MATS UNIVERSITY

Raipur (C.G.)

Syllabus Scheme

(3rd Semester)

For

Master of Technology

In

Turbo-Machinery

MATS School of Engineering & Technology

ARANG, RAIPUR (C.G.)

MATS UNIVERSITY
ARANG, RAIPUR

Subject Code for MATS School of Engg & Tech

3rd Semester- M. Tech (Turbo-Machinery)

S. No.	Subject Code	Subject Name
1	ME 311	OPTIMIZATION TECHNIQUES
2	ME 312	HIGH TEMPERATURE MATERIALS
3	ME 313	ELECTIVE –II
4	ME 314	CFD LAB
5	ME 315	PROJECT WORK PHASE – I

ELECTIVE –II		
1	ME 3131	DESIGN OF HEAT EXCHANGER
2	ME 3132	FATIGUE AND FRACTURE MECHANICS
3	ME 3133	DESIGN OF TURBINE BLADES

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Scheme of Teaching & Examination
M. TECH 3rd SEMESTER TURBO-MACHINERY

S.N.	Subject Code	Subject	Periods per week			Scheme of marks		Total Marks
			L	T	P	ESE	IM	
1.	ME 311	OPTIMIZATION TECHNIQUES	4	1	-	70	30	100
2.	ME 312	HIGH TEMPERATURE MATERIALS	4	1	-	70	30	100
3.	ME 313	ELECTIVE –II	4	1	-	70	30	100
6.	ME 314	CFD LAB	-		3	20	30	50
7.	ME 315	PROJECT WORK PHASE – I	-		3	150	50	200
		Total	**12**	**3**	**6**	**380**	**170**	**550**

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

ELECTIVES – II		
1	ME 3131	DESIGN OF HEAT EXCHANGER
2	ME 3132	FATIGUE AND FRACTURE MECHANICS
3	ME 3133	DESIGN OF TURBINE BLADES

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Optimization Techniques
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 311

UNIT I

Single and Multivariable optimization methods, constrained optimization methods, Kuhn-Tucker conditions-Necessary & Sufficiency theorems.

UNIT II

Linear programming - Traveling salesman problem and Transshipment problems-post optimization analysis. Integer programming all integers, mixed integer and zero-one programming

UNIT III

Geometric programming – concept – degree of difficulty –solution of unconstrained & constrained non linear problems by geometric programming. Dynamic programming.

UNIT IV

Energy System Simulation & optimization/Objectives/constraints, Problems formulation, Unconstrained problems, Constrained Variations, Kuhn-Tucker Conditions.

UNIT V

Probabilistic Technique – Tradeoffs between capital & energy using Pinch Analysis. Energy-Economy models –Scenario Generation.

TEXT BOOKS

1. Rao S.S., “Optimization Theory & Applications”, Wiley Eastern 1990.
2. K. Deb, “Optimization for Engineering Design”, Prentice Hall of India, 1995.
3. Reklaitis G.V., Ravindram A., Ragsdell K.M., “Engineering Optimization methods & Application”, Wiley 1983.

REFERENCES

1. New Fville R. “Applied System Analysis”, McGraw Hill, Int. Edition 1990.
2. Stocker, W.I. “Design of Thermal System”, McGraw Hll, 1987.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	High Temperature Materials
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 312

UNIT-I CREEP

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

UNIT- II DESIGN FOR CREEP RESISTANCE

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile & brittle materials, Monkman-Grant relationship.

UNIT III FRACTURE

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

UNIT IV OXIDATION AND HOT CORROSION

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

UNIT V SUPERALLOYS AND OTHER MATERIALS

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics, high temperature ceramics.

TEXT BOOKS

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

REFERENCES

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	CFD Lab
Code	:	ME 314

THIS LAB CONTAINS COMPUTATIONAL FLUID DYNAMICS THEORETICAL CALCULATIONS AND PRACTICES.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Project Work Phase – I
Code	:	ME 315

The objective of the phase – I of the students project work is to prepare themselves to undertake lively project which will found end application to the industry /society. Preparation for the project work involve

- ✓ Form a team of like minded students (not more than 4 in numbers) to carry out the project.
- ✓ Make a preliminary survey and data collection or literature review of the project proposed in the next semester.
- ✓ Conduct a thorough literature survey and publish or present a paper of the proposed work in any one of the forthcoming National seminars.
- ✓ Plan for necessary supports, facilities, analytical tools and fixation of faculties /supervisors for the final semester project work.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Design of Heat Exchanger
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 3131

UNIT-I

Review of Heat Transfer Principles & Convection Correlation. Introduction to Heat Exchangers and classification.

UNIT-II

Basic Design Methodologies, -NTU Method AND LMTD method, Design of Double Pipe Heat Exchangers, Shell & Tube Type Heat Exchangers, TEMA, Nomenclature, j –Factors.

UNIT-III

Conventional Design Methods, Bell-Delware Method, Compact Heat Exchangers, j -Factors, Design Method, Condensers Classification and Design, Methods for Surface Condensers.

UNIT-IV

Evaporators – classification and Design Methods, Plate Type – Heat Exchangers, Regenerators.

UNIT-V

Basic Concepts of Mechanical Design of Heat Exchanger, Fixed and Floating Tube Sheet Design, Design of Expansion Bellows.

TEXT BOOKS

1. Holger Martin, “Heat Exchangers” Hemisphere Publ. Corp. Washington, 1992.
2. Kuppan, T., “Heat Exchanger Design Handbook”, Macel Dekker, Inc., N.Y. 2000.
3. Saunders, E.A.D., “Heat Exchangers – Selection Design and Con struction”, Longmann Scientific and Technical, N.Y., 1988.

REFERENCES

1. Kern, D.O., “Process Heat Transfer”, McGraw Hill, 1965.
2. Shah R.K., Subbarao, E.C., Mashelkar, R.A., “Heat Transfer Equipment Design”, Hemisphere Publ. Corp., 1988.
3. Seikan Ishigai, “Steam Power Engineering -Thermal and Hydraulic Design Principles”, Cambridge Univ. Press 1999.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Fatigue and Fracture Mechanics
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 3132

UNIT-I FATIGUE OF STRUCTURES

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves.

UNIT-II STATISTICAL ASPECTS OF FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life – cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage - Miner's theory - Other theories.

UNIT-III PHYSICAL ASPECTS OF FATIGUE

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations -fatigue fracture surfaces.

UNIT-IV FRACTURE MECHANICS

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory -Irwin - Orwin extension of Griffith's theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT-V FATIGUE DESIGN ANDTESTINIG

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in Turbo machineries- Application to composite materials and structures.

TEXT BOOKS

1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pegamon press. Oxford, 1983.

REFERENCES

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983.

MATS UNIVERSITY, RAIPUR

Semester	:	3rd M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Design of Turbine Blades
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 3133

This subject contains the Designing process and methods for Turbine Blades.