SWAMIVIVEKANANDUNIVERSITY, SAGAR(M.P.)

SYLLABUS

For

Master of Technology

M.Tech in Aerospace Engineering

SubjectCode:MTASD

DepartmentofAerospace Engineering

FacultyofEngineering

DurationofCourse : 2Years

ExaminationMode : Semester

ExaminationSystem : Grading

SwamiVivekanandUniversity, Sagar, Madhya Pradesh

Mathematical Methods in Aerospace Engineering (MTASD-0101)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	
		L	T	P	C	Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0101	Mathematical Methods in Aerospace Engineering	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Review of Ordinary Differential Equations: analytical methods, stability – Fourier series, orthogonal functions, Fourier integrals, Fourier transform – Partial Differential Equations

Unit-II **Marks: 14**

First-order PDEs, method of characteristics, linear advection equation, Burgers' equation, shock formation

Unit-III **Marks: 14**

Rankine-Hogoniot jump condition classification, canonical forms; Laplace equation, min-max principle, cylindrical coordinates

Unit-IV **Marks: 14**

Heat equation, method of separation of variables, similarity transformation method; wave equation, d'Alembert solution

Unit-V **Marks: 14**

Calculus of Variations: standard variational problems, Euler-Lagrange equation and its applications, isoperimetric problems, Rayleigh-Ritz method, Hamilton's principle of least action.

<u>Text Books: References</u>

1. Brown, J. W. and Churchill, R. V., Fourier Series and Boundary Value Problems, 8th ed., McGraw-Hill, (2012).
2. Bleecker, D. D. and Csordas, G., Basic Partial Differential Equations, Van Nostrand Rein- hold (1992).
3. Myint-U, T. and Debnath, L., Linear Partial Differential Equations for Scientists and Engi- neers, 4th ed., Birkhauser (2006).
4. Strauss, W. A., Partial Differential Equations: An Introduction, 2nd ed., John Wiley (2008).
5. Kot, M., A First Course in the Calculus of Variations, American Math Society (2014).
6. Gelfand, I. M. and Fomin, S. V., Calculus of Variations, Prentice Hall (1963).
7. Arfken, G. B., Weber, H. J., and Harris, F. E., Mathematical Methods for Physicists, 7th ed., Academic Press (2012).

8. Greenberg, M. D., Advanced Engineering Mathematics, 2nd ed., Pearson (1998).

Elements of Aerospace Engineering (MTASD-0102)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0102	Elements of Aerospace Engineering	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

History of aviation – types of flying machines – anatomy of an aircraft

Unit-II **Marks: 14**

Fundamental aerodynamic variables – aerodynamic forces – lift generation – airfoils and wings – aerodynamic moments –concept of static stability – control surfaces; mechanism of thrust production

Unit-III **Marks: 14**

Propellers – jet engines and their operation – elements of rocket propulsion

Unit-IV **Marks: 14**

Loads acting on an aircraft – load factor for simple maneuvers; V-n diagrams; aerospace materials

Unit-V **Marks: 14**

Introduction to aerospace structures; basic orbital mechanics – satellite orbits; launch vehicles and re-entry bodies

Text Books: References

1. Anderson, J. D., Introduction to Flight, 7th ed., McGraw-Hill (2011).
2. Anderson, D. F. and Eberhardt, S., Understanding Flight, 2nd ed., McGraw-Hill (2009).
3. Szebehely, V. G. and Mark, H., Adventures in Celestial Mechanics, 2nd ed., Wiley (1998).
4. Turner, M. J. L., Rocket and Spacecraft Propulsion: Principles, Practice and New Developments,3rd ed., Springer (2009).

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Advanced Solid Mechanics (MTASD-0103)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0103	Advanced Solid Mechanics	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Review of basic equations of elasticity – state of stress at a point

Unit-II **Marks: 14**

Analysis of strain, constitutive relations – generalized Hook's law

Unit-III **Marks: 14**

Formulation of boundary value problems – solution of 2D problems

Unit-IV **Marks: 14**

Energy methods in elasticity – bending, shear and torsion

Unit-V **Marks: 14**

Thin walled beams –applications

Text Books:

1. Sadd, M. H., Elasticity: Theory, Applications, and Numerics, 3rd ed., Academic Press (2014)

References

1. Srinath, L. S., Advanced Mechanics of Solids, 3rd ed., Tata McGraw-Hill (2010)

2. Mase, G. T., Smelser, R. E., and Mase, G. E., Continuum Mechanics for Engineers, 3rd ed., CRC Press (2009)

3. Timoshenko, S. P. and Goodier, J. N., Theory of Elasticity, 3rd ed., McGraw-Hill (1970)

Finite Element Method (MTASD-0104)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0104	Finite Element Method	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Introduction – approximate solutions to governing differential equations (GDE) – finite element formulations starting from GDE

Unit-II **Marks: 14**

Finite element formulations based on stationary of a functional– one-dimensional finite element analysis;

Unit-III **Marks: 14**

Shape functions, types of elements and applications

Unit-IV **Marks: 14**

Two- and three-dimensional finite elements – numerical integration

Unit-V **Marks: 14**

Applications to structural mechanics and fluid flow

Text Books: References

1. Reddy, J. N., Introduction to the Finite Element Method, 3rd ed., McGraw-Hill (2006)

2. Seshu, P., Textbook of Finite Element Analysis, Prentice Hall of India (2009)

3. Chandrupatla, T. R. and Belegundu, A. D., Introduction to Finite Elements in Engineering, 2nd ed., Prentice Hall of India (2000)

4. Segerlind, L. J., Applied Finite Element Analysis, 2nd ed., John Wiley (1984). (1992)

Aerospace Structure Lab(MTASD-0107)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0107	Elective II	-	-	6	6	-	-	-	-	-	90		60	150	150

LIST OF EXPERIMENTS (PERFORM ANY 6 EXPERIMENTS)

1. Strain measurements
2. Structural vibration
3. Wave propagation
4. Fabrication and testing of laminated composites
5. Static and stability behaviour of thin-walled structures
6. Non-destructive testing
7. Structural modelling and analysis in CAE environment

Seminar(MTASD-0108)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0108	Seminar	-	-	2	2	-	-	-	-	-			50	50	50

Objective of GD and seminar is to improve the MASS COMMUNICATION and CONVINCING/Understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves.

Evaluation will be done by assigned faculty based on group discussion and power point Presentation.

Structural Dynamics (MTASD-0201)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0201	Structural Dynamics	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Elements of analytical dynamics – discrete systems with multiple degrees of freedom – elastic and inertia coupling – natural frequencies and mode

Unit-II **Marks: 14**

Free vibration response – uncoupling of equations of motion – modal analysis – forced vibration response – vibration isolation – vibration of continuous systems

Unit-III **Marks: 14**

Differential equations and boundary conditions – longitudinal, flexural and torsional vibrations of one-dimensional structures

Unit-IV **Marks: 14**

Vibration analysis of simplified aircraft and launch vehicle structures – structural damping – free and forced response of continuous systems

Unit-V **Marks: 14**

Introduction to concepts of nonlinear and random vibrations – elements of vibration testing and experimentation

<u>Text Books: References</u>

1. Meirovitch, L., Elements of Vibration Analysis, 2nd ed., McGraw-Hill (1986).

2. Paz, M., Structural Dynamics: Theory and Computation, 2nd ed., CBS Publishers & Distributors (2004).

3. Weaver Jr., W., Timoshenko, S. P., and Young, D. H., Vibration Problems in Engineering, 5th ed., John Wiley (1990).

4. Meirovitch, L., Computational Methods in Structural Dynamics, Sijthoff&Noordhoff (1980).

5. Cough, R. W. and Penzien, J., Dynamics of Structure, 2nd ed., McGraw-Hill (1993).

Mechanics of Composite Materials (MTASD-0202)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0202	Mechanics of Composite Materials	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Introduction, definition, classification, behaviors of unidirectional composites

Unit-II **Marks: 14**

Prediction of strength, stiffness – factors influencing strength and stiffness – failure modes

Unit-III **Marks: 14**

Analysis of lamina; constitutive classical laminate theory – thermal stresses – theories of failure

Unit-IV **Marks: 14**

Design consideration – mechanical properties of composite materials – analysis of composite laminated beams

Unit-V **Marks: 14**

Thin walled composite beams – bending of composite plates

<u>Text Books: References</u>

1. Jones, R. M., Mechanics of Composite Materials, 2nd ed., CRC Press (1998).
2. Kollar, L. P. and Springer, G. S., Mechanics of Composite Structures, Cambridge Univ. Press (2003).
3. Altenbach, H., Altenbach, J., and Kissing, W., Mechanics of Composite Structural Elements,Springer (2000).

Aero Computing Lab (Laboratory-II) (MTASD-0207)

Subject Code	Subject	Lecture Scheme				Distribution of Marks										
						Theory					Practical					
		L	T	P	C	End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0207	Aero Computing Lab (Laboratory-II)	-	-	6	6	-	-	-	-	-	90	36	60	150	150

Using any Softwares like PRO/E, CATIA, Solid Works, ANSYS, MSC / Nastran

1. Modeling of various components using any modeling software
2. Static analysis on cantilever beam
3. Static analysis of forces in a simply supported beam
4. Static analysis- Plane truss
5. 2-D static stress analysis
6. 3-D static stress analysis
7. Stress distribution in a shrink fit
8. Natural frequencies of a spring mass system

Seminar(MTASD-0208)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0208	Seminar	-	-	-	2	-	-	-	-	-			50	50	50

Objective of GD and seminar is to improve the MASS COMMUNICATION and CONVINCING/Understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves.

Evaluation will be done by assigned faculty based on group discussion and power point Presentation.

List of Elective:

Subject Code	Subject Name
MTASD-0501	Aero elasticity
MTASD-0502	Continuum Mechanics
MTASD-0503	Multi-Rigid Body Dynamics
MTASD-0504	Energy Methods In Structural Mechanics
MTASD-0505	Advanced Finite Element Method
MTASD-0506	Molecular Dynamics And Materials Failure
MTASD-0507	Fracture Mechanics And Fatigue
MTASD-0508	Stochastic Mechanics And Structural Reliability
MTASD-0509	Elastic Wave Propagation In Solids
MTASD-0510	Aerospace Materials And Processes
MTASD-0511	Operations Research
MTASD-0512	Structural Acoustics And Noise Control
MTASD-0513	Linear Algebra and Perturbation Methods
MTASD-0514	Mechanics Of Aerospace Structures
MTASD-0515	Introduction to Robotics
MTASD-0516	Smart Materials And Structures

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Aeroelasticity(MTASD-0501)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0501	Aeroelasticity	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Introduction to static and dynamic aeroelastic phenomena – divergence

Unit-II **Marks: 14**

Control efficiency and control reversal – two dimensional analysis

Unit-III **Marks: 14**

Divergence of unswept wings – effect of sweep on divergence and control reversal

Unit-IV **Marks: 14**

Two-dimensional (airfoil) flutter analysis with quasi-steady and unsteady aerodynamic loads

Unit-V **Marks: 14**

Introduction to buffeting, stall flutter, galloping and vortex- induced oscillations problems

Text Books: References

1. Hodges, D. H. and Pierce, G. A., Introduction to Structural Dynamics and Aeroelasticity , 2 nd ed., Cambridge Univ. Press (2011).

2. Fung, Y. C., An Introduction to the Theory of Aeroelasticity , Dover (1969).

3. Bisplinghoff, R. L., Ashley, H., and Halfman, R. L., Aeroelasticity , Dover (1996).

Continuum Mechanics (MTASD-0502)

Subject Code	Subject	Lecture Scheme				Distribution of Marks										
						Theory					Practical					Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)		
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)			
MTASD-0502	Continuum Mechanics	3	1	-	4	70	28	20	10	100						100

Unit-I **Marks: 14**

Review of tensor algebra – tensor analysis – concept of continuum

Unit-II **Marks: 14**

Kinematics of a deformable body – deformation and strain – motion and flow

Unit-III **Marks: 14**

Analysis of stress-stress tensors – conservation laws, mass and momentum conservation

Unit-IV **Marks: 14**

Continuum thermodynamics – first and second laws applied to continuum

Unit-V **Marks: 14**

Clausius-Duhem inequality – constitutive relation – applications

Text Books: References

1. Gurtin, M. E., Fried, E., and Anand, L., The Mechanics and Thermodynamics of Continua , Cambridge Univ. Press (2009).

2. Jog, C. S., The Foundations and Applications of Continuum Mechanics ,NarosaPublica- tions (2002).

3. Mase, G. E., Continuum Mechanics ,Schaum's Outline Series, McGraw-Hill (1969).

4. Spencer, A. J. M., Continuum Mechanics , Dover (2004).

5. Malvern, L. E., Introduction to Mechanics of a Continuous Medium , Prentice Hall (1969).

6. Chadwick, P., Continuum Mechanics: Concise Theory and Problems , Dover (1999)

Multi-Rigid Body Dynamics (MTASD-0503)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0503	Multi-Rigid Body Dynamics	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Review of planar motion of rigid bodies and Newton-Euler equations of motion; constraints – holonomic and non-holonomic constraints

Unit-II **Marks: 14**

Newton-Euler equations for planar inter connected rigid bodies; D'Alembert's principle, generalized coordinates

Unit-III **Marks: 14**

Alternative formulations of analytical mechanics and applications to planar dynamics – Euler-Lagrange equations, Hamilton's equations and ignorable coordinates

Unit-IV **Marks: 14**

Gibbs-Appel and Kane's equations; numerical solution of differential and differential algebraic equations; spatial motion of a rigid body

Unit-V **Marks: 14**

Euler angles, rotation matrices, quaternions, Newton-Euler equations for spatial motion; equations of motion for spatial mechanisms

<u>Text Books: References</u>

1. Ginsberg, J., Engineering Dynamics, Cambridge Univ. Press (2008).

2. Ardema, M. D., Analytical Dynamics: Theory and Applications, Kluwer Academic/Plenum Publishers (2005).

3. Fabien, B. C., Analytical System Dynamics: Modeling and Simulation, Springer (2009).

4. Harrison, H. R. and Nettleton, T., Advanced Engineering Dynamics, Arnold (1997).

5. Moon, F. C., Applied Dynamics, Wiley (1998).

6. Kane, T. R. and Levinson, D. A., Dynamics: Theory and Applications, McGraw-Hill (1985).

Energy Methods in Structural Mechanics (MTASD-0504)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0504	Energy Methods in Structural Mechanics	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

The vibrational principle and the derivation of the governing equations of static and dynamic systems

Unit-II **Marks: 14**

Different energy methods: Rayleigh-Ritz, Galerkin etc. – applications

Unit-III **Marks: 14**

Basic concept of stress analysis, Problems of stress analysis

Unit-IV **Marks: 14**

Determination of deflection in determinate and indeterminate structures

Unit-V **Marks: 14**

Stability and vibrations of beams, columns and plates of constant and varying cross-sectional area

Text Books: References

1. Langhaar, H. L., Energy Methods in Applied Mechanics, 2nd ed., Krieger Publishing Co. (1989).

2. Reddy, J. N., Energy and Variational Methods in Applied Mechanics, 2nd ed., Wiley (2002).

3. Tauchert, T. R., Energy Principles in Structural Mechanics, McGraw-Hill (1974).

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Advanced Finite Element Method(MTASD-0505)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0505	Advanced Finite Element Method	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Finite element formulations for beam, plate, shell (Kirchhoff and Mindlin-Reissner), and solid elements

Unit-II **Marks: 14**

Control efficiency and control reversal – two dimensional analysis

Unit-III **Marks: 14**

Divergence of unswept wings – effect of sweep on divergence and control reversal

Unit-IV **Marks: 14**

Two-dimensional (airfoil) flutter analysis with quasi-steady and unsteady aerodynamic loads

Unit-V **Marks: 14**

Introduction to buffeting, stall flutter, galloping and vortex- induced oscillations problems

<u>Text Books: References</u>

1. Reddy, J. N., Introduction to Nonlinear Finite Element Analysis, Oxford Univ. Press (2010).

2. Bathe, K. J., Finite Element Procedures, 2 nd ed., Klaus-Jurgen Bathe (2014)

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Molecular Dynamics and Materials Failure (MTASD-0506)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0506	Molecular Dynamics and Materials Failure	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Introduction – materials deformation and fracture phenomena

Unit-II **Marks: 14**

Strength of materials: flaws, defects, and a perfect material, brittle vs. ductile material behaviour

Unit-III **Marks: 14**

Need for atomistic simulations – applications basic atomistic modeling– classical molecular dynamics

Unit-IV **Marks: 14**

Interatomic potential-numerical implementation – visualisation – atomistic elasticity, the virial stress and strain

Unit-V **Marks: 14**

Multiscale modeling and simulation methods – deformation and dynamical failure of brittle and ductile materials – applications

Text Books: References

1. Buehler, M. J., Atomistic Modeling of Materials Failure , Springer (2008).

2. Doeblin, E. O., Understanding Molecular Simulation: from Algorithms to Applications ,Aca- demic Press (2001).

3. Rapaport, D. C., The Art of Molecular Dynamics Simulation , 2 nd ed., Cambridge Univ. Press (2004).

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Fracture Mechanics and Fatigue(MTASD-0507)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
		L	T	P	C	Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0507	Fracture Mechanics and Fatigue	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Linear elastic fracture mechanics; energy release rate

Unit-II **Marks: 14**

Stress intensity factor (SIF), relation be- tween SIF and energy release rate, anelastic deformation at the crack tip – J-integral, CTOD

Unit-III **Marks: 14**

Test methods for fracture toughness – crack growth and fracture mechanisms

Unit-IV **Marks: 14**

Mixed-mode fracture, fracture at nano scale – numerical methods for analysing fracture, applications

Unit-V **Marks: 14**

Fatigue and design against fatigue failure – prediction of fatigue life

<u>Text Books: References</u>

1. Prashant Kumar, Elements of Fracture Mechanics , Tata McGraw-Hill (2009).

2. Anderson, T. L., Fracture Mechanics: Fundamentals and Applications , 3 rd ed., CRC Press (2004).

3. Buehler, M. J., Atomistic Modeling of Materials , Springer (2008).

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Stochastic Mechanics and Structural Reliability(MTASD-0508)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0508	Stochastic Mechanics and Structural Reliability	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Basics of probability theory: axioms, definitions, random variable – probability structure of random variable

Unit-II **Marks: 14**

Joint distributions – functions of random variables – some common random variables – random processes/random fields

Unit-III **Marks: 14**

Structural reliability – fundamental concepts – first order reliability methods

Unit-IV **Marks: 14**

Second order reliability methods – probabilistic sensitivity – system reliability – simulation techniques – high dimensional model representation techniques for reliability analysis.

Unit-V **Marks: 14**

Stochastic finite element analysis for structural mechanics problems – random field discretiza- tion – perturbation method – Neumann expansion method

<u>Text Books: References</u>

1. Ang, A. H-S. and Tang, W. H., Probability Concepts in Engineering Planning and Design: Volume I Basic Principles , Wiley (1975).

2. Ang, A. H-S. and Tang, W. H., Probability Concepts in Engineering Planning and Design: Volume II Risk and Reliability , Wiley (1984).

3. Halder A., Mahadevan, S., Probability, Reliability and Statistical Methods in Engineering Design , Wiley (2000).

4. Ghanem, R. G., Spanos, P. D., Stochastic Finite Elements: A Spectral Approach , Springer (1991).

5. Melchers, R. E., Structural Reliability Analysis and Prediction , Wiley (1999).

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Elastic Wave Propagation in Solids (MTASD-0509)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0509	Elastic Wave Propagation in Solids	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Review of vibration of structural elements – one-dimensional motion in elastic media

Unit-II **Marks: 14**

Discrete Fourier transforms – spectral finite element method

Unit-III **Marks: 14**

Standing waves – flexural waves in beams and plates

Unit-IV **Marks: 14**

Torsional waves in shafts – guided waves

Unit-V **Marks: 14**

Structural health monitoring using wave propagation

Text Books: References

1. Rose, J. L., Ultrasonic Waves in Solid Media , Cambridge Univ. Press (1999).

2. Rose, J. L., Ultrasonic Guided Waves in Solid Media , Cambridge Univ. Press (2014).

3. Achenbach, J. D., Wave Propagation in Elastic Solids , Elsevier (1973).

4. Graff, K. F., Wave Motion in Elastic Solids , Dover (1991).

Swami Vivekanand University, Sagar (M.P)

Aerospace Materials and Processes (MTASD-0510)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0510	Aerospace Materials and Processes	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Properties of materials: strength, hardness, fatigue, and creep – Ferrous alloys: stainless steels, maraging steel, aging treatments

Unit-II **Marks: 14**

Aluminum alloys: alloy designation and tempers, Al-Cu alloys, principles of age hardening, hardening mechanisms, Al-Li alloys, Al-Mg alloys, nanocrys- tallinealuminum alloys – Titanium alloys: ∞-ß alloys

Unit-III **Marks: 14**

Superplasticity, structural titanium alloys, intermetallic – Magnesium alloys: Mg-Al and Mg-Al-Zn alloys

Unit-IV **Marks: 14**

Superalloys: processing and properties of superalloys, single-crystal superalloys, environmental degradation and protective coatings

Unit-V **Marks: 14**

Composites: metal matrix composites, polymer based composites, ceramic based composites, carbon carbon composites

Text Books: References

1. Polmear, I. J., Light Alloys: From Traditional Alloys to Nanocrystals , 4 th ed., Elsevier (2005).

2. Reed, R. C., The Superalloys: Fundamentals and Applications , Cambridge Univ. Press (2006).

3. Gupta, B., The Aerospace Materials , S. Chand Publishing (2002).

4. Cantor, B., Assender, H., and Grant, P. (Eds.), Aerospace Materials , CRC Press (2001).

5. ASM Speciality Handbook: Heat Resistant Materials , ASM International (1997).

6. Campbell, F. C., Manufacturing Technology for Aerospace Structural Materials , Elsevier (2006).

7. Kainer, K. U. (Ed.), Metal Matrix Composites , Wiley-VCH (2006).

Operations Research(MTASD-0511)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				
		L	T	P	C	End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0511	Operations Research	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Introduction – linear programming – revised simplex method

Unit-II **Marks: 14**

Duality and sensitivity analysis – dual simplex method

Unit-III **Marks: 14**

Goal programming – integer programming – network optimization models

Unit-IV **Marks: 14**

Dynamic programming – nonlinear programming

Unit-V **Marks: 14**

Unconstrained and constrained optimization, non-traditional optimization algorithms

<u>Text Books: References</u>

1. Ravindran, A., Phillips, D. T., and Solberg, J. J., Operations Research: Principles and Practice, 2nd ed., John Wiley (2012).

2. Taha, H. A., Operations Research: An Introduction, 9th ed., Prentice Hall of India (2010).

3. Winston, W. L., Operations Research: Applications and Algorithms, 4th ed., Cengage Learning (2010).

4. Rao, S. S., Engineering Optimization: Theory and Practices, 4th ed., John Wiley (2009).

5. Deb, K., Optimization for Engineering Design: Algorithms and Examples, 2nd ed., Prentice Hall of India (2012)

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Structural Acoustics and Noise Control (MTASD-0512)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
		L	T	P	C	Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD-0512	Structural Acoustics and Noise Control	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Basic acoustic principles – acoustic terminology and definitions

Unit-II **Marks: 14**

Plane and spherical wave propagation

Unit-III **Marks: 14**

Theories of monopole, dipole and quadrapole sound sources

Unit-IV **Marks: 14**

Sound transmission and absorption – sound transmission through ducts

Unit-V **Marks: 14**

Structure borne sound – sound radiation and structural response – introduction to noise control

Text Books: References

1. Munjal, M. L., Noise and Vibration Control , World Scientific Press (2013).

2. Williams, E. G., Fourier Acoustics: Sound Radiation and Nearfield Acoustic Holography , Academic Press (1999).

3. Kinsler, L. E., Frey, A. R., Coppens, A. B., and Sanders, J. V., Fundamentals of Acoustics , 4 th ed., Wiley (2000).

Linear Algebra and Perturbation Methods (MTASD-0513)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
		L	T	P	C	End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	
						Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0513	Linear Algebra and Perturbation Methods	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Vector Space, norm, and angle – linear independence and orthonormal sets – row reduction and echelon forms, matrix operations, including inverses

Unit-II **Marks: 14**

Effect of round-off error, operation counts – block/banded matrices arising from discretization of differential equations

Unit-III **Marks: 14**

Linear dependence and independence – subspaces and bases and dimensions – orthogonal bases and orthogonal projections – Gram-Schmidt process – linear models and least-squares

Unit-IV **Marks: 14**

Eigenvalues and eigenvectors – diagonalization of a matrix – symmetric matrices – positive definite matrices – similar matrices – linear transformations and change of basis – singular value decomposition

Unit-V **Marks: 14**

Introduction to perturbation techniques – asymptotic approximations, algebraic equations – regular and singular perturbation methods – application to differential equations – methods of strained coordinates for periodic solutions – Poincare–Lindstedt method

Text Books: References

1. Strang, G., Introduction to Linear Algebra , 4 th ed., Cambridge Univ. Press (2011).

2. Strang, G., Linear Algebra and its Applications , 4 th ed., Cengage Learning (2007).

3. Lang S., Linear Algebra , 2 nd ed., Springer (2004).

4. Golub, G. H. and Van Loan, C. F., Matrix Computations , 4 th ed., Hindustan Book Agency (2015).

5. Nayfe, A. H., Introduction to Perturbation Techniques , Wiley-VCH (1993).

6. Bender, C. M. and Orszag, S. A., Advanced Mathematical Methods for Scientists and Engineers: Asymptotic Methods and Perturbation Theory , Springer (1999).

Mechanics of Aerospace Structures (MTASD-0514)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	
		L	T	P	C	Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0514	Mechanics of Aerospace Structures	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Structural components of aircraft – loads and material selection

Unit-II **Marks: 14**

Introduction to Kirchhoff theory of thin plates – bending and buckling of thin plates

Unit-III **Marks: 14**

Symmetric and unsymmetric bending of beams

Unit-IV **Marks: 14**

Bending of open and closed thin walled beams – shear and torsion of thin walled beams

Unit-V **Marks: 14**

Combined open and closed section of beams – structural idealization

<u>Text Books: References</u>

1. Polmear, I. J., Light Alloys: From Traditional Alloys to Nanocrystals , 4 th ed., Elsevier (2005).

2. Reed, R. C., The Superalloys: Fundamentals and Applications , Cambridge Univ. Press (2006).

3. Gupta, B., The Aerospace Materials , S. Chand Publishing (2002).

4. Cantor, B., Assender, H., and Grant, P. (Eds.), Aerospace Materials , CRC Press (2001).

5. ASM Speciality Handbook: Heat Resistant Materials , ASM International (1997).

6. Campbell, F. C., Manufacturing Technology for Aerospace Structural Materials , Elsevier (2006).

7. Kainer, K. U. (Ed.), Metal Matrix Composites , Wiley (2006).

Introduction to Robotics (MTASD-0515)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				
						End Sem		Internal		Total (e=a+c +d)	End Sem		Internal	Total (i=f+h)	Grand Total (j=e+i)
		L	T	P	C	Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0515	Introduction to Robotics	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Overview of robotics – manipulators and field robots; robot mechanisms - serial chains, regional and orientation mechanisms, parallel chains, reachable and dexterous work space, mechanisms of wheeled and walking robots

Unit-II **Marks: 14**

Spatial displacements, rotation matrices, Euler angles, homogenous transformation, D-H parameters, forward and inverse problems for serial and parallel manipulators

Unit-III **Marks: 14**

Task planning – joint space and task space planning; sensors – joint dis- placement sensors, force sensors, range finders, vision sensors

Unit-IV **Marks: 14**

Actuators - electric motors - stepper, PMDC and brushless DC motors, pneumatic and hydraulic actuators; speed reducers; Servo control of manipulators - joint feedback control, effect of nonlinearities, inverse dynamic control, force feedback control; higher level control

Unit-V **Marks: 14**

Path planning, configuration space, road map methods, graph search algorithms, potential field method.

Text Books: References

1. Siciliano, B., Sciavicco, L., Villani, L., and Oriolo, G., Robotics: Modelling, Planning and Control, Springer (2009).

2. Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford Univ. Press (2006).

3. Choset, H., Lynch, K. M., Hutchinson, S., Kantor, G., Burgard, W., Kavraki, L. E., and Thrun, S., Principles of Robot Motion: Theory, Algorithms, and Implementations, MIT Press, Prentice Hall of India (2005).

Smart Materials and Structures (MTASD-0516)

Subject Code	Subject	Lecture Scheme				Distribution of Marks									
						Theory					Practical				Grand Total (j=e+i)
						End Sem		Internal		Total (e=a+c+d)	End Sem		Internal	Total (i=f+h)	
		L	T	P	C	Max (a)	Min (b)	MST (c)	TW (d)		Max (f)	Min (g)	LW (h)		
MTASD -0516	Smart Materials and Structures	3	1	-	4	70	28	20	10	100					100

Unit-I **Marks: 14**

Overview of smart materials – piezoelectric ceramics – piezo-polymers

Unit-II **Marks: 14**

Magnetostrictive materials – electro active polymers – shape memory alloys – electro and magneto rheological fluids

Unit-III **Marks: 14**

Mechanics of Piezoelectric Materials and Systems: constitutive modelling

Unit-IV **Marks: 14**

Actuator and sensor – piezoelectric beams and plates

Unit-V **Marks: 14**

Shape Memory Alloys: constitutive modelling – actuation models,Electroactive polymer materials applications

Text Books: References

1. Leo, D. J., Engineering Analysis of Smart Material Systems, Wiley (2007).

2. Culshaw, B., Smart Structures and Materials, Artech House (1996).

3. Gaudenzi, P., Smart Structures: Physical Behaviour, Mathematical Modelling and Applications, Wiley (2009).