerators.

Course Outcomes:

1. Ability to predict performance of different refrigeration systems
2. Knowledge of different parts of refrigeration systems.
3. Ability to analyze the effect of individual components on overall performance of system.
4. Capability to analyze and apply these systems .

Books:

1. Refrigeration & Air Conditioning by Stoecker, W.F. & Jones, McGraw Hill.
2. Principles of Refrigeration by Dossat R.J. Wiley& Sons.
3. Thermal Environmental Engineering by Threkeld, JL., Prentice Hall Inc.

4. Refrigeration & Air Conditioning by Ballaney, P.L., Khanna Pub. N. Delhi
5. Cryogenic Systems by Randall Barron, McGraw Hills.
6. Cryogenic Engineering by Bell J.H., Prentice Hall Inc.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X									
2	X	X	X						X	
3	X	X		X				X		
4	X	X	X					X		

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Aerospace Propulsion
Course Number	**:**	ME663N
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Outcomes:

1. Introducing basic design analysis of turbojets, turbofans, turboprops and scramjets
2. Analysis and design of air-breathing engine components.
4. Off-design performance analysis of single spool turbojets, turboprops, etc
5. Design aspects of rocket components, multi-staging and performance of liquid and solid propellants
6. Electric propulsion: Various types and deep space propulsion

Syllabus:

Fundaments of jet propulsion, Performance characteristics of propellers, fans and jets for propulsion. Basic configuration and analysis of turbojet, turboprop, turbo-shaft, turbofans, ramjet and scramjet engines

Aero-thermodynamics of Subsonic, Supersonic Inlets and nozzles, Combustors and after burners using Rayleigh and Fanno flows. Introduction to stoichiometry.

Off-design performance analysis of turboshaft, turbojet and turbofan engines, primarily of single-spool engines.

Basic Configuration and constructional detail of solid and liquid propellant rocket engines. static performance of rocket engine. Concept and requirement of multi-staging. desirable properties and performance of solid and liquid propellants. Basic design consideration of rocket nozzles and combustion chambers.

Non-Conventional rocket propulsion systems and their basic design considerations. Electric, Electro-thermal, Electromagnetic and Electrostatic rocket engines. General applications of electro-propulsion systems, nuclear propulsion systems.

Books:

1. P.P. Hill & C.R. Peterson; Mechanics & thermodynamics of Propulsion, Addison Wesley Publishing Company (Text Book)
2. Cohen, Rogers and Saravanamuttoo; Gas turbine theory, PHI
3. Sutton & Ross; Rocket Propulsion, John Wiley & Sons.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1	X	X								
2	X		X							
3	X		X							
4	X		X							
5		X	X							

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Sustainable and Renewable Energy Systems
Course Number	**:**	ME665N
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	Basic Thermal Science
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Outcomes:

1. Design and develop systems for utilizing waste and renewable energies of different forms.
2. Knowledge of different types of gasification and methods for gasification of coal, steam and Air, and also liquefaction of coal.
4. Knowledge of different types of fuel cells, thermoelectric and MHD/ EHD power generation.
5. Utilization of Wind and Geothermal Energy.

Course Objectives:

1. To impart fundamental knowledge of different non-conventional Energy Conversion systems.
2. To impart knowledge of the working principles of all such systems and methods of extracting and putting them to appropriate use.

Syllabus:

Introduction:
Primary energy resources, Energy Consumption & Energy demand. Synthetic Fuels: Introduction Carbon to Hydrogen ratio for different fuels, gasification & liquefaction of coal, comparison of synthetic fuel routes. Gasification of coal, steam/oxygen and steam / Air gasification, Indirectly, Heated & Molten Media gasification, Hydro-gasification and catalytic gasification, underground gasification. Indirect liquefaction, Pyrolysis and direct liquefaction of coal.

Biomass energy resources & conversion processes:
Direct Energy Conversion Systems: Introduction & general representation of D.E.C. Devices. Electrochemical effects and fuel cells (Faraday's law of Electrolysis, Reversible & ideal fuel cell, losses and efficiency of fuel cell).

Thermoelectric Systems:
Thermoelectric phenomena, Kelvin's Relations, Thermoelectricity for power generation and cooling. Magneto hydrodynamic Generator and other fluid energy converters, elementary formulation of MHD, Hall effect, Applications of MHD generation. Conversion using a liquid metal, Electro hydrodynamic and Electro kinetic conversions. Wind Energy; Fundamentals and Applications, Geothermal Energy, Geothermal Electric Power Plans.

Books:

1. Direct Energy Concept by S.L. Soo, Prentice Hall.
2. Principles of Energy Conversion by A.W. Culp, Tata McGraw Hills.
3. Director Energy Conversion by S.W. Angrist. Allyn & Bacon Inc., London.
4. Energy Technology – A Handbook Ed. D.M. Consdine.
5. Energy Technology by Ras & Parnlekar, Khanna Pub., New Delhi.

Mapping of COs with POs:

Course Outcomes	a	b	c	d	e	f	g	h	i	j
1			X			X	X	X		X
2	X	X	X				X			
3	X	X	X				X			
4	X	X	X				X			

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Thermal Environmental Engineering
Course Number	**:**	ME666
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Outcomes:

1. Ability to understand comfort chart for summer and winter.
2. Knowledge of system heat gains.
3. Design of air duct system
4. Knowledge of control systems used in air conditioning of buildings.

Course Objectives:

To impart knowledge of air conditioning systems for human comfort in domestic and industrial conditions.

Syllabus:

Psychrometry, Air Conditioning Calculation, Comfort Scales and measures. Concepts of Effective Temperature, Solar Heat Gains through glass, Sol-air Temperature, Internal & System Heat gains, Heat Storage, Diversity and Stratification Analytical solution of period heat transfer problem. Humidification and dehumidification equipments. Cooling towers, Spray air washers Design of air duct system. Room air Distribution principles. Various types of air conditioning systems. Temperature and humidity controls, System Control types. Heating Systems and their control, Building automation systems.

Books:

1. Heating Ventilating & Air Conditioning Analysis & Design by McQuiston & Parker, John
2. Wiley & Sons.
3. Modern Air Conditioning Practice by N.C. Harris, Mc-Graw Hill.
4. Heat & Cooling of Buildings by J.F. Kreeder, Mc-Graw Hill.
5. Refrigeration & Air Conditioning by C.P. Arora, TMH.

Mapping of COs with POs:

	Program Outcomes									
Course Outcomes	a	b	c	d	e	f	g	h	i	j
1							X		X	
2	X						X			
3	X	X					X			
4			X				X	X		

DEPARTMENT OF MECHANICAL ENGINEERING
Aligarh Muslim University, Aligarh

Course Title	**:**	Power Plant Engineering
Course Number	**:**	ME667
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

To impart knowledge of working principles of Thermal power plant, Nuclear, Gas turbine and diesel electric power plants. Also, thermodynamic analysis (Energy and Exergy) of these power plants. Different Combined Cycles(STAG and STIG).

Course Outcomes:

1. Analyze performance of different combined cycle power plants.
2. Calculate performance of thermal power plant.
3. Select ash handling, coal handling methods in a thermal power plant.
4. Explain working principle of different types of nuclear, gas turbine, diesel electric plants.
5. Calculate load factor, capacity factor, average load ,peak load on a power plant and power plant economics.
6. Basic knowledge of safety aspects of power plants

Syllabus:

General Introduction: Conventional, cogeneration, supercritical boilers and turbines. Basic design features of turbines, boiler and other essential elements of steam power plant. Performance characteristics of some popular versions. Gas turbine power plants, closed cycle and open cycle. Basicdesign features of compressors, turbines and combustors. Performance characteristics of popular
versions. Combine cycles general analysis, heat recovery system generators, STAG combined cycle, multi-pressure systems. Nuclear Power plants important features and basic performance considerations. Diesel generating sets, performance considerations.

Books:

1. Power Plant Technology by El-Wakil, McGraw Hill,1988.
2. Modern Power Plant Engineering by Eckart & Weisman,Prentice Hall, 1988.
3. Power Plant Engineering by P.K. Nag, Tata McGrawHill, 2001.
4. Turbomachines. Basic Theory & Applications, E. Logram, Marcel Dekker Inc. 1981.

Mapping of COs with POs:

POs/COs	a	b	c	d	e	f	g	h	i	j
1	X	X	X					X		
2	X	X	X						X	X
3										
4	X							X	X	
5						X			X	
6									X	X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Computational Methods in Thermal and Fluid Engineering
Course Number	**:**	ME668
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (2 hours) 60%

Course Outcomes:

1. Knowledge and understanding of finite-difference discretization techniques for governing fluid/thermal partial differential equations.

2. Introducing different methodologies for solving 2D and 3D Navier-Stokes equations.

3. Basic introduction to various numerical techniques for solving Poisson equation.

5. Introducing finite-volume methodology for solving 2D diffusion and convection problems.

6. Mesh generation of boundary-fitted grids and solution of equations in curvilinear coordinates.

Syllabus:

Finite-difference based discretization, consistency, conservative and transportive properties, Von-Neumann stability analysis of implicit and explicit methods Upwind schemes – first order and higher-order schemes, CFL and viscous stability constraints

FD applications in convective heat transfer, steady conduction in cylindrical and spherical geometries, Incompressible flows in streamfunction-vorticity formulation esp. 2D lid-driven problems, introduction to point SOR techniques for Poisson equations

1D steady convection-diffusion problems using FV methods, 2D diffusion problems using FV methods, introduction to TDMA solvers

Structured Mesh generation using algebraic/pde solvers, conversion of governing equations to curvilinear coordinates, introduction to solution of compressible N-S equations

Primitive variables based N-S solvers esp. Projection methods and Fractional-step schemes, Applications in 2D channel flows, incorporation of boundary conditions

Books:

1. Computational fluid flow and heat transfer Eds. Murlidhar and Sundararajan, Narosa Pub.
2. Computational methods for fluid dynamics by Ferziger and Peric, Springer
3. Introduction to CFD by Versteeg and Malalasekhara using FV methods, Prentice Hall.

Mapping of COs with POs:

POs/COs	a	b	c	d	e	f	g	h	i	j
1	X	X						X		
2				X				X		
3		X								
4	X			X						
5										

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced I C Engines
Course Number	**:**	ME669
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course objectives:

1. To introduce relationships between engines design parameters and performance characteristics.
2. To understand the latest technological advancement of in the field of IC engines
3. To deliver the control strategies of emissions in IC engines.

Course Outcomes:

After taking this course the students should be able to

1. Classify the IC engines based on various criteria.
2. Compare the SI and CI engines in terms of performance characteristics, overall design, cycles and applications.
3. Perform thermodynamic analysis of engines and evaluate combustion chambers designs and type of fuels effects on engine performance.
4. Express and distinguish the importance of conventional and modern fuel injection systems on engine performance.
5. Quantify the effects of new technologies such as EGR, turbocharging, MPFI, CRDI etc. on engines performance characteristics and their critical analysis.
6. Have concepts of high performance and low emission engines for addressing new challenges in this field.
7. Design and apply latest technologies exhaust emissions of IC engines to control the automotive pollution.

Syllabus:

SI and CI Engines: Classification of Engines and their performance requirements. Basic difference between the overall design, combustion chambers, performance characteristics and cycles. Influence of the engine performance characteristics on the shape of thermodynamic cycles. Relationship between the design of the combustion chamber and properties of fuels being used in engines. Typical Application of SI and CI Engines.

SI Engines: Thermodynamic analysis. Gas Exchange Process and design of Ports. Classification of Combustion chambers. Role of the ignition delay in the design of the engine. Influence of the design of combustion chamber on the performance of the relevant engine. Conventional Fuel Metering Systems vs Fuel Injection System. High Efficiency and Low Emissions Engines. Modern Concept of EGR, OHC and Multi-valve concept. Performance Trade-Off and exhaust emissions control strategies. Two strokes engines and scavenging process.

CI Engines: Thermodynamic analysis. The concept of the ignition delay and its relationship with the performance of the engine. Classification of diesel engine combustion chamber and the type of the nozzle on the performance of the relevant engine. Type of fuel injection systems. Conventional Fuel Injection Systems vs Electronic Fuel Injection Systems. High Performance and Low Emission Engines. Performance Trade Off and exhaust emissions control strategies. Two strokes engines and scavenging process.

Books:

1. IC Engine Fundamentals by J.B. Heywood, McGraw-Hill Book Company International Student Edition.
2. Internal Combustion Engines by E.F. Obert, Harper International Edition.
3. Combustion Engineering by G.L. Borman & K.W. Rogland, McGraw Hill.
4. IC Engines by C.R. Ferguson, John Wiley, International Student Edition.
5. Thermodynamics & Gas Dynamics of I.C. Engines by R.S. Benson, Pergamon Press, Vol. I & II.

Mapping of COs with POs:

PO/CO	a	b	c	d	e	f	g	h	i	j
1	X		X							
2	X		X							
3	X	X	X							
4						X				
5			X	X		X		X		
6	X		X					X	X	X
7				X					X	X

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Wind Energy
Course Number	**:**	ME761N
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

The main focus of the course is on the analysis of the wind energy system in a world faced with various environmental issues and compare cost, performance and social acceptability with the conventional energy conversion systems. The course also aims at making the student proficient in calculations of performance and preliminary design of wind turbines.

Course Outcomes:

After taking this course, students should be able to:

1. Measure and analyze the wind resource potential of a given site.
2. Model a horizontal axis wind turbine (WT) and predict the power production using different aerodynamic theories.
3. Understand WT dynamics and working of various components
4. Communicate reliability problems for WT and be conversant with related monitoring technologies and standards.
5. Classify WECs and understand electric grid connections.
6. Develop a background on site selection methodology.
7. Assess the economic aspects of investments and operations of WT and understand the environmental aspects.

Syllabus:

Introduction: History of wind energy, Modern Wind Turbines: Classification

Wind Characteristics and Resources: Nature of wind, Analysis of wind data, Statistical models for wind data analysis: Weibull distribution, Rayleigh distribution. Wind Turbine Energy Production Estimates Using Statistical Techniques, Wind Measurement and Instrumentation

Aerodynamics of Wind Turbines: Power available in the wind spectra, Wind turbine power and torque, Aerodynamic theories: Axial momentum theory, Blade element theory,Strip theory. Blade Design for Modern Wind Turbines ,Aerodynamics of Vertical Axis Wind Turbines

Wind Turbine Dynamics: Wind Turbine Loads & Rotor Dynamics , Machine Elements, Principal Wind Turbine Components.

Wind Turbine Materials, Design and Testing: Wind Turbine Materials & Design Procedure, Material Fatigue, Wind Turbine Topologies, Wind Turbine Standards, Technical Specifications, and Certification, Computer Codes for Wind Turbine Design, Wind Turbine and Component Testing

Wind energy conversion (WEC) & control systems:
Classifications of WECs, Interconnection with Electric Power Systems, Overview of Wind Turbine Control Systems

Wind Turbine Siting & System Design: Site Analysis Methodology, Micrositing, Layout of Wind Farm, Installation and Operation Issues

Wind Energy Economics & Environmental Impact: Economic Assessment of Wind Energy Systems, Energy market, Incentives and exemptions

Cost of wind energy:
Initial investment, Operation and maintenance costs
Environmental Aspects and Impacts, Introduction Avian/Bat Interaction with Wind Turbines, Visual Impact of Wind Turbines, Wind Turbine Noise, Electromagnetic Interference Effects, Land-Use Environmental Impacts, Other Environmental Considerations

Additional Topics: Wind Energy Applications, Hybrid Power Systems, Offshore Wind Energy, Energy Storage, Fuel Production

Books:

1. Wind Energy Explained: Theory, Design and Application, J. F. Manwell, J. G. McGowan & A. L. Rogers (Wiley)
2. Wind Energy: Fundamentals, Resource Analysis and Economics, Sathyajith Mathew (Springer)
3. Wind Energy: Theory & Practice, Siraj Ahmed (PHI)
4. Renewable Energy Resources, John Twidell & Tony Weir (Taylor & Francis)

Mapping of COs with POs:

	Program Outcomes									
Course Outcome	a	b	c	d	e	f	g	h	i	j
1	x	x				x	x	x	x	x
2	x	x	x					x		x
3			x							x
4			x			x	x	x		x
5						x		x		x
6	x	x				x		x	x	x
7		x				x	x	x	x	x

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Solar Energy
Course Number	**:**	ME763
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

To impart knowledge of measurement and prediction of solar radiation; performance analysis of solar thermal systems for domestic and industrial applications.

Course Outcomes:

1. Ability to predict direct and diffuse radiation on different dates, times and locations.
2. Knowledge of solar radiation measurement.
3. Ability to analyze the performance of solar thermal collectors.
4. Capability of using solar energy for distillation, drying, cooking, heating and cooling in buildings and power generation.

Syllabus:

Solar radiation, its measurement and prediction, Flat plate collectors; liquid and air type. Performance analysis; transmissivity-absorptivity product, overall loss coefficient, collector efficiency factor, collector heat removal factor, effect of various parameters on performance. Selective coating. Transient analysis. Testing procedures of flat plate collectors, Solar water heater. Performance analysis of conventional air heaters. Other types of air heaters; packed bed solar air heaters, Optical design of concentrating collectors. Thermal analysis of solar still, solar dryers, solar cookers. Solar cooling and refrigeration, solar power generation. Solar thermal storage systems and solar pond. Active and passive heating of buildings.

Books:

1. *Solar Engineering of Thermal Processes by Duffie & Beckman;, Willey & Sons.*
2. *Solar Heating and Cooling by Kreider & Kreith, McGraw Hill.*
3. *Solar Energy Engineering by Saigh, Academic Press, New York.*
4. *Solar Energy Principles Thermal collection and Storage by S.P. Sukhatme and J.K. Nayak, Tata McGraw Hill.*

Mapping of COs with POs:

POs/COs	a	b	c	d	e	f	g	h	i	j
1		X								
2		X		X					X	
3	X		X					X	X	
4	X							X	X	

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Engine Emission Control
Course Number	**:**	ME764
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Objectives:

1. To impart knowledge of combustion and emission fundamentals of Internal Combustion Engine.
2. To provide new concepts of combustion and emission control in Internal Combustion Engine.
3. Discuss after-treatment of Internal Combustion Engine
4. To develop ideas of simulation and diagnose of Engine Combustion and emission.
5. To discuss alternative fuel and emission regulations.

Course Outcomes:

1. Introduce the new concepts of combustion and emission control of Internal Combustion Engine.
2. Provide an introductory of combustion simulation and diagnose technology.
3. Provide experiences of group discussion on combustion and emission control in Internal Combustion Engine.

Syllabus:

Engine Emission Control Laws and Regulations, Regulatory Test Procedures, Test Cycles, Exhaust Gas Pollutants, Particulate Pollutants, Evaporative Emissions, Blow by Emissions, Emissions from two Wheelers and Two Stroke Engines. Mechanism of pollutant formation in SI Engines, formation of nitrogen oxides, formation of carbon monoxide, formation of unburnt hydrocarbons, formation of particulates, formation of PAH and nitrated derivatives. Influence of Fuel Properties Pollution Control Measures inside the engine and the Lean Burn Engines. Mechanism of pollutant formation in IDI and DI Diesel Engines, Formation of Nitrogen Oxides, formation of carbon monoxide, formation of unburnt hydrocarbons, formation of particulates, formation of PAH and nitrated derivatives. Influence of Fuel properties. Pollution Control Measures inside the engine. HCCI (Homogeneous Charged Compression Ignition) and CCS (Combine Combustion system) Engines. Post Combustion Treatments, Physical Conditions and Exhaust Gas composition, Catalytic mechanism of CO Oxidation, unburnt hydrocarbon oxidation and nitrogen oxide reduction. Dual catalysis. Three way catalysis. Thermal reactors, catalyst structures. Installation of catalyst. Catalyst Poisoning catalyst light off temperature. Catalyst wear. Oxidation catalyst. Particulate Matter Nox Trade off in Diesel engines, Diesel Trap Oxidizers.

Books:

1. Automobiles & Pollution by P. Degobert, SAE, 1996.
2. I.C. Engines Fundamentals by J.B. Heywood, McGraw Hills Intl. Std. Ed.

Mapping of COs with POs:

POs/COs	a	b	c	d	e	f	g	h	i	j
1	X	X	X					X		
2	X	X	X						X	X
3		X								

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Turbulent Flows
Course Number	**:**	ME765
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Course Outcomes:

1. Introducing governing equations and tools used for studying turbulence
2. Analyzing canonical turbulent flows of homogeneous shear and free-shear variety.
3. Analyzing canonical turbulent flows involving wall-bounded flows.
4. Introducing turbulence modeling for turbulence closure problem.
5. Fundamental modeling of turbulence using DNS and LES approach.

Syllabus:

Nature of turbulence and tools for studying turbulence: Statistical and time-domain analysis Equations and scales of motion: turbulence energy equations, cascade.

Canonical turbulent flows:free flows involving homogeneous shear flows, jets and wakes

Canonical turbulent flows: wall-bounded flows involving 2D channel flows and boundary layers.

RANS models: modelling canonical flows, compressibility, roughness, pressure-gradients and eddy viscosity/Bousinessq closure

DNS and LES models, Unsteady RANS and hybrid RANS/LES methods.

Books:

1. Turbulent flows, Pope, Cambridge University Press
2. Introduction to turbulent flows, Mathieu and Scott, CUP
3. Turbulence: Introduction, Davidson, CUP

Mapping of COs with POs:

POs/COs	a	b	c	d	e	f	g	h	i	j
1	X	X						X		
2	X		X							X
3	X		X							X
4	X		X					X		
5		X	X					X		

DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

Course Title	**:**	Climate Physics
Course Number	**:**	ME766
Credits	**:**	4
Course Category	**:**	PE
Pre-Requisites (s)	**:**	None
Contact hours	**:**	3-0-1
Type of Course	**:**	Theory
Course Assessment	**:**	Course Work 15% Mid Sem Examination (1 Hour) 25% End Sem Examination (2 hours) 60%

Syllabus:

Introduction to climate physics, instrumental record of the earth's climate, paleoclimate.

Composition of the atmosphere, radiative heat transfer, convective heat transfer and radiative-convective equilibrium, single column multi-layer modeling.

Basic climate physics: Atmospheric circulation, Oceans and climate.

Clouds, aerosols and climate, Carbon cycle, forcings and feedbacks.

Climate modelling: Introducing basic numerical techniques and climate models.

Books:

1. IPCC 2007 climate report
2. MIT OCW material from MIT website

Mapping of COs with POs:

	Program Outcomes									
Course Outcome	a	b	c	d	e	f	g	h	i	j
1			X	X				X		
2	x	X						X		
3	X		X							
4	X		X	X						
5	X	X	X							X

INDUSTRIAL & PRODUCTION

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Advanced Mathematics and Statistics
Course Number	:	AM-631
Credits	:	04
Course Category	:	Mathematics and Engineering Sciences (DC)
Pre-Requisite(s)	:	Basic knowledge of linear algebra, numerical methods and statistics
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Assessment	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

To learn the concepts of Linear Algebra, numerical methods for the solution of Partial differential equations and Statistical techniques.

Syllabus:

Linear Algebra: Introduction to vector spaces and linear transformations, matrices, eigenvalue and eigenvector problems, diagonalization and quadratic forms.

Numerical Methods: Introduction to numerical solution of Partial differential equations. One dimensional Diffusion and Two dimensional Laplace equations .

Statistics: Discrete distribution models. Geometric, Hypergeometric, Multinomial and Pascal distributions. Continuous distribution models, Exponential, Gamma and Chi-square distributions. Two-dimensional random variables. Covariance and Correlation coefficient, Regression. Method of least squares. Introduction to sampling and hypothesis testing. Analysis of variance.

Contents beyond syllabus: Use of SPSS/MINITAB for statistical analysis.

Course Outcomes:

After completing the course the students are expected to be able to:

1. Understand vector spaces and linear transformations,
2. Understand matrices and its applications to solve the engineering problems.
3. Solve and interpret the solution of partial differential equations in engineering discipline.
4. Learn and apply concepts of Statistical technique in engineering problems.

Books:

1. *Ben Noble and Daniel, Applied Linear Algebra, Prentice Hall International.*
2. *P. L. Meyer, Introductory Probability and Statistical Applications, Oxford and IBH Publishing Co. Pvt. Ltd.*
3. *M. K. Jain, S.R.K. Lyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd. Publishers.*
4. *Chandrika Prasad, Advanced Mathematics for Engineers, Pothishala Pvt. Ltd. Allahabad.*
5. *R. H.Walpole and R.H.Myers, Probability and Statistics for Engineers and Scientists, Macmillan Publishing.*
6. *S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall India Pvt. Ltd.*

Mapping of COs with POs:

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	L	M		M	H	H		H		
2		M	H	H	H	H		M		M	H	
3	H	H	H	H	H	H					M	H
4		M		M		M	H	H	L	M	L	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Measurement & Control
Course Number	:	EE 601
Credits	:	04
Course Category	:	Professional Core (DC)
Pre-Requisite(s)	:	Basic knowledge of measurement systems and their control techniques
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

To introduce the basic concepts related to the operation of Electrical Measuring Instruments with potential application to engineering systems and to focus on general concept of control systems incorporating modelling and performance analysis.

Syllabus:

Measurement: Transducer, Different types of Transducers, Transducers Characteristics, Selection of an Instrumentation Transducer, Digital Transducer, Measurement using laser, Measurement using Ultrasonic technique, Measurement using Vacuum technique, Microprocessor based Instrumentation system.

Control: Transfer function, Transfer function for Mechanical System, Control system components, Signal flow Graph with Problems, Transient response of feedback control systems, Transient response of second order system, Steady state response and steady state error, problems, Routh stability criterion, Polar plots, bode plots, Nyquist criterion, Controller: Hydraulic and Pneumatic Controllers.

Contents beyond syllabus: Applications of Mechatronics in measurement and control.

Course outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Have a general understanding of control systems, including system modelling and its performance analysis.
2. Develop mathematical models of a mechanical and electrical system.
3. Have a general understanding to measure common physical quantities using sensors and transducers.
4. Apply the knowledge about the instruments for typical measurements in real engineering system.

Books:

1. *M Gopal, "Control System", McGraw Hill, 4th Edition.*
2. *D. Patranabis, "Principles of Industrial Instrumentation", TMH, 2nd Edition.*
3. *K. Ogatta, "Modern Control Engineering", PHI (India), 5th Edition.*
4. *A.K. Sawhney, "Electrical & Electronic Measurement & Instrumentation", DRS, 2nd Edition*

Mapping of COs with POs

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	H	H	M					M		
2	H	H			H					M		M
3	M		H	M		M						
4	H	H	H	H	H			L		M	L	L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Modelling, Simulation & Computer Applications
Course Number	:	ME 611
Credits	:	04
Course Category	:	Mathematics & Engineering Sciences (DC)
Pre-Requisite(s)	:	Knowledge of Basic modelling and computers
Contact Hours	:	3L – 1T – 0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To enhance skills in the area of computer number representation and MATLAB.
2. To impart knowledge of basic numerical tools like construction of polynomial interpolation on 1D and higher dimensional data sets.
3. To impart knowledge of basic Newton-Cotes and Gauss integration formulae and their applications.
4. To enhance skills in the areas discrete event simulation for manufacturing systems.

Syllabus:

Physical Modeling: Concept of system and environment, continuous and discrete systems, linear and non-linear systems, stochastic activities, static and dynamic models, principles used in modeling.
System Simulation: Techniques of simulation, Monte Carlo method, experimental nature of simulation, numerical computation techniques, continuous system models, analog and hybrid simulation, feedback systems.
System Dynamics: Growth and decay models, logistic curves, system dynamics diagrams.
Probability Concept in Simulation: Stochastic variables, discrete & continuous probability functions, random numbers, rejection method.
Simulation of Mechanical Systems: Simulation of transnational and rotational mechanical system, simulation of hydraulic systems.
Simulation of Flow & Thermal System: Laminar & turbulent flow modeling, simulation of conduction, convection and radiation problems, modeling of engine processes.
Simulation of Manufacturing Systems: Simulation of job shop model and material handling, flexible manufacturing system.

Contents beyond syllabus: Introduction to GPSS.

Course Outcomes:

1. Development of an understanding the concepts of computer number representation and round-off error propagation during arithmetic operations.
2. To Impart knowledge of MATLAB (basic features involving linear algebra, file handling and scientific visualization)
3. To impart knowledge of basic numerical tools like construction of polynomial interpolation (global and piecewise) on 1D and higher dimensional data sets. Awareness of physical issues in interpolation and their remedies.
4. Development of concepts of numerical; estimation of derivatives and integrals. Knowledge of basic Newton-Cotes and Gauss integration formulae and their applications. Handling improper integrals and integrand discontinuities.
5. To apply discrete event simulation tools for evaluating the performance of the manufacturing systems.

Books:

1. *System Simulation by Geoffrey Gordon, Prentice Hall.*
2. *System Simulation The Art & Science by Robert E. Shennon, Prentice Hall.*
3. *System Modeling & Control by J. Schwaizenback & K.F. gill, Edward Arnold.*
4. *Modeling and Analysis of Dynamic Systems by Charles M. Clooe & Dean K. Frederick, Houghtan, Miffin.*
5. *Simulation of Manufacturing by Allan Carrie, John Wiley & Sons.*
6. *Computational Heat Trasfer by Y.Jaluria & K.E. Torrace, Hemisphere Publishing Corporation.*

Mapping of COs with POs

Course Outcome	Program Outcomes (POs)											
	a	b	c	d	e	f	g	h	i	j	k	l
1	H		H						L		L	M
2	H		H	H	M		L			L		M
3	H		H	M						L		L
4	H		H	M								
5	H		H							M		M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Operations Management
Course Number	:	ME 621
Credits	:	04
Course Category	:	Professional Core (DC)
Pre-Requisite(s)	:	Basic knowhow of Industrial Engineering & any programming language
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To understand the role of operations management (OM) in the overall business strategy of the firm.
2. To understand the interdependence of the operating system with other key functional areas of the firm.
3. To identify and evaluate the key factors and their interdependence for operating systems effectively.
4. To identify and evaluate a range of tools appropriate for analysis of operating systems of the firm.
5. To understand the application of OMs policies and techniques for service & Manufacturing sectors.

Syllabus:

Introduction: Operation function in organization, Historical evolution of Production & Management, Strategic role of operations, Role of models. Operations Strategies for Competitive Advantage: Strategic Planning Productivity & Quality, Technology & Mechanization. Job Design & Work Measurement: Effective job design, Production & operation standard, work measurement. Scheduling Systems & Aggregate Planning for Production & Services: Operations Planning and scheduling systems, Aggregate Planning process and strategies, Master scheduling and rough cut capacity planning, implementing aggregate plans and master schedules. Operations Scheduling: Inventory concepts, costs, modeling and applications. Material Requirement Planning: Planning and application on a scheduling and ordering system, limitation and advantages of MRP, Manufacturing resource planning MRPII

Contents beyond syllabus: Use of SAP in ERP.

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms.
2. Develop skills necessary to effectively analyze and synthesize the many inter-relationships inherent in complex socio-economic productive systems.
3. To reinforce analytical skills already learned, and build on these skills to further increase the ability to use analytical tools to assist in decision making.
4. To understand how ERP and MRPII systems are used in managing operations.
5. To understand the overall managerial responsibility for production and operations.

Books:

1. *Modern Production & Operations Management by Buffa and Sarin, Wiley India.*
2. *Operations Management by William J Stevenson, Tata McGraw Hill*
3. *Production & Operation Management by Everett E. Adam Jr., Ronald J. Ebert, Prentice Hall (PHI).*

Mapping of COs with POs:

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	L	M		M	H	H		H		
2		M	H	H	H	H		M		M	H	
3	H	H	H	H	H	H					M	H
4		M		M		M	H	H	L	M	L	
5	M	M	L	L	H		H	L	H	H		H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Quality Management
Course Number	:	ME 622
Credits	:	04
Course Category	:	DC
Pre-Requisites(s)	:	Basic knowledge of Statistics
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments; (15 Marks); and End Semester Examination (60 Marks), 3 hours durations.

Course Objectives:

1. To improve students' understanding of the quality engineering and management terminologies.
2. To acquaint students with various issues pertaining to reliability.
3. To prepare students for their professional roles as quality engineers.

Syllabus:

Definitions and dimensions of quality; Benefits of good quality; Quality costs; Quality and productivity; Quality philosophies; Quality engineering terminology; Chronological developments; Total quality management (TQM) and related topics.
Statistical quality control and techniques; Acceptance sampling plans; Process control charts for attributes and variables; Process capability analysis; Measurement errors.
Concepts of reliability; Bath-tub curve; Systems reliability; Reliability and life-testing plans.

Contents beyond syllabus: Applications of quality control techniques in Manufacturing Industries.

Course Outcomes:

Upon course completion, the students will be able to:

1. Understanding of the basics of quality engineering and management and their origins.
2. Learning statistical quality control techniques and their applications in engineering.
3. Gaining knowledge of measurement errors and analyze process capability.
4. Determining reliability of devices and systems.

Books

1. *Mitra, A. (2008), Fundamentals of Quality Control and Improvement, ed.iii, John Wiley & Sons Inc.*
2. *Montgomery, D.C. (2009), Introduction to Statistical Quality Control, ed. vi, John Wiley & Sons Inc.*

Mapping of COs with POs

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	L			H				L			L	
2	L	L		M	H	H	L	M		M	M	
3	M	M		L	M	H	L			L	L	
4	H	L				M					H	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Operations Research
Course Number	:	ME 623
Credits	:	04
Course Category	:	Professional Core (DC)
Pre-Requisites(s)	:	Exposure to mathematical modeling.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims at exposure to various operations research tools in service and manufacturing sectors.
2. To understand queuing models and cost based decision models.
3. To study the dynamic programming approach for solution of industries problems.
4. To understand the applications of unconstrained and constrained non-linear optimization techniques.

Syllabus:

Introduction to OR Techniques and Tools. Linear optimization models. Linear programming formulation. Various complication in linear programming. Duality theory and Sensitivity analysis. Transshipment models. Linear goal programming.

Waiting line models. Priority queues. Application of waiting line theory to industrial service sectors. Formulation of waiting-cost function. Decision models.

Dynamic programming. Characteristics of dynamic programming problems. Problems with finite number of stages. Deterministic and Probabilistic dynamic programming.

Non-Linear programming. Introduction to single and multi variable unconstrained optimization. Constrained optimization techniques. Geometric programming.

Contents beyond syllabus: Use of MATLAB for OR problems.

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Knowledge and understanding of mathematical models and programming techniques for service and manufacturing industries.
2. Select and analyze a queuing model based upon given data. Understanding of priority queuing systems and decision models.
3. Analyze the industrial systems through deterministic and probabilistic dynamic programming problem solving approach.
4. Knowledge and understanding of single and multi-variable constrained and unconstrained optimization.

Books:

1. *F.S. Hillier & G.J. Lieberman, Operation Research, Tata McGraw Hills, New York*.
2. *P. K. Gupta & D. S. Hira; Operation Research, S. Chand & Company Ltd., New Delhi. 2009 edition.*
3. *Principles of OR with Applications to Managerial Decisions by Wagner, Prentice Hall.*
4. *Fundamentals of OR by Ackoff & Sasieni Wiley Eastern.*
5. *Non-linear and Dynamic Programming by Stephen Nash & Aiela Sofer, Tata McGraw Hill.*
6. *Non Linear & Dynamic Programming by Hadley, Addison Willey.*

Mapping of COs with POs:

COs	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	M	H	M	H	H		M	M	L	M
2	H	M	H	H	H	H	M	M	M	M	H	M
3	M	H	M	M	M	H	H	M	M	H	L	H
4	M	M	H	M	H	H	M		M	H	H	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Advanced Manufacturing Process
Course Number	:	ME 624
Credits	:	04
Course Category	:	Professional Core (DC)
Pre-Requisite(s)	:	Basic exposure to unconventional machining processes.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments, Tutorials, Quiz (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims in identifying the classification of unconventional machining processes.
2. To understand the principle, mechanism of metal removal of various unconventional machining processes.
3. To study the various process parameters and their effect on the component machined on various unconventional machining processes.
4. To understand the applications of different processes.

Syllabus:

General Classification of Unconventional Machining Processes; Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Chemical Machining, Electro-chemical Machining Electric Discharge Machining, Electron Beam Machining, Laser Beam Machining, Ion Beam Machining, Plasma Arc Machining; Comparative Evaluation of Different Processes.

Contents beyond syllabus: Introduction to hybrid and Nano finishing processes.

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Identifying the need of non-conventional machining processes.
2. Understand the principle of working and the mechanism of metal removal involved in various unconventional machining process.
3. Identify the process parameters, their effect and applications of different processes.
4. Develop and analyze mathematical models and problem solving for these non-conventional processes

Books:

1. *Modern Machining Processes by Pandey & Shan, Tata McGraw Hills.*
2. *Non-Traditional Manufacturing Processs by Gray F. Benedict, Marcel Dakker.*
3. *Non-Conventional Machining by P.K. Mishra, Narosa.*
4. *Principles of Electro-chemical Machining by McGeough, J.A., Chopman& Hall, London*

Mapping of COs with POs:

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M									L	
2		H			M							L
3	H		M		M	L						
4	H	H		H	L					L	M	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Metal Cutting Analysis
Course Number	:	ME 625
Credits	:	04
Category	:	Professional Core (DC)
Pre-Requisite(s)	:	Basic knowledge of metal cutting processes.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Assessment	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. Understanding basic physics behind metal cutting phenomenon.
2. Knowhow of optimum cutting process parameters for practical applications
3. Knowledge of parameters effect on characteristic and surface integrity of machined surfaces.

Syllabus:

Mechanics of Metal Cutting: Mechanics of orthogonal and oblique cutting: shear angle and chip flow direction in oblique cutting; chip control methods; analysis of cutting processes like turning, drilling, milling etc.; machining with rotary tools; thermodynamics of chip formation; temperature distribution at the tool chip interface; machining at super high speeds.
Tool Wear and Machinability: Single and multiphase machining operations; Criteria; Variables and restrictions for selecting economical conditions.
Dynamic Metal Cutting: Comparison of steady state and dynamic process; shear angle and force relationships.
Abrasive Processes: Grinding mechanics; wheel characteristics and theory of wheel wear; lapping; honing; high speed grinding theory. Grinding of Drills; form cutters etc.
Machining of Plastics: Problems associated with machining of plastics; tools for cutting of plastics.

Contents beyond syllabus: Experimental Techniques in Metal Cutting.

Course Outcomes:

1. Acquire knowledge of the parameters involved in various metal cutting processes and ability to estimate them.
2. Have an understanding to compare, optimize and estimate the cutting process parameters with respect to variables of other manufacturing processes.
3. Acquire knowledge and estimation of the effect of parameters while cutting metals and nonmetals.

Books:

1. *Machining of Metal by Armarego & Brown, Prentice Hall.*
2. *Principles of Metal Cutting by Shaw Oxford IBH.*
3. *Metal Cutting Theory & Cutting Tool Design by Arshinov& Alekseev, Mir Publishers.*
4. *Machining Science & Application by Kronenberg, Pergamon Press.*

Mapping of COs with POs:

COs	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	L	H				M		L	M	H	M
2	H	H	M	M	M		L	L	M	H	H	H
3	M	M	H	M	M	L	M			L	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Probability and Statistics
Course Number	:	ME 626
Credits	:	04
Course Category	:	Mathematics and Engineering Sciences (DC)
Pre-Requisite(s)	:	Basic exposure to statistics.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To enhance students' knowledge of statistics as the science to deal with processing and interpretation of scientific data.
2. To improve students' understanding of probability and distributions as applied to engineering problems.
3. To prepare students for making decisions under conditions of uncertainty and variability through application of appropriate statistical techniques.

Syllabus:

Statistics, variability and uncertainty; Descriptive and inferential statistics; Classification of data; Population and sample; Frequency distribution and descriptive analysis of data.
Probability and related concepts; Application of basic rules of probability; Bayes' theorem and its applications; Random variables and their functions.
Probability distributions and mathematical expectations of random variables; Discrete and continuous distributions; Sampling distributions and central limit theorem.
Inferential statistics and concepts in hypothesis testing; t-test for single and two samples; F-test; One-way and two-way analysis of variance (ANOVA); Correlation and regression analyses; Chi-square and other non-parametric tests.

Contents beyond syllabus: Use of SPSS/MINITAB for statistical analysis.

Course Outcomes:

1. Understanding of statistics as the science to deal with collection, tabulation, processing, and interpretation of scientific data.
2. Learning the concepts and applications of probability and distributions in analyzing engineering problems.
3. Understanding the various statistical methods and their applications to describe different phenomena of engineering relevance and draw inferences under conditions of uncertainty and variability
4. Learning how to develop statistical models to examine causal relationships between the variables of engineering problems under study.

Books:

1. *Johnson, R.A., Miller, I. and Freund, J. (2014), Miller & Freund's Probability and Statistics for Engineers, Pearson.*
2. *Spiegel, M.R., Schiller, J.J. and Srinivasan, R.A. (2012), Probability and Statistics, ed. iii, Mc-Graw Hill.*
3. *Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K. (2012), Probability and Statistics for Engineers and Scientists, ed.ix, Pearson.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	L			L		H	M			H
2	H			H	L					M		
3	M	H		L	H	L	H	H	M		M	
4	H	H		H	M		M	H	M			L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Quality, Reliability, and Maintenance
Course Number	:	ME 627
Credits	:	04
Course Category	:	Professional Core (DC)
Pre-Requisite(s)	:	Basic knowledge of statistics.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To improve students' understanding of the quality engineering and management terminologies.
2. To acquaint students with various issues pertaining to reliability and maintenance of devices.
3. To prepare students for their professional roles as quality engineers.

Syllabus:

Definitions and dimensions of quality; Benefits of good quality; Quality costs; Quality and productivity; Quality philosophies; Quality engineering terminology; Chronological developments; Total quality management (TQM) and related topics.
Statistical quality control and techniques; Acceptance sampling plans; Process control charts for attributes and variables; Process capability analysis; Measurement errors.
Concepts of reliability; Bath-tub curve; Systems reliability; Reliability and life-testing plans.
Maintenance and its need; Maintenance alternatives; Measures of maintenance performance; Decision tools for maintenance management.

Contents beyond syllabus: Introduction to 6 sigma.

Course Outcomes:

1. Understanding of the basics of quality engineering and management and their origins.
2. Learning statistical quality control techniques and their applications in engineering.
3. Gaining knowledge of measurement errors and analyzing process capability.
4. Determining reliability of devices and systems.
5. Learning how to make decisions on maintenance alternatives for mechanical devices.

Books:

1. *Mitra, A. (2008), Fundamentals of Quality Control and Improvement, ed.iii, John Wiley & Sons Inc.*
2. *Montgomery, D.C. (2009), Introduction to Statistical Quality Control, ed. vi, John Wiley & Sons Inc.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	L			H				L			L	
2	L	L		M	H	H	L	M		M	M	
3	M	M		L	M	H	L			L	L	
4	H	L				M					H	
5	L					L					M	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Instrumentation and Automatic Control Systems
Course	:	ME 630
Course Category	:	Professional Core (DC)
Prerequisite(s)	:	Nil
Contact Hours	:	3L-1T-0P
Type of course	:	Theory
Course Assessment	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To make students familiar with various types measuring instruments.
2. To build the concept of feedback control algorithms, classical and optimal control problems.
3. To prepare the students for broader applications of control systems to mechanical engineering. Problems like active vibration control of light weight structures.

Syllabus:

Unit-I: Safety and environment at workplace, Instrument and measurement systems, Sources of uncertainty and errors, Behaviour of first order and higher order instruments, Static and dynamic characteristics of instruments, Noise in measurement systems, Filtering and signal analysis, Measurement and control of various response parameters.

Unit-II: Transducers and sensing elements, Mass sensing elements, Thermal detectors, thermo-couples, hydro-pneumatic sensors, electro-mechanical transformation, Piezoelectric sensors and actuators, velocity, acceleration piezoelectric& magneto-striction transducers, Optical instrumentation.

Unit-III: Classification and representation of control systems, open and closed-loop systems, Concept of Feedback, Review of classical control systems, control response analysis in time and frequency domain analysis, Stability analysis of control response, Modern control system design instate space, Model reduction, concept of negative velocity feedback.

Unit-IV: Optimal control design, Performance index, Algebraic Riccati equation, Linear Quadratic Gaussian (LQG) control, Statistical descriptions of noise, Kalman filter, Controllability and observability

Unit-V: Applications of linear control system in noise and vibration reduction in instruments, Vibration control of structures and machines, Control of thermos-fluid systems, Nonlinear systems and Linearization of nonlinear systems, Solution of some nonlinear control problems, Robust control design, control systems in MATLAB and SIMULINK.

Contents beyond syllabus: Introduction to mechatronics.

Course Outcomes:

Students who successfully complete the course will demonstrate the following outcomes:

1. Understand the basic characteristics of a measurement system.
2. Ability to understand and analyze the working principle of different measuring instruments.
3. Design and performance evaluation of a measurement system.
4. Application of the basic knowledge of classical control systems to synthesize the modern feedback control algorithms for physical systems.
5. Ability to solve linear dynamic problems and implement the control laws using state space approach for dynamical problems.
6. Implementation of nonlinear control algorithms to evaluate the nonlinear dynamical problems.

Books:

1. *J.P. Bentley, Principle of Measurement Systems, John Wiley and Sons.*
2. *J. P. Holman, Experimental methods for engineers, McGraw Hill.*
3. *J. B. Burl, Linear optimal control, Addison-Wesley.*
4. *K. Ogata, Modern control engineering, Pearson education.*
5. *J. J. E.Slotine, and W. Li, Applied Nonlinear Control, Prentice–Hall, Upper Saddle River, NJ.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H		H	H	H					H		
2	H		H	H	H					H		
3	H	M	H	H	H		M			H		
4	H	M	H	H		M	H			M		H
5	H	H	H	H		M	H			M		H
6	H	H	H	H		M	H			M		H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Design of Experiments
Course Number	:	ME 636
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	Basic knowledge of statistics.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work :		Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To increase awareness of the need for statistics and design of experiments in Research.
2. To obtain knowledge in the application of statistical methods for the analyses of research data.
3. To create skill towards design and analyses of Experiments.

Syllabus:

The role of statistics in experimental analyses. Specifying the problem and the hypotheses. Basic concepts of Probability and Probability distributions (Discrete and continuous probability distributions).
Parametric Statistical Inferences (Estimation. Properties of estimators. Confidence intervals. Hypothesis testing. The Z-test, the T-test, the $\chi 2$-test, and the F-test. Sample size).
Simple Linear Regression and Correlation; Multiple linear Regression and Certain nonlinear Regression Models.
Randomized complete block design (The model and assumptions. The ANOVA table. Post Hoc tests).

Factorial Experiments (two or more factors); Fixed, Random and Mixed Models (One-and-two factor models. Pseudo-F tests); Nested Factorial Experiments (Nested-factorial experiments and Repeated-measures design)
Non-parametric Statistics (Sign Test; Rank Test; Kruskal-Wallis Test and Runs Test)

Contents beyond syllabus: Use of SPSS/MINITAB and Design Expert software for statistical analysis.

Course Outcomes:

After completing this course, participants should be able to:

1. Understand statistical methods for the analyses of experimental data.
2. Understand the importance of factors involved in the experiments such as IV, FV, DVs etc.
3. Implement the statistical methods such as ANOVA, ANCOVA etc. in research problems.

Books:

1. *Probability and Statistics for Engineers and Scientists Ed. 7th, by Walpole, Myers, Myers and Ye. Pearson Education in South Asia*
2. *Probability and Statistics for Engineers, by Richard A Johnson, PHI.*
3. *Design and Analysis of Experiments by Dean & Voss, springer International Edition*
4. *Fundamental concepts in the Design of experiments by Hicks, Oxford University Press*

Mapping of COs with POs:

COs	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H											L
2			M		H							
3						H			M			H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Advanced Numerical Methods
Course Number	:	ME 640
Credits	:	04
Course Category	:	Mathematics and Engineering Sciences (DC)
Pre-Requisites(s)	:	Basic knowledge of linear algebra and MATLAB.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End

Course Objectives:

1. Ability to apply the knowledge of basic numerical methods in obtaining solutions of various mathematical models encountered in research, analysis and design.
2. Ability to apply the knowledge of basic numerical methods in the development of advanced numerical methods like FEM, FDM etc. for the solution of mathematical models represented by ODE's / PDE's.
3. Ability to analyse the data trends by utilizing the techniques of function representation via interpolation
4. Capability to utilize the available software like MATLAB and various built-in MATLAB functions for solution of mathematical models, data analysis and visualization.
5. Capability to write parallel codes using MPI.

Syllabus:

Number Representation: Representation of decimal numbers integers and floats, machine epsilon, Round-off error, error propagation in arithmetic operations, Truncation error.

MATLAB: Introduction, Basic operations involving scalars, vectors and matrices, built-in functions for vector and matrix analysis, Programming constructs, Plotting commands - XY plots, Contour plots, 3D plots

Interpolation: Global Polynomial interpolation methods, Interpolation errors, Piecewise polynomial methods - Splines. Multi-dimensional polynomial interpolation, linear and Bilinear Lagrange interpolation in 2D.

Root finding: One Dimensional models: Simple and Non-simple roots, Bracketing and non-Bracketing methods, Higher Dimensional models: Non-linear Systems of algebraic equations.

Numerical Differentiation: Finite difference approximations, central and biased schemes for first and second order derivatives, Higher order Compact Schemes, least square methods, Practical issues.

Numerical Integration: Newton-Cotes lntegration methods, Gauss Quadratures-Gauss-Legendre and Gauss-Laguerre methods, Practical issues- Improper integrals, Integrand discontinuities.

ODE systems: Initial and Boundary value problems, R-K methods, Multi-step methods, Stiff systems, shooting and Finite Difference methods.

Linear Algebra: Linear non-homogenous systems-Direct methods, Iterative methods - Stationary and Non-stationary methods, Jacobi's method, Gauss Siedel and SOR methods, Multi-grid acceleration, Linear homogenous systems or Eigenvalue problems-Power method, Simultaneous Iteration, QR method.

High Performance computing: Basic MPI subroutines, basic MPI commands, MPI and 2D models, Domain decomposition and classical methods for linear systems.

Contents beyond syllabus: High performance computing based case studies in practical environment. .

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Development of an understanding the concepts of computer number representation and round-off error propagation during arithmetic operations.
2. To impart knowledge of MATLAB (basic features involving linear algebra, file handling and scientific visualization)
3. To impart knowledge of basic numerical tools like construction of polynomial interpolation (global and piecewise) on 1D and higher dimensional data sets. Awareness of practical issues in interpolation and their remedies.
4. Understanding the concepts of simple and non-simple roots of a nonlinear algebraic or transcendental equations and applications of different types of bracketing and non-bracketing methods for root estimation.
5. Development of concepts of numerical estimation of derivatives and integrals. Knowledge of basic Newton-Cotes and Gauss integration formulae and their applications. Handling improper integrals and integrand discontinuities
6. To provide knowledge of methods of integrating Ordinary Differential Equations.
7. To impart knowledge of basic concepts in linear algebra, types of matrices, vector and matrix norms, Direct and Iterative Solution methods

Books:

1. *Applied Numerical Methods with MATLAB by Steven C. Chapra, Tata McGraw-Hill, 2e, 2007.*
2. *Applied Numerical Methods for Engineers using MATLAB and C by Robert J Schilling and Sandra L. Harries, Thomson Brooks / Cole, 2000.*
3. *Iterative methods for sparse linear systems, 2nd Edition, Yousef Saad, SIAM, 2003.*
4. *Getting Started with MATLAB 7: A quick introduction for scientists and engineers by Rudra Pratap, Oxford University Press, Indian Edition, 2006.*
5. *Computational Mathematics: Models, methods, and analysis with MATLAB and MPI by Robert E. White, CRC Press, 2004.*
6. *Using MPI by W. Gropp, E. Lusk and A. Skjellum , MIT Press, 1995.*

Mapping of COs with POs:

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H		H						L		L	M
2	H		H	H	M		L			L		M
3	H		H	M						L		L
4	H		H		M							
5	H		H	M								
6	H		H									
7	H		H									H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	**:**	Maintenance Management
Course Number	**:**	ME 651
Credits	**:**	04
Course Category	**:**	Departmental Elective (DE)
Pre-Requisite(s)	**:**	Knowledge of fault diagnosis, maintenance policies and replacement models
Contact Hours	**:**	3L-1T-0P
Type of Course	**:**	Theory
Course Work	**:**	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To develop and understand the different configuration systems and models used in performing reliability engineering analysis.
2. To understand the various management issues in the maintenance of equipments, inventory and infrastructure, and train the personnel in specific maintenances skills.
3. To study the different problem-solving models/approaches to replacement and repair decisions, and develop fault rectification system to achieve enhanced organization performance.

Syllabus:

Reliability: Hazard rate, mean time to failure, Hazard models constant hazard Weibull model. **System Reliability:** Series, parallel and mixed configurations. K out of n structure. Optimum design configuration of a series / parallel system. **Maintainability:** Maintainability increment Equipment and mission availability.

Replacement Decisions: Economic models, block and age replacement policies, replacement policies to minimize downtime, preventive maintenance. **Inspection Decisions:** Optimal inspection frequency, minimization of downtime and availability maximization. **Overhaul & Repair Decision:** Optimal overhaul/repair/replace maintenance policies for equipment subject to breakdown optimal repair effort of a maintenance work force & spares provisioning for single and multi-echelon system.

Contents beyond syllabus: Introduction to the determination of system availability.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Ability in performing reliability engineering analysis and its management throughout the product life cycle.
2. Develop and demonstrate different configurations systems and ability to determine the optimal design configuration used in system reliability.
3. Analyse and perform maintenance activities in a cost effective manner using modern maintenance management practices and their integration within the organization.
4. Plan, develop, and apply performance management system for effective maintenance and fault rectification to achieve continuous improvement.
5. Ability to evaluate net present value for asset replacement using replacement policies and to apply problem-solving models to system reliability, maintenance and replacement decisions.

Books:

1. *Industrial Maintenance Management by Horrigren, S. Chand*
2. *An Introduction to Reliability & Maintainability Engineering by Charles Ebeling, Tata McGraw Hill.*
3. *Maintenance Best Practices by Ramesh Gulati, 2nd ed. Edition, Industrial Press.*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1		M	L							H		
2	L		M	M		L						L
3	M	M		L	L				L	H		M
4	L					H			L	M	M	
5		M		L	M							L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	**:**	Advanced Materials Science
Course Number	**:**	ME 652
Credits	**:**	04
Course Category	**:**	Departmental Elective (DE)
Pre-Requisite(s)	**:**	Knowledge of materials and their properties.
Contact Hours	**:**	3L-1T-0P
Type of Course	**:**	Theory
Course Work	**:**	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

The objective of the course is to provide students understanding of advanced materials for engineers, emphasizing the production /structure /property /function relation and to apply that knowledge for selecting and developing materials for different engineering applications.

Syllabus:

Mechanical Behaviour: Introduction to Crystalline and Non-Crystalline Materials, Concepts of Stress and Strain. Elasticity, Inelasticity, Point of Instability in Tension, Strain – Ageing, Griffith's Theory of Brittle Fracture, Fatigue, Creep and High Temperature Materials Properties.
Non Metallic Materials: Polymer's and ceramics, composites, Fiber, Matrix and Fiber/Matrix considerations. Types of composites and their fabrication techniques.
Modern Materials: Liquid Crystals, Superconductors, Smart Materials & Intelligent Structures Tech., Biomaterials. Molecular Nano-Technology Micro Tech.
Material Selection and Design Considerations: Environmental Issues, Recycling, Economics and Availability of Materials

Contents beyond syllabus: Introduction to newer materials like Nano composites.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Classify various classes of advanced materials and applications.
2. Understand the mechanism involved in the material deformations and the various mechanical testing methods, materials failure, examine the causes and predict of material failure.
3. Identify various classes of polymer and composites, common types of fibers and matrices.
4. Understand manufacturing techniques of composite, their mechanical properties and applications.
5. Classify biomaterials based on their properties / applications and select appropriate biomaterial(s) for desired in-vitro or in-vivo clinical application(s).

Books:

1. *Materials Science & Engineering by W.D. Callister Jr., Wiley, 1997*
2. *Engineering Materials Technology by J.A. Jacobs & T.F.Kilduff, Prentice Hall, 1997*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M									L	
2		H			M							L
3	H		M		M	L						
4	H	H		H	L					L	M	
5	H											

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Computer Integrated Manufacturing System
Course Number	:	ME 653
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic knowledge of computer controlled manufacturing systems.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To use computers in the area of manufacturing and also linking computers to all the manufacturing machines.
2. To learn the overall configuration and components of computer integrated manufacturing systems.
3. To study about simulation and its application in developing models of CIM systems.
4. Be familiar with fundamental concepts of rapid manufacturing.

Syllabus:

Evolving manufacturing environment, evolution towards CIM systems, role of computers in CIM, alternative views on CIM and development of CIM. CIM hardware and software. CIM database and database management system. CIM systems: Flexibility, Integration, Communication and Automation Opportunities. Components of CIM system. CIM shop floor data collection systems, material handling and storage systems. CAD/CAM in CIM, Automated process planning, rapid manufacturing, production planning and control systems. Simulation of CIM systems.

Contents beyond syllabus: Use of ARENA for simulation modelling.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Investigate; understand new and ongoing developments in the area of computer integrated manufacturing (CIM) system.
2. Understand the challenges involved in the integration of CIM database and evaluate the performance of CIM system.
3. Utilize discrete event simulation techniques to analyze, design, and develop models for manufacturing systems using ARENA etc.
4. Understand the principles of rapid manufacturing and produce an operational plan for its manufacturing.
5. Understand process planning of CIM systems.

Books:

1. *Automation, Production Systems, and CIM by Mikell P. Groover Prentice Hall of India Pvt. Ltd. New Delhi*
2. *Principles of CIM by S. Kant Vajpayee, Prentice Hall of India Pvt. Ltd. New Delhi*
3. *CIM: Revolution in Progress by Robert U. Ayres, Chapman & Hall, Madras.*
4. *Simulation Modeling and Analysis by Averill M. Law and W. David Kelton, Tata McGraw Hill, New Delhi.*

Mapping of COs with POs

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M			H					M		H	M
2	H		L		H	H	H	M			L	
3	H		H	M	H	H	M	M	L	M		M
4	M	H	M						M			
5		M		M				L	M			

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Metal Forming
Course Number	:	ME 654
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Exposure to metal forming processes.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objective:
The course aims to explain the advanced scientific theoretical aspects of metal forming processes.

Syllabus:
Analysis of Stress & Strain Tensors. Yield Criteria and Flow Rules.
Methods of Analysis of Metal Forming Problems:
Stress equilibrium Approach – Applications to plane-strain cases of forging. Rolling, Wire & Tube Drawing.
Slip Line Field Analysis – solution of simple cases of extrusion and forging.
Upper bound Analysis – solution of simple cases of extrusion & forging.
Introduction to visco-plasticity method. Defects produced in various bulk forming processes and their remedies.

Contents beyond syllabus: Explosive Forming

Course Outcomes:
After successfully completing the course, students should be able to do the following:

1. Acquired knowledge of the affect of stress and strain on the various forming processes and able to compute them.
2. Know-how of the factors affecting the various forming process and ability to compute the parameters involved therein.
3. Acquired knowledge of the defects that may induce in the products while processing through forming methods and their remedies.

Books:

1. *Plasticity & its Application to Metal Forming Problems by R.A.C. Slater.*
2. *Elements of Metal Working Theory by G.W. Rowe.*
3. *Rowe, and Geoffrey W, "An Introduction to Principles of Metal Working", St. Martin Press.*
4. *Avitzur B., "Metal Forming Analysis", Mc Graw Hill.*
5. *Polukhin V.P., "Mathematical Simulation and Computer Analysis of Thin StripRolling Mill", MIR Publishers.*
6. *Jhonson W.and Meller P.B., "Plasticity of Mechanical Engineers", Van Nostrand.*
7. *"High Velocity Working of Metals", ASTME.*
8. *Ghosh A. and Mallik A. K., "Manufacturing Science", Affiliated East-West.*

Mapping of COs with POs

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	M	L	H	L				M	L	L
2	H	L	M	L	M	L				M	L	M
3	H	L	M	M	M	L				M	L	L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Flexible Manufacturing Systems
Course Number	:	ME 655
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic exposure to computer controlled manufacturing systems
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. Be familiar with the fundamental concepts of flexible manufacturing system, manufacturing flexibility etc.
2. Understand the elements and benefits of automation in product realization.
3. Learn concepts in material handling, industrial robotics, cellular manufacturing, group technology and simulation.

Syllabus:

Definition and classification of manufacturing system, Flexible manufacturing systems: Introduction, Needs, Industrial Relevance. Problems of conventional batch manufacturing systems. Automation strategies, overview of multi model and mixed model flexible lines, types of flexibility in FMS, flexible and dynamic manufacturing systems. Typical FMS operation, decision support systems, computer simulation, process control strategies Group technology, role of integrated and automated material handling systems, robotics and its peripherals, various FMS configurations.

Contents beyond syllabus: Introduction to CIMS.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Investigate; understand new and ongoing developments in the area of flexible manufacturing systems (FMS) and explore types of manufacturing flexibilities.
2. Understand the role of design, planning and control decisions on the performance of FMS and utilize data communication for components integration.
3. To apply modern tools and concept in forming part families to be produced in FMS.
4. Understand the role of different components of FMS in enhancing the flexibility of the manufacturing systems.
5. To apply latest decision making tools for evaluating the performance of FMS and to investigate FMS relevance to industry and research.

Books:

1. *Automation, Production Systems, and Computer-Integrated Manufacturing by Mikell Groover, PHI.*
2. *CAD/CAM: Computer-Aided Design and Manufacturing, Mikell Groover, Emory W. Zimmers, JR., PHI.*
3. *Robotics, by Appu Kuttan K.K., I.K. International Publishing House Pvt.Ltd.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	M	H					L	H	M	
2	M	H	M	L	M		H	M	L			M
3		H	H				M				L	
4		L		M	M	M				M		
5			H			H	M	M				M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Noise and Vibration Engineering
Course Number	:	ME 656
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic knowledge of Ergonomics
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To increase awareness of the need for and role of noise in occupational health.
2. To obtain knowledge in the application of sound measurement principles to design of industrial workplaces and the prevention of occupational injuries
3. To understand the breadth and scope of vibration ergonomics.

Syllabus:

Physical Acoustics: Sound waves, Audible, Infrasonic and Ultrasonic sound.
Character of Noise: Discrete, Broad band, impulse impart noise, frequency weighting scales.
Sound Measurement: Sound level meter, spectral analyzer, impact noise measurement, Dosimeter.
Noise Effects: Hearing loss, physiological and performance effects, Noise exposure limits.
Noise Control: Acoustic material, passive and active control of noise, Reverberate control.
Vibration: Hand arm and whole body vibration, ISO standards Terminologies.
Vibration Effects: Effect of hand arm vibration on manual performance; HAV syndrome, physiological and performance effects of WBV.
Vibration Measurement & Control: Vibration control at source, vibration isolators, vibration measurement and analysis.
Environmental Acoustics: Sound control in buildings, mechanical equipment, community noise.

Contents beyond syllabus: Recent researches on Human Noise and Vibration.

Course Outcomes:

At the end of this course, the students should be able to:

1. Describe fundamental concepts of noise and vibration, measurement techniques and instruments
2. Understand the effect of noise and vibrations on humans. Knowledge of standards, laws and regulations followed in the field.
3. Identify, describe and analyze physical phenomena that generate sound and vibration in mechanical systems; apply models to analyze sound and vibration generation.
4. Explain the fundamental mechanisms of noise and vibration isolation.

Books:

1. *Industrial Noise Control by Lewis H. Bell, Dekker.*
2. *A hand book of Industrial Noise Control by L.L. Faulknere, Industrial Press Inc. New York.*
3. *Human Factors in Engineering & Design by McCormick, McGraw Hill.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	L			H				L			L	
2	L	L		M	H	H	L	M		M	M	
3	M	M		L	M	H	L			L	L	
4	H	L				M					H	
5	L					L					M	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Computer Aided Process Planning
Course Number	:	ME 657
Credits	:	04
Course Category	:	Departmental; Elective (DC)
Pre-Requisite(s)	:	Basic knowhow of CAD-CAM & computers
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. Fundamentals of computer aided process planning and its role in the manufacturability
2. Ability to evaluate product designs through effective selection of processes and support parameters.
3. Impart Knowledge regarding the applications of computers for generating process plans.

Course Outcomes:

1. Knowledge of fundamentals of developing process plans based on design information.
2. Knowhow of the criterion used for selection of manufacturing processes and parameters to enable process plan development.
3. Use computer aided methodologies for process plan development.
4. Students will be able to appreciate the effect of design changes on the manufacturability of the product.

Syllabus:

Introduction and concept; Frame work for process Engineering; Computer Aided process planning procedure; Process and equipment selection; Machine requirements, Capacity and output; Computer Aided manpower planning; Process Analysis; Process Charts; Operation, Planning and tolling requirements; Computer Aided Line Balancing; Manual Process Planning; Automated Process Planning; Generative Process Planning.

Contents beyond syllabus: Introduction to Feature Recognition Techniques.

Books:

1. *Operations Management by Barry Shore, Tata McGraw Hill, N. Delhi.*
2. *Operations Management Theory & Problems by Joseph Monks, 3rd Ed., McGraw Hill International, New York.*
3. *Modern Production/Operations Management by Buffa Elwood S., 7th Ed., Willey, New Delhi.*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	L							M		
2	H	H									L	
3		M				M				L	L	L
4										H	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Ergonomics
Course Number	:	ME 658
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic knowledge of Ergonomics and its priciples
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To increase awareness of the need for and role of ergonomics in occupational health.
2. To obtain knowledge in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries
3. To understand the breadth and scope of occupational ergonomics.

Syllabus:

Basic Ergonomics, Introduction to Human physiology related to occupational tasks; Methods for evaluation of stress & strain related to occupational tasks: Objective methods (O2, HR, EMG etc.) & Subjective methods (RULA, REBA, Strain Index), Manual Material handling and lifting tasks design (NIOSH Lifting index), Work Place design (Layout of equipment; Arrangement and utilization of physical space) & Application of anthropometrics data and design of work place; Design of Displays & Controls; Control tools and related devices; Hand held Tools design, Effect of environmental factors on human performance (Illumination, Noise, Heat and Vibration); Industrial Health and Safety regulations: Case studies for ergonomics improvement.

Contents beyond syllabus: Introduction to LabVIEW software.

Course Outcomes :

After completing this course, participants should be able to:

1. Understand ergonomics and its principles.
2. Understand the "physiology" of human body and types of movements causing ergonomic problems related to tools, task and workplace.
3. Creating "pragmatic" solutions for the design of tools, workplace and tasks using ergonomics knowledge.
4. Applying ergonomics in industry for effective and efficient use of facilities with low risk of WMSDs.

Books:

1. *Human Factors in Engg. & Design by Mark S. Sanders & E. J. McCormick, McGraw Hills*
2. *Introduction to Ergonomics, R. S. Bridger*
3. *Encyclopedia of Ergonomics & Human Factors Engineering, Karwawoski*

Mapping of COs with POs:

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M								L			M
2				M		H						
3		H						M				
4			M				M					

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	**:**	Information Systems and Data Management
Course Number	**:**	ME 659
Credits	**:**	04
Course Category	**:**	Departmental Elective (DE)
Pre-Requisite(s)	**:**	Basic knowledge of data structure and Information Technology
Contact Hours	**:**	3L-1T-0P
Type of Course	**:**	Theory
Course Work	**:**	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives

1. To understand the usage of different types of information systems in different business settings.
2. To understand the activities that are undertaken in acquiring an information system in an organization.
3. To get awareness of various information system issues and concepts like data administration, data networking and data communication, and how they affect the business performance.
4. To understand the major technological, behavioral and ethical issues pertaining to Information systems.

Syllabus:

Survey of information systems and technology, Concept of information; Information as a resource. Types of information systems – management information systems. Decision support Systems, Transaction processing system, on line systems, Executive Support Systems, Real Live Systems, Expert Systems. Information Systems Planning, architecture and prioritization, Flexibility in information systems and MIS success, Quality and value of information, User involvement, MIS life cycle. Organizing for managing information resources; data administration and information management, data center administration. The application development backlog. Outsourcing information system security, managing technology – driven change. End user computing.

Contents beyond syllabus: Introduction to Big Data analysis.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Knowledge and understanding of different types of information systems useful in business settings.
2. Utilizing and administrating information systems to successfully manage systems development projects.
3. Ability to analyze the information systems in-line to: planning, development, flexibility and prioritization for its success.
4. Knowledge of basic concepts and technologies applied in the field of management information systems. Understanding the outsourcing information system security
5. Ability to manage information resources like data administration and information management, business data and data center administration as well as ability to analyze the advances in networking, data communications and internet, and how they affect the way business is conducted.
6. Understanding the major technological, organizational, behavioral, and ethical issues that the information systems professionals are facing today.

Books:

1. *Management Information Systems by J. Griffith, Prentice Hall*
2. *Management Information Systems by Jaiswal and Mital, Oxford.*
3. *Management Information Systems by James A. O' Brien, 5th ed, Tata McGraw Hill.*
4. *Management Information Systems by Davis and Olson, 2nd ed., Tata McGraw Hill.*
5. *Management Information Systems by DP Goyal, 3rd ed., MacMillan.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1			H			M	L					
2	M			H					L			
3	M	H					M					M
4			L	M							L	
5	H					L			L	H		
6							M	L			H	H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Mechanics of Composite Materials
Course Number	:	ME 682
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic knowledge of materials science
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To increase awareness of composites materials.
2. To obtain knowledge of composite lamina under different loads.
3. To have knowledge about failure criteria in composites.

Syllabus:

Composite Materials:

Introduction; Mechanical behavior of an isotropic materials, Stress-Strain relations; Micro mechanics and production of electric constants; Macro-mechanical behavior of composite lamina under longitudinal, Transverse and Shear loads; Poisson's Ratio determination; Halpin – Tsai equation.

Strength of Laminates:

Generalized Theory of multi layered laminates, Cross – ply and angle – ply laminates.

Composite Material Structural Elements:

Development of a simple theory for bending of laminated beams; axially loaded simply supported beams; Thermo elastic effects on beams of composite materials.

Plate equilibrium equations and bending of composite material plates.

Composite material cylindrical shells subjected to axially symmetric load, laminated composite cylindrical shells.

Contents beyond syllabus: Introduction to smart composites.

Course Outcomes:

At the end of this course, the students should be able to:

1. Understand the principles of mechanical behavior of layered composites.
2. Determine stresses and strains in composites.
3. Apply failure criteria and critically evaluate the results.
4. Understand mechanical behavior of composites due to variation process parameters.

Books:

1. *Mechanics of composite materials by Jones, McGraw Hill.*
2. *Analysis of structural composite materials by Gar, et.al. Marcel Dekkar Inc. NY.*
3. *Behavior of structures composed of Composite Materials by Vinson & Martinus Nijhoff & Sierakowski.*
4. *Composite materials Vol. 1 – 8 by Bronman & Krock, Academic Press.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	L			H		M		L				M
2	M	H	M	M	M	L				L		
3	M	M	L		H	M				L		
4	H	M	M		H	M	L		L		M	L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Project
Course Number	:	ME 691I
Credits	:	03
Course Category	:	Humanities and Practice (DC)
Pre-Requisite(s)	:	None
Contact hours	:	0L-0T-3P
Type of Course	:	Practical
Course Assessment	:	Course Work: 60 marks; End Semester Examination: 40 marks

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts / data from various available sources (Journals, articles, web-based resources etc.)
2. To impart training to recognize and incorporate social, ethical and professional aspects in technological solutions.
3. To provide an exposure to the analysis / solution of a real world complex engineering problem.
4. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
5. To develop data representation and interpretation skills along with an approach of critical reasoning.
6. To develop documentation and technical report writing skills.
7. To develop overall management (technical and financial) skills required for successful completion of research and design task.
8. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Capability to identify a potential research and design problem on the basis of a literature survey.
2. Awareness of social, professional and ethical aspects associated with a given technology.
3. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem and employ various data analysis (visualization and interpretation) approaches through logical and critical reasoning.
4. Ability to effectively communicate the research / design / analysis through technical reports.
5. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M	M	H	M	L		M		M	M	M	M
2		M					M		L	M	H	M
3	H	H	M	M	M	H	M	M	M	M	L	M
4	L	M	L	M	L	H	L	M	H	M	L	H
5	L	M	M	M		M	M	H	L	M	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Industrial & Production Engineering Lab
Course Number	:	ME 692
Credits	:	04
Course Category	:	Professional Core (Experimental) (DC)
Pre-Requisites(s)	:	Nil
Contact Hours	:	0L-0T-3P
Type of Course	:	Practical
Course Work	:	Mid Semester Examination (60 Marks); and End Semester Examination (40 Marks).

Course Objectives:

1. Understanding of Ergonomics aspect of design, WMSDs and human compatibility with machines and environment.
2. Practical understanding of metallurgy and heat treatment process on properties of engineering materials.
3. Analyzing data using Statistical techniques and interpretation of results.

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Develop skills in the application of ergonomic principles to design of industrial workplaces with the reduced risk of injuries.
2. Perform experiments which may evaluate the compatibility of human aspects with tools, workplace, tasks etc.
3. Develop the understanding of Metallurgy and Materials.
4. Able to choose proper material and heat treatment methods as per requirement in Machinery.

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	L	M		M	H	H		H		
2		M	H	H	H	H		M		M	H	
3	H	H	H	H	H	H					M	H
4		M		M		M	H	H	L	M	L	
5	M	M	L	L	H		H	L	H	H		H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Ergonomics & Data analytics Lab
Course Number	:	ME 692N
Credits	:	04
Course Category	:	Departmental Core (Experimental) (DE)
Pre-Requisites(s)	:	None
Contact Hours	:	0L- 0T- 3P
Type of Course	:	Practical
Course Work	:	Course work: 60 Marks; End Semester Examination: 40 Marks

Course Objectives:

1. To develop skills in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries.
2. To conduct experiments which may evaluate the compatibility of human aspects with tools, workplace, tasks etc.
3. To expose the students to the different aspects of human factors and its effects on Productivity.
4. To design an ergonomically sound workplace for comfortable and efficient working.
5. To understand the basics of data analytics/bid data using Python in different industrial Engineering application.

Syllabus :

A) Python programming for DATA Analytics

- Data Structures and related procedures: Simple: integer, float, string, Boolean; Compound: List, tuple, dictionary; Local vs. Global Variables
- Operations: Integers & Floating point numbers: int, float, and arithmetic operators.
- Statements: conditionals (if), for-loops, while-loops, function definitions, break, continue, global, import, pass, print, return etc.
- Math Module: Mathematical Operations: e.g. math.log, math.exp, math.sin, math.cos, etc.
- Random Module: Operations: random.choice, random.randint, random.randrange, random.random, random.shuffle, random.seed

B) Ergonomics

- To measure individual capacity in perform cycling task (Bicycle Ergometer).
- To perform finger endurance test on subjects and then analyze the results manually using ANOVA.
- To perform static grip endurance test at 50 % and 20% of maximum voluntary contraction using electromyogram.
- Evaluation of given workplace and Lifting Task in HCAD
- To record the maximum breathing capacity using Respirometry

Contents beyond syllabus: Signal Processing and LabVIEW.

Course Outcomes:

After completing this course, participants should be able to:

1. Develop skills to apply the ergonomic principles in designing industrial workplaces and preventing work injuries.
2. Performing experiments to evaluate compatibility of human aspects with tools, workplace and tasks.
3. Exposure to different aspects of human factors and its effects on productivity.
4. Designing ergonomically sound workplaces for comfortable and efficient working leading to productivity improvement.
5. Understand the basics of big data using Python in different Industrial Engineering applications.

Books:

1. *Introduction to Python(e-Book)*
2. *Human Factors in Engg. & Design by Mark S. Sanders & E. J. McCormick, McGraw Hills*
3. *Encyclopedia of Ergonomics & Human Factors Engineering, Karwawoski*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H										
2			H									
3		M					M					
4		M		H								
5	H					H						

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Artificial Intelligence and Operation Research Laboratory
Course Number	:	ME 693
Credits	:	03
Course Category	:	Professional Core (Experimental) (DC)
Pre-Requisite(s)	:	Exposure to mathematical modeling, basic operation research techniques and computer programming language
Contact Hours	:	0L-0T-3P
Type of Course	:	Laboratory
Course Work	:	Computer Programs/Reports/Viva-Voce/Short, Projects/Case Studies (60 Marks) & End Semester Examination (2 Hours) (40 Marks)

Course Objectives:

1. To study and apply the various operations research tools in service and manufacturing organizations.
2. To gain the knowledge of various simulation techniques.
3. To analyze operations research tools using MATLAB software.
4. To understand the applications of artificial intelligence in various Industries.

Syllabus:

Introduction to Operation Research (OR). Overview of the OR Modelling Approach. Review of various OR Techniques. Linear Programming. Goal Programming. Dynamic Programming. Non-Linear Programming.

Overview of Simulation. Simulation Techniques. Common types of applications of Simulation. Introduction to Artificial Intelligence (AI). Genetic Algorithm. Artificial Neural Networks (ANN), Fuzzy Logic. Applications of AI to various Industries. Use of MATLAB software.

Contents beyond syllabus: Introduction to Python Programming.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Knowledge and understanding of mathematical models and decision making techniques.
2. Select an appropriate operations research technique to analyze the given data using MATLAB software.
3. Develop and analyze the industrial systems through simulation techniques.
4. Development and execution of case studies for decision making through artificial intelligence in manufacturing and service industries.

Books:

1. *F.S. Hillier & G.J. Lieberman, Operation Research, Tata McGraw Hills, New York.*
2. *P. Mariappan, Operation Research: An Introduction, Pearson Publication.*
3. *Averill Law, Simulation Modelling and Analysis, McGraw Hills, New York.*
4. *M. Ross Sheldon, Simulation, Academic Press Publication.*
5. *Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall Publication.*
6. *MATLAB software.*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M	M	H	H	M	H	M	L	L	M	M	M
2	H	H	M	H	H	H	M	M	H	H	M	M
3	H	H	H	H	H	H	H	M	M	H	M	H
4	M	M	H	H	H	H	H	H	H	M	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Facility Planning & Plant Engineering.
Course Number	:	ME 721
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	Basic knowledge of planning, site location, inventory models and plant layout.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments (15 Marks); and End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims in identifying the necessity for facility Planning & layout in multi plant operation.
2. To understand the techniques applying in computerized layout planning for single and multi-facilities location and layout model.
3. To study the various inventory models and their need for inventory management.
4. To understand the applications of different networks.

Syllabus:

Plant location factories and theories. Location of Plant with multi-plant operation. Location dynamics. Facilities Planning Types of Layouts. Quantitative methods in process layout. Computerized Layout Planning CRAFT, CORELAP, ALDEP. Single and multi-facilities location and Layout models. Min-max location. Location allocation models. Population and assembly line balancing. Various algorithms in assembly line balancing. Inventory Models Necessity for maintaining inventory, fixed order quantity models, models with deterministic and probabilistic demands, multi-item deterministic model, Inventory management Techniques. PERT networks and time estimates and their computations. CPM, time estimates, Project cost Analysis.

Contents beyond syllabus: Computer programming for facility layout problems.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Understanding the need of facility planning & layout and analysing plant layout problems through approaches like Systematic Layout Planning & REL Charts.
2. Knowledge and application of the techniques of computerized layout planning like CRAFT, CORELAP & ALDEP for single and multi-facilities location and layout model.
3. Knowledge and understanding of inventory models and their application in inventory management.
4. Develop and analyze CPM & PERT networks and understand their applications in modern industries.

Books:

1. *Facility Layout & Location-An Analytical Approach by Richard L. Francis, John A. White, Prentice Hall.*
2. *PERT & CPM Principles & Applications by L S Srinath, East west Press.*
3. *Facilities Design by S. Konz John, John Wiley & Sons.*
4. *Practical Plant Layout by Muther R.,McGraw Hill.*

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	L			L		H	M			H
2	H			H	L					M		
3	M	H		L	H	L	H	H	M		M	
4	H	H		H	M		M	H	M			L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Welding Science
Course Number	:	ME 751
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Basic knowhow of different joining processes and metallurgy
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments, Tutorials, Quizzes (15 Marks); and End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. To provide a comprehensive overview of all common fusion (liquid state), solid state welding processes and allied thermal spray process and process parameters.
2. To develop concepts related physics of welding and welding metallurgy associated with welding processes.
3. To provide an understanding of weld quality characterization and weld integrity of welding process by understanding welding defects, and testing techniques to assess the quality of welded joints.

Syllabus:

An Overview of arc welding and gas welding processes; Power sources for arc welding resistance and electro slag welding; Recent trends in welding – Electron beam, laser beam welding, solid-state welding, under water welding; joining of plastics and ceramics; Welding metallurgy – study of HAZ, Residual Stress and Distortion, Weld ability of different materials; Defects in welding and their remedies, Testing of Welds, Safety in Welding; Metal Coating on surfaces by Spray and other methods; Soldering & brazing.

Contents beyond syllabus: Modern joining processes like FSW.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Use of physical metallurgy principles to explain the response of ferrous and non-ferrous metals to welding.
2. Ability to interpret the microstructures of weldments for a wide range of ferrous and non-ferrous alloys.
3. Ability to identify appropriate NDE techniques for welded fabrications and interpret NDE.
4. Understand surface modification methods such as thermal spraying and thermal cutting of metals.

Books:

1. *Welding – A Hand Book*
2. *Metallurgy of Welding by J.F. Lancaster*
3. *Welding & Welding Technology by R.L. Little*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1		M	L							H		
2	L		M	M		L						L
3	M	M		L	L				L	H		M
4	L					H			L	M	M	
5		M		L	M							L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Machine Tool Design and Control
Course Number	:	ME 753
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisite(s)	:	Exposure to machine tools and their control processes.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments, Tutorials, Quizzes (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims to gain the knowledge of machine tool drives and their controls.
2. To understand the principle and mechanism of various machine tool components and structures.
3. To study the design and dynamics of machine tools.
4. To understand the applications of numerically controlled machine tools.

Syllabus:

Introduction to machine tool derives and mechanisms. Regulation of speed and feed rates. Design of machine tool structures. Design of guide ways and power screws. Design of spindle and spindle supports. Dynamics of machine tools. Control systems in machine tools. Numerical Control of machine tools.

Contents beyond syllabus: Introduction to NC/CNC programming.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Knowledge and understanding of machine tool drives and mechanisms.
2. Understanding of design and analysis of machine tool structures.
3. Knowledge of design of guide ways, power screws, spindle and spindle supports and dynamics of machine tools.
4. Applications and understanding of numerical control systems of machine tools.

Books:

1. *Machine Tool Design by Macherkan, Vol. I & II Mir Pub., Moscow.*
2. *Machine Tool Design & Numerical Control by N.K. Mehta, Pub: Tata McGraw Hills Publications.*
3. *Multiagent Systems for Manufacturing Control: A Design Methodology by S. Bussmann, N.R. Jennings and M.J. Wooldridge, Pub: Springer*
4. *Advanced Design and Manufacturing Based on Springer Series in Advance Manufacturing by Xun Xu and Andrew Y. Ching Nee, Pub:Springer*

Mapping of COs with POs

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M			L						M		
2	M	M	L	M	L					L	L	
3	H	M	M			M	L		L			M
4	H	L	L		M	L		L		M	L	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Robotics and Control
Course Number	:	ME 754
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	Exposure to basic electronics.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Assignments, Tutorials, Quizzes (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims to acquire knowledge of Robotics and Robot components.
2. To understand the various Robot configurations.
3. To study the Robot path and speed control systems.
4. To acquire knowledge of Robot programming for industrial and manufacturing systems.

Syllabus:

Introduction: Definition, Structure and Classification.

Robot Elements: Manipulators; end effectors; sensors; drivers; actuators etc. Synthesis of geometrical configurations.

Robot Control: Fundamental Principles, Classification Position; Path and speed control systems; adaptive control.

Robot Programming: Foundry; press working; heat treatment welding; machine tools material handling; warehousing assembly etc. robot economics and safety; robot integration with CAD and CAM.

Contents beyond syllabus: Introduction to sensing systems applied to robots.

Course Outcomes:

1. Understanding and knowledge of Robot structure and classification.
2. Knowledge and understanding of sensors, drivers, actuators, manipulators and end effectors.
3. Optimize the robot path and apply speed and adaptive control systems.
4. Understanding and knowledge of Robot programming in industrial and manufacturing systems.

Books:

1. *Robotic Technology Voll & V by Phillipe Coeffet Prentice Hall.*
2. *Industrial Robots by Koyyred, Mir Publishers*
3. *Industrial Robotics by Groover & Mitchel, McGraw Hill.*

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M				M					M		
2	H	M		H	H	M	H			M		M
3	H	H	M	M	M	H	H	M	M	H	L	H
4	H	M	H	M	H	H	M	M	M	H	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Production Systems
Course Number	:	ME 755
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	None
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The primary goal of this course is to provide an overview of state-of-the-art of production system.
2. To enhance skills in the areas of different machine layouts, group technology, NC systems, JIT, TQM etc.
3. To impart knowledge in automation of production system, flexible manufacturing systems, adaptively controlled systems etc.

Syllabus:

Introduction to various production systems. Main features of conventional machine layout systems. Flow line systems. Group technology systems. Transfer machines. NC Systems, machine Centers, Flexible manufacturing systems and adaptively controlled systems. Comparison of economics of various systems.

Development in the automation and optimization of component manufacture, system design and operation planning. Methods of line identification and control, Japanese production system concepts, JIT and TQM.

Contents beyond syllabus: Introduction to Reconfigurable Systems.

Course Outcomes:

1. Investigate, understand new and ongoing developments in the area of production systems.
2. Investigate new and ongoing developments in the area of numerical control of machine tool.
3. Understand the role of flexible manufacturing system adaptively controlled systems in improving the performance of the production systems.
4. Understand the development in design, planning and automation of production systems.
5. Acquaint with Tools viz. GT, TQM, JIT and their contribution towards production management.

Books:

1. *Production Management Systems and Synthesis by Starr, Prentice Hall*
2. *Automation, Production Systems and CAM by Groover, Englewood.*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H		M								M	
2	H			M			H					
3	H		H	M							L	
4	H			M						M		
5			H					M				M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Group Technology & Production Strategy
Course Number	:	ME 756
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	None
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The primary goal of this course is to provide an overview of state-of-the-art of group technology and production strategy.
2. To impart knowledge in manufacturing policy, manufacturing structure, manufacturing audit and technological forecasting.
3. To enhance skills in the areas of classification and grouping components with the help of group technology.

Syllabus:

Characteristics of mass, batch and job manufacturing. Economics of industry. Technology of industry. Top to down approach to manufacturing policy determination. Analysis of anachronistic factory, focused factory. Manufacturing Structure, Manufacturing audit approach to production system design. Technological forecasting.

Group Technology: Introduction, classification and grouping in general Component classification systems. Economics of group technology. Case studies in the application of group technology.

Contents beyond syllabus: Current advances in cellular manufacturing.

Course Outcomes:

1. Investigate new and ongoing developments in the area of group technology and production strategy.
2. Understand different types of manufacturing environment, manufacturing policy, manufacturing structure, manufacturing audit, and technological forecasting.
3. Understand different types of factory and apply different approaches for production system design.
4. Acquaint with group technology tool for grouping and classification of parts in their contribution towards production management.

Books:

1. *Group Technology; Production methods in manufacturing by Gallagher & Knight, Ellis Hosewood.*
2. *Automation, Production Systems and Computer Integrated Manufacture by Groover Prentice Hall.*
3. *Machining Science & Application by Kronenberg, Pergamon Press.*

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H		M	M				M				
2											H	M
3	H		H	M							L	
4	H	H		M						M		

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Advanced Optimization Techniques
Course Number	:	ME 757
Credits	:	04
Course Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	Exposure to mathematical modeling.
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Work	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. The course aims to acquire knowledge of optimization models used in industries.
2. To understand the genetic algorithm and stochastic programming.
3. To study the applications of robust design techniques.
4. To understand the applications of various analysis software.

Syllabus:

Steepest descent method, conjugate direction method, penalty function method, integer programming methods.
Genetic algorithms, simulated annealing, Turbo search.
Multi-objective optimization, robust design techniques (variation reduction techniques), optimal control, stochastic programming.
Optimization – geometric modeling analysis, computational time vs accuracy, interfacing with geometric modeling and analysis softwares, Graphics interfacing.
Application of Optimizations methods to engineering design problems, Comparison with existing solutions.

Contents beyond syllabus: Use of MATLAB in optimization.

Course Outcomes:

After successfully completing the course, students should be able to do the following:

1. Understanding and knowledge of necessity and development of optimization models for various industries.
2. Knowledge and understanding of genetic algorithm, multi-objective optimization and stochastic programming.
3. Optimize the industrial systems through robust design techniques and geometric modeling approach.
4. Applications of various optimization methods to engineering design problems and knowledge of various analysis softwares.

Books:

1. *Optimization Techniques by A.K. Malik, S.K. Yadav and S.R. Yadav, Pub: I K International Publishing House*
2. *Optimization of Stochastic Discrete Systems and Control on Complex Networks by D. Lozovanu and S. Pickl, Pub: Springer*
3. *Optimization Techniques for Solving Complex Problems by E. Alba, C. Blum, P. Asasi, C. Leon, Pub: Wiley-Blackwell*
4. *Approximation, Randomization and Combinatorial Optimization. Algorithms and Techniques by K. Jansen, S. Khanna, Jose D.P. Rolim and D. Ron, Pub: Springer*

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	M	H	M	H	H		M	M	L	M
2	H	M	H	H	H	H	M	M	M	M	H	M
3	M	H	M	M	M	H	H	M	M	H	L	H
4	M	M	H	M	H	H	M		M	H	H	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	: Behavioral Science
Course Number	: ME-758
Credits	: 04
Course Category	: Departmental Elective (DE)
Pre-Requisite(s)	: None
Contact Hours	: 3L-1T-0P
Type of Course	: Theory
Course Work	: Mid Semester Examination (25 Marks), 1 hour; Course Work: Assignments, Tutorial, Quiz (15 Marks); End Semester Examination (60 Marks), 3 hours

Course Objectives

1. To acquaint students with the fundamentals of industrial psychology.
2. To make students learn human behavior as individuals and in groups at work.
3. To make students understand group dynamics and interpersonal relationships.
4. To prepare students to communicate in an organizational set up.

Syllabus

Integration of behavioral science theory, concepts research and techniques for understanding human behavior in organization and groups; motivation and job satisfaction; computer simulation of human behaviors; personality and conflict; informal and formal group dynamics; interpersonal relationships, supervision and leadership; communications; Organization structure and process; impact of technology; career development.

Contents beyond syllabus: Introduction to Physio-Psychology and Psycho-Physiology.

Course Outcomes

1. Understanding the various components of industrial psychology.
2. Learning human behavior at work as individuals and in groups.
3. Learning how to communicate with different people in an organization.
4. Understanding work-related conflicts and ways to resolve them.

Books

1. *Behavior in Organizations by Porter, Lawler & Hackman.*
2. *Motivation and Work Behavior by Steers & Porter.*
3. *Organizational Communication- The keystone to Managerial Effectiveness by Wofford, Gerloff & Cummins*

Mapping of COs with POs:

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1				L							M	
2	M						M					M
3				L					H			
4							H				L	

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Foundry Technology
Course Number	:	ME 759
Credits	:	04
Category	:	Departmental Elective (DE)
Pre-Requisites(s)	:	Basic knowledge of metal casting processes
Contact Hours	:	3L-1T-0P
Type of Course	:	Theory
Course Assessment	:	Mid Semester Examination (25 Marks), 1 hour duration; Course Work (Home Assignments, Tutorials, Quizzes) (15 Marks); End Semester Examination (60 Marks), 3 hours duration.

Course Objectives:

1. Provide the students with knowledge on the principles that guides production of sound engineering castings.
2. Study of die and pattern design, gating system design, advanced casting processes and mechanization of foundry.
3. Study of casting metallurgy and defects.

Course Outcomes:

After the completion of the course, the students should be able to:

1. Estimate and control the dimensional accuracy of the cast components.
2. Study and design the steps/stages involved in the fabrication of defect free ferrous castings.
3. Design and develop the steps/stages involved to fabricate quality non-ferrous metals and alloys components.
4. Ability to design and mechanize the metal casting technique to produce a typical near net shape end product.

Syllabus:

Overview of Metal Casting Processes; Sands, Binders and Additives; Furnaces, Fuels and Refractory materials; Metallurgical and Heat Transfer Principles in Moulds; Design of Gating & Rise ring Systems; Casting Design; Mechanization and Automation in Foundries; S.G. Iron, Steel and Non-ferrous Casting Technology.

Contents beyond syllabus: Recent researches in steel making.

Books:

1. *Principles of Metal Casting by Hume, R.W., Loper C.R., & Rosenthal P.C. Tata McGraw Hills Pub.*
2. *Foundry Engineering by Taylor, Fleming &Wal, John Wiley & Sons.*
3. *American Society of Metals – A Source Book on Ductile Iron, ASM Pub.*
4. *American Foundrymen's Society – Design of Die Casting, AFS Pub.*
5. *Casting & Forming Processes by Cambel, McGraw Hills Pub.*

Mapping of COs with POs

Cos	Program Outcomes (POs)											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	L	L	L	L	H	L	H	H	L	L	L
2	H	L	M	L	M	M	M	H	H	H	L	H
3	H	L	M	L	L	H	L	H	H	H	L	H
4	H	H	H	M	H	M	H	M	H	H	L	H

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	General Seminar
Course Number	:	ME 780I
Credits	:	02
Course Category	:	Humanities and Practice (DC)
Pre-Requisites(s)	:	None
Contact Hours	:	0L-0T-3P
Type of Course	:	Lab
Course Work	:	Mid Semester Examination (60 Marks) and End Semester Examination (40 Marks).

Course Objectives:

1. Identify, understand and discuss current, real-world issues.
2. Improve oral and written communication skills.
3. Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of the Industrial and production engineering discipline.
4. Apply principles of ethics and respect in interaction with others.

Course Outcomes:

Course Objectives Upon course completion, the students will be able to:

1. Use multiple thinking strategies to examine real-world issues, explore creative avenues of expression, solve problems, and make consequential decisions.
2. Integrate, organize and present information across disciplines.
3. Acquire, articulate, create and convey intended meaning using verbal method of communication.
4. Apply principles of ethical leadership, collaborative engagement and sustainable development.

Mapping of COs with POs:

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	L			H		M	H		H	H	H	H
2	M			H		L	H	L	H	H	M	M
3						M	M	M	M	H	H	M
4		L		H		L	M	L	H	H	H	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	**:**	Preliminary Dissertation
Course Number	**:**	ME 781I
Credits	**:**	03
Course Category	**:**	Humanities and Practice (DC)
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0L-0T-3P
Type of Course	**:**	BSA
Course Assessment	**:**	Course Work 60 marks; Mid Sem Examination; End Sem Examination 40 marks

Course Objectives:

1. To assess the plan of study / work for feasibility in terms of research potential and the required infrastructural support at the Departmental level.
2. To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
3. To develop the ability for justification and defence of a research proposal.
4. To develop documentation and research proposal writing skills.
5. To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Capability to identify a potential research and design problem on the basis of a literature survey.
3. Capability to identify proper theoretical / research methods and tools for obtaining solutions for a specific problem.
4. Ability to effectively communicate the research plan through a technical report.
5. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	M	M	M		H	M		M	L	H	
2	H	H	M	M	L	M	M	M	M	L	L	M
3	M	M	M	H	H	H	M	M	M	M	M	M
4	L	M	M	M		M	L	L	H	M	M	H
5	M	M	M	M	L	M	M	H	H	L	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	**:**	Dissertation Seminar.
Course Number	**:**	ME 782I
Credits	**:**	02
Course Category	**:**	Humanities and Practice (DC)
Pre-Requisites (s)	**:**	None
Contact hours	**:**	0L-0T-3P
Type of Course	**:**	General
Course Assessment	**:**	Course Work 60; Mid-Semester Examination, End-Semester Examination 40

Course Objectives:

1. To assess the study / work for submission feasibility as a thesis.
2. To invite any suggestions / comments from the pertinent faculty members for enhancing the quality of the proposed research work.
3. To develop the ability for justification and defence of research work.
4. To develop documentation and research report/thesis writing skills.
5. To develop presentation and communication skills (oral and written) using modern multimedia facilities and aides.

Course Outcome:

1. Capability to justify and defend a research work/thesis.
2. Ability to effectively communicate the research work through a technical report.
3. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	H	H	H	M	M	H	M	M	M	M	H	M
2	M	M	M	M	M	H	M	H	H	M	M	H
3	M	M	M	L	M	M	M	H	M	M	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Project
Course Number	:	ME 791I
Credits	:	03
Course Category	:	Humanities and Practice (DC)
Pre-Requisite(s)	:	None
Contact hours	:	0L-0T-3P
Type of Course	:	Practical
Course Assessment	:	Course Work: 60 marks; End Semester Examination: 40 marks

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts / data from various available sources (Journals, articles, web-based resources etc.)
2. To impart training to recognize and incorporate social, ethical and professional aspects in technological solutions.
3. To provide an exposure to the analysis / solution of a real world complex engineering problem.
4. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
5. To develop data representation and interpretation skills along with an approach of critical reasoning.
6. To develop documentation and technical report writing skills.
7. To develop overall management (technical and financial) skills required for successful completion of research and design task.
8. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Capability to identify a potential research and design problem on the basis of a literature survey.
2. Awareness of social, professional and ethical aspects associated with a given technology.
3. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem and employ various data analysis (visualization and interpretation) approaches through logical and critical reasoning.
4. Ability to effectively communicate the research / design / analysis through technical reports.
5. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs

	Program Outcomes (POs)											
COs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M	M	H	M	L		M		M	M	M	M
2		M					M		L	M	H	M
3	H	H	M	M	M	H	M	M	M	M	L	M
4	L	M	L	M	L	H	L	M	H	M	L	H
5	L	M	M	M		M	M	H	L	M	M	M

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Production Engineering Laboratory
Course Number	:	ME 792
Credits	:	04
Course Category	:	Professional Core (Experimental) (DC)
Pre-Requisites(s)	:	None
Contact Hours	:	0L-0T-3P
Type of Course	:	Practical
Course Work	:	Course Work 60%; End Sem Examination (2 hours) 40%

Course Objectives:

1. Analysis and estimation of optimum machining parameters for machining processes.
2. Development of NC and CNC codes for any given job.
3. Self-designing of experiments

Course Outcomes:

1. Understanding and learning how to operate different measuring instruments.
2. Learning to use different manufacturing processes and parameters for fabricating engineering components and evaluating quality of a product.
3. Ability to evaluate and compare various mechanical properties of different engineering materials.
4. Develop part programs with the help of G-M codes and manufacture a component on CNC machines.
5. Self-designing of experiments related to material, manufacturing and automation.

Contents beyond syllabus: Applications of Piezoelectric sensors.

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1		M	L							H		
2	L		M	M		L						L
3	M	M		L	L				L	H		M
4	L					H			L	M	M	
5		M		L	M							L

DEPARTMENT OF APPLIED MATHEMATICS

Aligarh Muslim University, Aligarh

Course Title	:	Dissertation
Course Number	:	ME 798I
Credits	:	10
Course Category	:	Humanities and Practice (DC)
Pre-Requisites (s)	:	None
Contact hours	:	0L-0T-3P
Type of Course	:	General
Course Assessment	:	Course Work 60; Mid-Semester Examination & End-Semester Examination 40

Course Objectives:

1. To impart training in identification of a potential research problem via collection of facts / data from various available sources (Journals, articles, web-based resources etc.)
2. To provide an exposure to the analysis / solution of a real world complex engineering problem.
3. To develop the ability towards application of the theoretical knowledge / various research methods and tools for the solution of a research and design problem.
4. To develop data representation and interpretation skills along with an approach of critical reasoning.
5. To develop documentation and technical report writing skills.
6. To develop overall management (technical and financial) skills required for successful completion of research and design task.
7. To supplement the knowledge gained in various theory courses.

Course Outcomes:

1. Awareness of fact and data sources and collection procedures on a specific technical topic.
2. Capability to identify a potential research and design problem on the basis of a literature survey.
3. Awareness of social, professional and ethical aspects associated with a given technology.
4. Capability to apply proper theoretical / research methods and tools for obtaining solutions for a specific problem.
5. Capability to employ various data analysis (visualization and interpretation) approaches and to extract the relevant trends.
6. Ability to effectively communicate the research / design / analysis through technical reports.
7. Ability to employ basic management approaches to monitor and regulate the progress necessary for timely completion of a given task.

Mapping of COs with POs

	Program Outcomes (POs)											
Cos	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	M	M	H	M	L		M		M	M	M	M
2	H	H	M	M	M	H	M	M	M	M	L	M
3	H	H	M	M	H	H	M	M	M	M	M	M
4	L	M	L	M	L	H	L	M	H	M	L	H
5	L	M	M	M		M	M	H	L	M	M	M