(Autonomous)

NAGAPATTINAM – 611002

(Affiliated to Anna University, Chennai | Accredited by NAAC with 'A++' Grade|Accredited by NBA T1(B.E. – CSE, CIVIL, ECE, EEE, MECH& B.Tech – IT) | Approved by AICTE, New Delhi)

M.E. – MANUFACTURING ENGINEERINGR- 2024

SECOND YEAR

CURRICULUM AND SYLLABUS FOR THIRD SEMESTER

Course Code	Course Title	Category	Periods per week			Credits	Total contact periods
			L	T	P	C	
Theory Course							
	Professional Elective – IV	PEC	3	0	0	3	3
	Professional Elective – V	PEC	3	0	0	3	3
	Open Elective	OEC	3	0	0	3	3
Laboratory Course							
2404MF301	Project Work - Phase I	EEC	0	0	14	7	14
Total			9	0	16	19	26

2403MF025	COMPOSITEMATERIALS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Material science and metallurgy
2. Strength of materials
3. Non-traditional machining
4. Manufacturing technology

COURSE OBJECTIVES:

1. Summarize the characteristics of composite materials and effec to frein force mentin composite materials.
2. Identify the variousre in forcements used in composite materials.
3. Compare the manufacturing process of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

COURSE OUTCOMES:

CO1:	Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2:	Know the variousre in forcements used in composite materials.
CO3:	Understand the manufacturing processes of metal matrix composites.
CO4:	Understand the manufacturing processes of polymer matrix composites.
CO5:	Analyze the strength of composite materials.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	3	2	3	2	3	3	2	3	3	3
CO2	2	1	3	2	3	2	3	1	3	1	1	3	3	3	3
CO3	2	1	3	1	2	1	2	2	2	2	2	2	3	3	3
CO4	2	1	3	2	1	2	1	3	1	3	3	1	3	3	3
CO5	2	1	3	3	3	3	3	1	3	1	1	3	3	3	3

COURSE CONTENTS:

MODULE I INTRODUCTION **9 Hours**

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size,shape,distribution,volume fraction)on overall composite performance.

MODULE II REINFORCEMENTS **9 Hours**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - MechanicalBehaviorofcomposites:Ruleofmixtures,Inverseruleofmixtures-IsostrainandIsostressconditions.

MODULE III MANUFACTURINGOFMETAL MATRIX COMPOSITES **9 Hours**

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phasesintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving – Propertie sand applications.

MODULE IV	**MANUFACTURINGOFPOLYMERMATRIXCOMPOSITES**	**9 Hours**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

MODULE V	**STRENGTH**	**9 Hours**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-plydiscounttruncatedmaximumstraincriterion;strengthdesignusingcapletplots;stressconcentrations.

TOTAL: 45 HOURS

REFERENCES:

1. *CahnR.W.-MaterialScienceandTechnology–Vol13 –Composites, VCH,WestGermany.*
2. *Callister,W.DJr.,AdaptedbyBalasubramaniamR,MaterialsScienceandEngineering,Anintroduction, JohnWiley& Sons,NY,Indian edition,2007.*
3. *ChawlaK.K.,CompositeMaterials, 2013.*
4. *Lubin.G,HandBookof CompositeMaterials, 2013.*

2403MF017	SURFACEENGINEERINGANDCOATINGS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Material science and metallurgy
2. Strength of materials
3. Non-traditional machining
4. Metrology and measurements.

COURSE OBJECTIVES:

1. To impart knowledge on friction.
2. To understand wear and measurement methods.
3. To understand corrosion and combating methods.
4. To learn various techniques to cure corrosi on,wear and friction using surface treatments.
5. To familiarize the real friction, wear and corrosi on combating methods.

COURSE OUTCOMES:

Students will be able to

CO1:	Understand the surface engineering and surface modification methods that will come in handy to solve the industrial problems.
CO2:	Examin grelated to various materials failure due to friction ,wear and corrosion.
CO3:	Predicting the surface problems and select a suitable surface treatment.
CO4:	Integrating case studies in various application srelated to surface engineering.
CO5:	Learn various process and techniques developed for surface treatment.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	3	2	3	2	3	3	2	3	3	3
CO2	2	1	3	2	3	2	3	1	3	1	1	3	3	3	3
CO3	2	1	3	1	2	1	2	2	2	2	2	2	3	3	3
CO4	2	1	3	2	1	2	1	3	1	3	3	1	3	3	3
CO5	2	1	3	3	3	3	3	1	3	1	1	3	3	3	3

COURSE CONTENTS:

MODULE I **FRICTION** **7 Hours**

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non-metallicmaterials–Friction inextremeconditions–Thermalconsiderationsinsliding contact

MODULE II **WEAR** **6 Hours**

Introduction–Abrasivewear,Erosive,Cavitation,Adhesion,FatiguewearandFrettingWear-Lawsof wear – Theoretical wear models – Wear of metals and non metals - International standards infrictionand wearmeasurements

MODULE III **CORROSION** **10 Hours**

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factorsinfluencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratorytesting–EvaluationofcorrosionPreventionofCorrosion–

Materialselection,Alterationofenvironment,Design,CathodicandAnodicProtection,Corrosion inhibitors

MODULE IV	**SURFACETREATMENTS**	**12 Hours**

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistantcoatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation –Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatingsand surface treatments inwear and friction control– Characteristics ofWearresistantcoatings –New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings –Other coatings,Corrosion resistantcoatings

MODULE V	**CASE STUDIESON TRIBOLOGYAND CORROSION**	**10 Hours**

Bio-fouling, Tribology and corrosion applicable in biomedical implants, Nano Tribology – electronicdevices, hot corrosion in power plants – corrosion in nuclear industry –Machining through controlledWearand corrosion.

TOTAL: 45 HOURS

REFERENCES:

1. *BasuSK,SenguptaSNandAhujaB.B,FundamentalsofTribology,Prentice–HallofIndiaPvtLtd,NewDelhi,1st Edition,2010.*
2. *HallingJ(Editor),"PrinciplesofTribology",Macmillian–1991.*
3. *RabinowiczE, "FrictionandWearofmaterials",JohnWilleyandSons, UK,2013.*
4. *StachowiakG WandBatchelorAW, "Engineering Tribology",Butterworth-Heinemann,UK,4th edition2014.*
5. *WilliamsJ.A,"EngineeringTribology",OxfordUniv.Press,2005.*

2403MF020	ADVANCEDOPTIMIZATIONTECHNIQUES	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Mathematics
2. Industrial engineering
3. Research methodology

COURSE OBJECTIVES:

1. Learn to solve in teger programming problems
2. To knowhow to solve the Dynamic programming problems
3. Learn to solven on–linear programming problems with unconstrained optimizati on problems
4. Understand to solven on-linear programming problem susing KKT conditions,quadrati and separ able programming
5. To create awareness of Meta heuristical gorithms.

COURSE OUTCOMES:

CO1:	Know how to solve integer programming problems
CO2:	Able to solve Dynamic programming problems
CO3:	Familiar in solving unconstrained non linear optimization problems
CO4:	Familiar in solving constrained liner optimization problems
CO5:	Know how to solve non linear optimization problems using Meta heuristic algorithms

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	3	2	3	2	3	3	2	3	3	3
CO2	2	1	3	2	3	2	3	1	3	1	1	3	3	3	3
CO3	2	1	3	1	2	1	2	2	2	2	2	2	3	3	3
CO4	2	1	3	2	1	2	1	3	1	3	3	1	3	3	3
CO5	2	1	3	3	3	3	3	1	3	1	1	3	3	3	3

COURSE CONTENTS:

MODULE I **INTEGER PROGRAMMING** **9 Hours**

Branch and Bound technique –cutting plane algorithm method - Travelling Salesman problem - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP – Chinese Postman Problem -Vehicle Routeing Problem

MODULE II **DYNAMIC PROGRAMMING** **9 Hours**

Characteristics of Dynamic Programming Problems – Deterministic Dynamic Programming-Forward and Backward recursive recursion – selected dynamic programming application–investment model – inventory model – replacement model – reliability model –stagecoach problem.

MODULE III **NONLINEAR PROGRAMMING-I:** **9 Hours**

Types of Nonlinear Programming Problems – One – Variable Unconstrained Optimization- Multivariable Unconstrained Optimization-		
MODULE IV	**NONLINEAR PROGRAMMING–II:**	**9 Hours**
The Karush - Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming –Separable Programming –Convex Programming – Non convex Programming		
MODULE V	**NON-TRADITIONAL OPTIMIZATION**	**9 Hours**
Overview of Genetic algorithms, Simulated Annealing, neural network based optimization. Particle Swarm optimization, Ant Colony Optimization ,Optimization of Fuzzy Systems		
		TOTAL: 45 HOURS

REFERENCES:

1. FredrickS.HillierandG.J.Liberman,"IntroductiontoOperationsResearch",McGrawHillInc.1995.
2. KalymanoyDeb,"OptimizationforEngineeringDesign",PHI,2003
3. ChristosH.Papadimitriou,KennethSteiglitz,CombinatorialOptimization,PHI2006
4. Ravindran–Phillips–Solberg,"OperationsResearch–PrinciplesandPractice",JohnWileyIndia, 2006.
5. SingiresuS.Rao,"Engineeringoptimization–Theoryandpractices",JohnWileyandSons,1996.