ANNA UNIVERSITY : : CHENNAI - 25

FACULTY OF MECHANICAL ENGINEERING

Approved Special Electives for

M.S. / Ph.D. Degree Programs

(upto 21th AC 07.01.2016)

ANNA UNIVERSITY : CHENNAI – 600 025.

SPECIAL ELECTIVES FOR FACULTY OF MECHANICAL ENGINEERING

COURSE CODE	COURSE TITLE	L	T	P	M / C
FM1911	Electro And Electroless Plating	3	0	0	100
FM1912	Design And Theory of Heat Pipe	3	0	0	100
FM1913	Secondary Steel Making	3	0	0	100
FM1914	Advanced Steel Making Processes	3	0	0	100
FM1915	Special Optimization	3	0	0	3
FM1916	Distribution And Inventory Models	3	0	0	3
FM1917	Theory of Metal Cutting	3	0	0	3
FM1918	Mechanics of Sheet Metal Forming	3	0	0	3
FM1919	Catalytic Converters Design & Durability	3	0	0	3
FM1920	Bio fuel in I.C. Engines	3	0	0	3
FM1921	Metaheuristics	3	0	0	3
FM1922	Fischer–Tropsch Method for Fuels	3	0	0	3
FM1923	Safety Management	3	0	0	3
FM1924	Occupational Health and Hygiene	3	0	0	3
FM1925	Cognitive Ergonomics	3	0	0	3
FM9001	Nonferrous Metallurgy	3	0	0	3
FM9002	Design of Excavators	3	0	0	3
FM9003	Machinability of Materials	3	0	0	3
FM9004	Engineering and Technology Management	3	0	0	3
FM9005	Fatigue and Damage analysis with Genetic algorithms	3	0	0	3
FM9006	Solidification Engineering	3	0	0	3
FM9007	Automotive Suspension And System Dynamics	3	0	0	3
FM9008	Powder Metallurgy	3	0	0	3
FM9009	Geometric Dimensioning And Tolerancing	3	0	0	3
FM9010	High Speed Jet Flows	3	0	0	3
FM9011	Automobile Engine Lubrication and Condition Monitoring System	3	0	0	3

FM9012	Propeller Aerodynamics	3	0	0	3
FM9013	Flight Simulation for Combat Aircraft System	3	0	0	3
FM9014	Fundamentals of Combustion	3	0	0	3
FM9015	Biofuels as Energy Sources	3	0	0	3
FM9016	Design, Fabrication and Testing Methods of Microactuators	3	0	0	3
FM9017	Nanofluids Heat Transfer	3	0	0	3
FM9018	Practical Vibration Analysis and Diagnostics	3	0	0	3

FM1911 ELECTRO AND ELECTROLESS PLATING 3 0 0 100

UNIT I FUNDAMENTALS OF ELECTROPLATING AND ELECTROLESS PLATING

Fundamental Principles – Electro Deposition of Copper, Nickel, Chromium, Zinc, T in and Precious metals such as Gold and Silver – Surface Preparation for Electro Deposition – Electrolitic cleaning.Measurement of pH, Surface Tension, Conductivity, Throwing Power and Current Efficiency of Electro plating electrolytes.

UNIT II TYPES OF PLATING

Brush Plating – Barrel Plating – Pulse Plating – Electro Forming – Electro Winning – Electro Refining and their applications.

UNIT III COMPOSITE COATING

Need for composite coating – Principles of Alloy Deposition – Mechanism of Co-Deposition – Composite coating by Electrode position and Electroless Deposition for Nickel – Chromium, Nickel – Silicon Carbide, Nickel – PTFE – Alloys. Engineering applications of composite coating for Wear resistance and Tribological applications.

UNIT IV INSPECTION AND TESTING OF ELECTRO / ELECTROLE DEPOSITION

Testing of Electrodeposit for Thickness, Adhesion, Stress, Porosity, Hardness, Ductility and Solderability – Use of Hull Cell in Plating – Determination of Corrosion Rate by Polarization method.

UNIT V EFFECT OF VARIOUS PARAMETERS AND DEFECTS IN ELECTRO / ELECTROLESS PLATING

Effect of current density, Particle size, Volume Fraction of Particle in the bath, Agitation, temperature, PH on deposition rate and volume fraction of Co-deposited particles.Defects in electro plating and electroless plating – Porosity, Poor adhesion, Hydrogen embrittlement etc – Causes and Remedies.

REFERENCES:

1. Lowenkeeim, F A – Model Electroplating – John Wiley & Sons, Inc., USA
2. Metal Finishing Guide Book and Directory, USA
3. Electro Platers Process control Hand Book, Foulke and Grane.
4. Plating and Surface Finishing – Journal
5. Transactions of the Institute of Metal Finishing – Journal
6. Product Finishing – Journal

FM1912 (Old Code EY1678) DESIGN AND THEORY OF HEAT PIPE L T P C
3 0 0 100

UNIT I INTRODUCTION 9

Operating principle, Working fluids and its temperature ranges, Heat transfer limits and Heat pipe characteristics.

UNIT II INTERFACIAL PHENOMENA 9

Interfacial heat and mass transfer, Physical surface phenomena, Capillary and disjoining forces – Interfacial resistance in vaporization and condensation process, Interfacial mass, Momentum, energy, pressure balance – Interfacial phenomena in grooved structures.

UNIT III THERMAL ANALYSIS 9

Steady hydrodynamics – Thermal characteristics and heat transfer limitation, Thermal Fluid phenomena in capillary media, Vapor flow Analysis, Thermal characteristics including the wall effects and effect of vapor flow – Capillary boiling – Sonic, Entrainment, Viscous, condenser, Continuum, and Frozen startup Limitations.

UNIT IV DESIGN CONSIDERATION 9

Area temperature relations, Pipe dimensions and structural considerations. Heat pipe heat exchanger, transient model calculations and procedures.

UNIT V LIMITATIONS 9

Heat pipe Behaviour – Transient response to sudden change in temperature heat input, Frozen startup and shut down of heat pipe – Numerical and Analytical model for Frozen start up. Two phase closed Thermosyphon – Reflux condensation heat transfer in Analysis, Evaporation heat transfer Analysis, Transient and oscillatory behavior of Thermosyphon. Minimum liquid fill requirement, Thermosyphon with capillary wicks.

TOTAL: 45 PERIODS

REFERENCES:

1. Amir Faghri, 1995 Heat pipe science and Technology, publisher: Taylor and Francis.
2. V.P. Carey, 1992, Liquid – Vapor phase – Change phenomena: An Introduction to the Thermophysics of vaporization and condensation Processes in Heat Transfer Equipment, Hemisphere Publishers, New York.
3. J.N. Israelachvili, 1985, Intermolecular and surface forces – Academic press, London.
4. I.B. Ivanov, 1988, Thin Liquid films: Fundamentals and Application – Marcel Dekkar, New York.
5. S.S. Kutateladze, 1963, Fundamentals of Heat Transfer, Academic Press – New York.
6. S.W. Chi, 1976, Heat pipe Theory and practice, Hemisphere publishing corporation, Washington.
7. J.G. Collier, 1972, Convective Boiling and Condensation, second Edition, McGraw – Hill Book Company.
8. M.N. Ivanovskii, V.P. Sorokin and I.V. Yagodkin, 1982, The physical principles of Heat pipes, Clarendon press, Oxford.

FM1913 SECONDARY STEEL MAKING 3 0 0 100

UNIT I THERMODYNAMICS AND KINETICS OF DEOXIDATION

Oxygen in molten steel, Types of Deoxidation, Complex Deoxidisers, Kinetics of removal of Deoxidation products, Deoxidation on Industrial Scale

UNIT II METALLURGICAL PRINCIPLES IN SECONDARY STEEL MAKING

Thermodynamics of reactions during degassing, Fluid flow and mixing in ladle, Kinetics and mass transfer, Ladle injection metallurgy

UNIT III LADLE FURNACES AND SECONDARY STEEL MAKING

Introduction, Process variables, Stirring, Synthetic slag, Purging, Vacuum treatments, Injection metallurgy, Ladle furnaces

UNIT IV INCLUSIONS IN STEEL

Influence of inclusions on mechanical properties, Identification of inclusions, Origin of non-metallic inclusions, Inclusion control

UNIT V CONTINUOUS CASTING AND SEGREGATION

Solidification rate in ingot, Heat transfer in continuous casting, Segregation of solutes in plane front solidification, Dendritic solidification, Morphology of killed steel ingots, Defects in continuous cast products, Developments in continuous casting

REFERENCES:

1. Principles of secondary processing and casting of liquid steel", Ahindra Ghosh, Oxford & IB A Publishers, 1990
2. Making, Shaping and Treating of steel", Steel making and refining volume, 11th Edition, AISE steel foundation, 1998.

FM1914 ADVANCED STEEL MAKING PROCESSES 3 0 0 100

UNIT I REVIEW OF STEEL MAKING PROCESSES

Bessemer, Open hearth, Electric Arc and Oxygen steel making processes and operating practice, Thermodynamics of refining, Oxygen transport mechanism in Open Hearth, Slag Theories

UNIT II RECENT TRENDS AND DEVELOPMENTS

Electric steel making, Design improvements, Process modifications, Charge modifications, Developments in LD- LD - AC Process, Sub lance Practice, Hybrid refining Processes

UNIT III CONTINUOUS STEEL MAKING PROCESSES

General principles and process types, Spray steel making, IRSID and WORCRA process, AISI continuous refining process, Economic evaluation of continuous steel making processes, Modified OH processes-AJAX process, Tandem furnace process, SIP and Twin hearth process.

UNIT IV ENERGY OPTIMISING FURNACE PROCESS

Development of the process, Process technology, EOF Equipment features - Scrap preheater, Double ladle transfer car, Coal ignition system, Slag free tapping system. Constructional features of EOF steel works

UNIT V OPERATIONAL PRACTICE OF E.O.F

Plant practice at CSP - Brazil, Open hearth EOF synergy, World wide Production trends, Indian experience at JSW (Hosepat) & SISCOL (Salem) - India, Market for EOF products, Environmental issues.

REFERENCES:

1. ”An introduction to modern steel making", Tupkary.R.H, khanna publishers, 2004.
2. "Making, Shaping and Treating of steel", Steel making and refining volume, 11th Edition, AISE steel foundation, 1998.
3. Proceedings of the International Conference on Alternative routes to Iron and Steel under Indian conditions, Vol. 1, Indian Institute of Metals, 1988.
4. "E.O.F Process-16 years of successful operation-outlook", Pfeifer. H.C E.al, paper presented at the 2nd CATEC Seminar of ILAFA on Technological Development, May 1998.
5. "E.O.F Process-Two new EOF melt shops commissioned in India", Scherer. S.W.G et.al., Seminar on melting, refining and solidification, Belo Horizonte/MG, May, 1999.

FM1915	SPECIAL OPTIMIZATION	L	T	P	C
		3	0	0	3

UNIT I **6**

Classification of Optimization problems, Classical optimization techniques for continuous and differentiable functions.

UNIT II **10**

Introduction to non – linear programming – One dimensional minimization methods, constrained and unconstrained optimization; Multi-objective optimization methods

UNIT III **10**

Integer programming methods, Dynamic programming in Markov Decision Processes, Introduction to Geometric and Stochastic programming

UNIT IV **10**

Genetic Algorithm, Simulated Annealing, Tabu Search, and Ant-Colony algorithms and their applications

UNIT V **9**

Artificial Neural networks and their applications in Engineering, Fuzzy logic as an optimization tool

TOTAL : 45 PERIODS

REFERENCES:

1. Deb Kalyanmoy , Optimization for Engineering Design,Prentice Hall of India, New Delhi, 1988.
2. Goldberg, D.E., Genetic Algorithms in Search, Optimization, and Machine Learning, Addision-Wesley, 1989.
3. Engineering Optimization, Theory and Practice,John Wiley ,1996
4. Robert.J.Schalkoff, Artificial Neural Networks,McGraw-Hill companies Inc.,1997
5. Yegnanarayanan.B, Artificial Neural Networks, Prentice Hall of India, New delhi,1999

FM1916 DISTRIBUTION AND INVENTORY MODEL L T P C
3 0 0 3

UNIT I DETERMINISTIC INVENTORY MODELS 9

Economic Order Quantity (EOQ) model, Economic Production Quantity (EPQ) Model, Purchase model with shortage – Manufacturing model without shortage – Manufacturing model with shortages –Quantity discounts – Selective Inventory Control.

UNIT II PROBABILISTIC INVENTORY MODELS 9

Single period model- Service level and Safety stock-Percent order service safety stock and multiperiod case –Percent unit service safety stock – back order –Lead time adjustment - Lead time availability.

UNIT III INVENTORY SYSTEMS UNDER RISK 9

Inventory control systems in practice, Single order Quantities (SOQ)- Known demand and Known Lead time, variable demand and known lead time SOQ in process inventory, Cost analysis techniques. Perpetual Inventory simulation, Periodic inventory simulation

UNIT IV DISRIBUTION REQUIREMENT PLANNING 9

Multistage distribution systems, push versus pull distribution systems.

UNIT V 9

Case studies in Inventory Logistics and Warehousing

TOTAL: 45 HOURS

REFERENCES:

1. Seetharaman L.Narasimhan,Dennis W.McLeavey,Peter J.Billington,Production Planning and Inventory control, Prentice Hall of India, New Delhi, 2002.
2. Monks,J.G,Operations management, John Wiley ,1999

FM1917 THEORY OF METAL CUTTING 3 0 0 3

UNIT I MECHANICS OF MACHINING 9

Mechanism of chip formation - Types of chips - chip breakers - orthogonal and oblique cutting - Derivation of equation of equation of forces - Merchant's theory - Ductile Regime machining - Mechanisms - Applications.

UNIT II TOOL GEOMETRY / NOMENCLATURE & CUTTING FORCES 9

Nomenclature of single point tool - Systems of Tool Nomenclature and conversion of rake angles - Nomenclature of multipoint tools like drills, milling cutters and Grinding wheel - Forces in turning, drilling and milling - Measurement of cutting forces.

UNIT III THERMAL ASPECTS OF MACHINING 9

Heat development in machining - Effects of various parameters - Measurement methods to determine chip tool interface temperature - action of cutting fluids - High speed machining.

UNIT IV TOOL WEAR, CHATTER & TOOL LIFE 9

Requirements of tool materials - Forms of wear - Mechanism of wear - Factors affecting chatter in machining - types of chatter - Avoidance of chatter - Mechanisms of chatter based on force and speed - Tool life - Optimum tool life - Grinding ratio.

UNIT V ECONOMICS OF MACHINING PROCESSESS 9

Cost associated with machining processes - Optimum cutting speed for minimum cost in turning - Optimum cutting speed for maximum profile rate - Effect of feed on cutting speed for minimum cost - Restrictions on optimum cutting conditions - Effect of stochastic variability of work and tool properties.

TOTAL: 45 PERIODS

REFERENCES:

1. Juneja, B.L. and Sekhon, G.S., "Fundamentals of Metal cutting and Machine tools", New Age International (P) Ltd., NewDelhi, 2000.
2. Shaw, M.C., "Metal cutting Principles", Oxford clarendon Press, 1984.
3. Bhattacharya, "Metal cutting Theory and Practice", Central Book Publishers, Calcutta, 1984.
4. Boothroyd, G., "Fundamentals of Metal Machining and Machine Tools", McGraw-Hill Co., 1975.
5. Armarego, E.J.A. and Brown, R.H., "The Machining of Metals", Prentice Hall of India,1982.

FM1918 MECHANICAL SHEET METAL FORMING 3 0 0 3

UNIT I

Yield Theories and Instability-Yield Theories -Tresca Criterion-Von mises criterion - Plastic work - Flow rules-Principles of normality- Effective stress and strain.Instability during plastic deformation-Instability in uniaxial Tensile test - Biaxial Tension -spherical and cylindrical shells-Bulging of circular disc.

UNIT II

Upper bound Theorem- Lower bound Theorem -Plain strain condition- Simple indentation-Compression between smooth plates - sticking friction- Combined upper bound and slab method-Plane strain wedge sheet drawing- Axi symmetric Rod drawing-Extrusion through various dies - End extrusion- Sideways Extrusion-Simultaneous extrusion of sheets

UNIT III

Slip line Field theorySlip line field for frictionless indentation- Velocity equation- Velocity diagram-simple stress boundary condition- Thick-walled cylinder under internal pressure-Drawing process-Slip line field nets- Drawing through a frictionless wedge shaped die-Indenting-Yield of a notched bar in tension

UNIT IV

Slab analysis**-** sheet drawing-wire or rod drawing- Direct compression in plane stain-Average pressure- Sticking friction at the interface- Axisymmetric compression-Cold rolling theory- Plastic Anisotropy Bending of sheet metal Variables in bending a sheet-Stress distribution-Equilibrium condition- Choice of material- Bending without tension- Elastic perfectly plastic bending-unloading- residual stress and spring back- Bending under Tension

UNIT V

Necking in sheet metals- uniaxial Tension of a perfect strip-Imperfect strip- rate dependent material- continuous sheets-condition for local necking - Biaxial Tension -Effect of strain hardening and rate sensitivity-Ductile fracture Plasticity for sintered powder materials-plastic flow-stress- strain behavior-Poisson Ratio- plasticity Theory- upsetting- plane strain compression-Repressing

REFERENCES:

1. Narayanasamy.R and Ponalagusamy.K" Theory of Engineering Plasticity"- Ahuja Book Company, 2000. 1st Ed.
2. SCHUUER -" Metal Forming Handbook If- Springer Verlag Publication, 1998.
3. HOSFORD.WF and CADDELL,RM. - " Metal Forming. Mechanics and Metallurgy ". PrenticeHall.Eaglewood Cliffs, I993.
4. DIETER.G.E - " Mechanical Metallurgy (Revised EditionII) 1!- McGraw Hill Co. 1980.
5. NAGPAL.G R – "Metal Forming Processes ". Khanna Publishers 1998.
6. CHAKRABARTHY,J- "Theory of Plasticity ", McGraw Hill Co, 1987.
7. ALTAN. T.-"Metal Forming-Fundamentals and applications-American Society of Metals" Metals parkJ9S3.
8. SHIRO KOBAYASHLSOO-IK-oh-ALTAN.T - * Metal Forming and Finite Element Method ", Oxford University Press,1989.
9. NARAYANASAMY.R. -"Theory of Metal Forming Plasticity", Ahuja Book Company,. 2001, 2nd Ed.
10. ALTAN T, SOO-IK-oh, GEGEL, HL - "Metal Forming, fundamentals and applications". American Society of Metals, Metals Park, Ohio 1983.

FM1919 CATALYTIC CONVERTER DESIGN & DURABILITY L T P C
3 0 0 3

UNIT I ENGINE POLLUTION 6

Sources, types, Formation Mechanisms – Control Methods – In cylinder, After Treatment.

UNIT II CATALYTIC CONVERTERS 10

Types-Substrates Requirements, Properties, Thermal and Mechanical Durability Strength, Types, Wash coat – Design Aspects.

UNIT III CATALYSTS & CATALYST DEACTIVATION 15

Catalyst materials – Slection – Properties – Surface Area, Pore size, Pore size distribution, Pore structure, Pore volume – Poisoning – Selective and non selective, reactions, Sintering – Alloying – Catalysts wear – chemical and thermal mechanisms- carbon deposits and mechanical factors.

UNIT IV S.I. ENGINE EMISSION CONTROL 7

Close coupled catalyst – Electrically heated catalyst, Hydrocarbon traps, chemically heated catalyst, exhaust gas ignition, preheat burners.

UNIT V EMISSIONS MEASUREMENT 7

Emission Norms – Driving cycles – NDIR Analyser – Flame Ionisation Detector, Chemiluminescense Nox analyzer, Gas Chromotograph.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "CATALYTIC AIR POLLUTION CONTROL – Commercial Technology", Ronals M. Heck and Robert J. Farrauto with Suresh T. Gulati, Second Edition, A John Wiley and Sons INC Publication, 2002, ISBN 0-471-43624-0.
2. "AUTOMOBILES AND POLLUTION", Paul Degobert, published by Society of Automotive Engineers, Inc., USA, 1995, ISBN 1-56091-563-3.

REFERENCES:

1. "AIR POLLUTION FROM MOTOR VEHICLES: Standards and technologies for controlling emissions", Asif Faiz, Christopher S. Weaver, Michael P. Walsh, with contributions by Surhid gautam and Lit-Mian Chan., Published by The international bank for reconstruction and development/ The World Bank, USA, 1996, ISBN 0-8213-3444-1.
2. "POTENTIAL OF EXHAUST AFTER TREATMENT AND ENGINE TECHNOLOGIES TO MEET FUTURE EMISSIONS LIMITS", Y. Kwon et.al., Report Published by CONCAWE, Brussels, 19999 (from internet).

FM1920 BIO FUEL IN I.C. ENGINES L T P C
3 0 0 3

UNIT I INTRODUCTION 5

Energy and Environment Overview – Energy scenario in India – Importance of biodiesel in India - Sources of Biodiesel - Biodiesel standards - Emission standards

UNIT II VEGETABLE OILS 6

Availability of vegetable oils -Non-edible oils as biodiesel - Scenario of non-edible oils in India - Blending, Emulsification, Pre heating and - transesterification

UNIT III PHYSICAL , CHEMICAL AND THERMAL PROPERTIES 10

Effect of vegetable oils physical characteristics on biodiesel properties
Effect of vegetable oil chemical structure on biodiesel properties - Methodology for various properties estimation - Physical and chemical properties of Biodiesel-Effect of specific heat on biodiesel combustion and performance - Role of latent heat of vaporization in biodiesel combustion process - Effect of thermal conductivity and thermal diffusivity on performance of D.I. diesel engine

UNIT IV WEAR AND FRICTION ANALYSIS 12

Solid friction- Introduction to friction-Basic theory of Solid friction- Frictional heating calculations-Internal combustion engine lubricants- Characterization of roughness and wear scar dimensions-Microscopy Techniques-Micro-mechanical properties techniques-Thermal, Chemical and X-ray methods

UNIT V PERFORMANCE,COMBUSTION AND EMISSIONS CHARACTERISTICS OF BIODIESEL FUEL 12

Performance of fuel pump, filter, injection, piston head, Piston rings, and lub oil - Performance parameters of Biodiesel as well as blends - Combustion characteristics of Biodiesel (ignition delay, maximum pressure, combustion duration, maximum temperature, heat release rate and mass burning rate) and blends - Emission characteristics of Biodiesel and blends

TOTAL: 45 PERIODS

REFERENCES:

1. Richard L Bechtold, Automotive Fuels Guide Book SAE Publication.
2. Tickell, Joshua, Tickell, Kaia, “From the Fryer to the Fuel Tank, The Complete Guide to using vegetable oils as an alternative Fuel”, Second Edition 1999.
3. Sheehan, J., Camobreco, V., Duffield, J., Grabuski .M, & Shapouri, H, “ Life Cycle inventory of Biodiesel and Petroleum Diesel for use in an urban Bus”, Report Number NREL /SR-580-24089, National Renewable Energy Laboratory.
4. Biodiesel Handling and use Guidelines (2004). Energy Efficiency and Renewable Energy, U.S. Department of Energy.
5. ASM Handbook on “lubrication and Lubricants”

FM1921 (Old Code EY091) METAHEURISTICS 3 0 0 3
(Special Elective)

UNIT I INTRODUCTION TO METAHEURISTICS 8

Metaheurictics – Definition, Computational complexity – Heuristics and approximation algorithms – Hill – climbing / iterative improvement Heuristics – methods – applications.

UNIT II SIMULATED ANNEALING 10

Metropolis algorithm, Monte Carlo methods in Physics and Chemistry, Physical Analogies of Simulated Annealing (SA) and basic algorithm, The annealing schedule, diferent theories for its selection, Computational implementation and Convergence. The Number Partitioning problem, Applications of SA. Correlations between local minima and Other acceptation functions.

UNIT III GRASP AND GENETIC ALGORITHMS 12

Introduction. GRASP, its strategies and components, Design of a GRASP - Local search and Applications, The analogies of Genetic Algorithms, Elements of a GA. Selection of an initial population, Fitness' and scaling problems related with its selection regarding the true objective function, Forma Analysis. Corner formae and the TSP, The concept of deceptiveness'' and ``GA-Hardness''.

UNIT IV TABU SEARCH AND MEMETIC ALGORITHMS 8

Introduction, Basic techniques, Short-term memory, Long-term memory, Estrategic Oscillation, Path-relinking and Applications. Memory structures. Recency and frequency based memory, Path relinking and Scatter Search. Memetic algorithms fundamentals, Correlation of local optima and Application to the Euclidean TSP.

UNIT V NEURAL NETWORKS 7

Artificial neural network for combinational optimization, Case studies, hofield's approach, Mean field theory, Kohonen's Algorithm, Elastic networks and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J. Dreo, A. Petrowski, P. Siarry, E. Taillard and A. Chatterjee, Metaheuristics for hard optimization : Methods and case studies, Springer-Verlag Berlin and Heidelberg GmbH & Co. K , 2005,
2. H. H. Hoos and T. Stützle. Stochastic Local Search. Foundations and Applications. Elsevier / Morgan Kaufmann, San Francisco, CA, 2004

REFERENCES:

1. Xavier Gandibleuk, Marc Sevauk, Kenneth Sorensen and Vincenr Tkindt, Metaheuristics for Multiobjective Optimization , Springer, 2004
2. Jorge Pinho De Sousa, Applied Optimization - Metaheuristics: Computer Decision-Making, Kluwer Academic Publishers, 2004.
3. Haykin S., Neural Networks , 2nd Edition, Prentice Hall, 1999
4. David E. Gold berg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Professional, 1989.

FM1922 FISCHER – TROPSCH METHOD FOR FUELS 3 0 0 3

UNIT I

Introduction of coal processing – Franz Fischer and Hans Tropsch process – Need for Bergius process – Development stages of F-T Process – Fischer Tropsch Approaches – Hydrogenation method used – Significance of F-T Process – Comparison to Bergius and Karrick methods – Advantages and disadvantages.

UNIT II

Study of successful commercial and pilot plants using F-T process – Problems and difficulty faced – Suggested methods for improvement – Alternative approaches for the process – Process parameters – Applications related to liquefaction

UNIT III

Suitability of coals for processing – Coal properties needed – Preparation of Coal for undergoing the Fischer Tropsch process – Need for effective preparation of fuel – Pulverisers – Synthetic Gas Production – Oxygen and steam systems – Gas reactors – Removal of residues, ash and wasteful gases – Proportions of reactants – Processing details – End products of the process and composition.

UNIT IV

Development of equipment and tools for F-T Process – Criteria for equipment / machinery selection – Suppliers ability to cope with varied parameters of processing – Auxiliaries selection – Funding criteria for purchase and development of test rigs – setup procedures.

UNIT V

Methods of Data collection at various stages – Analysis of the data – Modifications and retesting methods of F-T coal processing – Control methods and Presentation of the report for further development – Applications of the F-T processes – Future scope and commercial implementation in India.

REFERENCES:

1. Fischer-Trosch Technology by Andre & Steynberg, Elsevier Science Publishers, ISBN10: 044451354x
2. Fischer-Trosch Synthesis, Catalysts and Catalysis, by Burtron H.Davis, Mario L.Occelli, Elsevier science Publisher; 2006, ISBN-10:04445222212
3. The Fischer-Trosch Synthesis by Robert Bernard Anderson, Published by Academic Press, ISBN-10: 0120584603
4. Gas to liquids, Fischer-Tropsch Catalysis, Reactors, Products and Process Peter J.A.Tijm, Author & Publisher – online purchase.

FM1923 SAFETY MANAGEMENT 3 0 0 3

UNIT I SAFETY PHILOSOPHY AND ORGANIZATION 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity, safety and reliability, causes and costs of accidents, accident prevention programmes.

UNIT II OPERATIONAL SAFETY 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – safety in welding and cutting,– safety in machine shop –metal cutting – shot blasting, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety in material handling. Process safety management, safety in process industries, reactive hazards and inherent safety.

UNIT III SAFETY APPRAISAL AND CONTROL 9

Specific hazard control strategies – HAZOP, PHA, what if analysis, FAMIT tree analyzers, – System safety analysis – FTA, FMEA and THERP training and development of employees – first aid – fire fighting devices – accident reporting, investigation. Measurement of safety performance, accident investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – Operating procedures - safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT IV ENVIRONMENTAL MANAGEMENT AND EMERGENCY PLANNING 9

Water and air pollution, Hazardous waste management, safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – on site and off site emergency planning. Control of major industrial hazards. Site security. Risk analysis

UNIT V CASE STUDIES 9

TEXT BOOKS:

1. John.V .Grimaldi and Rollin. H Simonds, “Safety Managenent”, All India traveler book seller, New Delhi – 1989.
2. Krishnan N.V, “Safety in Industry” , Jaico Publisher House, 1996.

REFERENCES:

1. Occupational Safety Manual BHEL.
2. Industrial Safety and the law by P.M.C Nair Publishers, Trivandrum.
3. Managing emergencies in industries, loss prevention of India Ltd., proceedings, 1999.
4. Safety security and Risk management by U.K singh & J.M Dewam,. A.P.H. publishing company, New Delhi, 1996.
5. singh, U.K and Dewan, J.M., “Sagety, Security And Risk Management”, APH publishinf company, New Delhi, 1996.
6. John V Grimaldi, Safety Manageemnt. AITB publishers, 2003.
7. Safety MaNUAL. EDEL engineering Consultancy, 2000.
8. publications of Centre for Chemical Process Safety, American Institute of Chemical Engineers, USA.
9. Process Safety, Bos Skelton.

FM1924 OCCUPATIONAL HEALTH AND HYGIENE 3 0 0 3

UNIT I PHYSICAL AND CHEMICAL HAZARDS 9

Recognition, evaluation and control of physical hazards – Noise and vibration- effects and control measures – thermal stress – parameter control, radiation – types- source – effect and control – illumination and lighting. Recognition, evaluation and control of chemicals hazards – types – dust – fumes- mist- vapour – fog etc., air contaminants – evaluation- types of sampling system – method analysis – control measures.

UNIT II OCCUPATIONAL HEALTH 9

Concept and spectrum of health-functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickle, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT III OCCUPATIONAL PHYSIOLOGY 9

Man as a system component – allocation of functions – efficiency – Human errors - occupational work capacity-aerobic and anaerobic work-steady state-evaluation of physiological requirements of jobs-parameters of measurements-categorization of job heaviness – work organization – stress – strain – fatigue – rest pauses – shift work – audiometric test-eye test-vital function test-pre employment and periodic employment medical examinations.

UNIT IV PERSONAL HYGIENE AND FIRST AID 9

Hygiene concepts – correct and clean dresses - clean body - washing – good habits – oral and stomach hygiene – cleaning – compressed air and degreasing agents – skin disorder – long hair and nails and tom and loosely hanging clothes – smoking – lavatories maintenance - living in unhygienic area, first aid concept – first aid boxes – legal requirement, Personal protective equipment.

UNIT V REGULATIONS FOR OCCUPATIONAL HEALTH AND ENVIROMENT 9

Factories Acts and rules – Indian explosives Act – Environment Protection Act –
OSHA stds – OISD stds – API stds – manufacture, storage and water and air pollution rultes, Import of Hazardous chemicals rules.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Hand Book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.

REFERENCES:

1. Encyclopedia of Occupational Health and Safety”, vol. I and II, published by International Labour Office, Geneva, 1985.
2. Clayton & Clayton, Patty’s “Industrial Hygiene and Toxicology”, vol. I,II and III, willey inter science, 1986
3. Encyclopedia Of Occupational Safety and Health” ILO publication, 1980.
4. Terry Brimson, “The Health and Safety Guide”, Mc Graw Hill Book Company, Eruope-England.
5. Peter. P., “Occupational Health Hazards—A practical Industrial Guide (2nd Edition).
6. “Safety and Good House-keeping”, NPC, New Delhi, 1985.

WEB REFERENCE:

1. www.OSH.net

FM1925 COGNITIVE ERGONOMICS 3 0 0 3

OBJECTIVES:

Understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data, and research methods to design in order to optimize human and system performance

UNIT I HUMAN MACHINE INTERFACE (HMI) 10

Inter disciplinary aspects of Human factor Engineering, Cognitive Psychology Concept and Principle of HMI, Development of User interface design, Usernomics, methods for usability evaluation

UNIT II IMAGERY COGNITION 10

Cognition - Perceptual Process –Sensory Memory, Patten Recognition, Attention , Attention deficit disorder , Memory- Models of memory, Atkinson – Shiffrin Model , Levels of Processing approach , Short term & Long Term Memory and Improving memory

UNIT III VISUAL COGNITION 10

Cognitive approach of Vision & Illumination Design-color vision, Measurement of Visual acuity , Aging Eye, Illumination at work, mental Image ability - Characteristics of Mental Images – Imagery and Rotation, size , angle Shape , and Part -whole Relationship , Imagery and Interference Imagery & Memory , Cognitive maps

UNIT IV ENVIRONMENTAL FACTORS 10

Noise and Vibration – Measurement of sound, Hearing protectors, reduction of noise, effects of noise on Human performance , Interference of noise with spoken communication, Whole body vibration , sources of vibration discomfort

UNIT V SHIFT WORK 5

Problems with shift work, Improving Shift work , Shift work schedule , selection of Individuals for shift work

REFERENCES :

1. Martin Helander, A guide to human factors & Ergonomics, Taylor & Francies , second edition, 2006
2. 2R.S.Bridger, Introduction to Ergonomics , McGRAW- HILL , INC., 2003
3. John Long, A.Whitefield, Cognitive Ergonomics and Human-computer Interaction , Cambridge University Press, 1989
4. The models of cognition and perception (collections from International Journals of Cognitive Psychology), Vol. 18 (ISSN:0010-0277), Elsevier Science Publisher, Amsterdam , Netherlands, 1986

WEBSITE REFERENCES:

http://psy.otago.ac.nz/cogerg/ University of otago
http://ergonomics.osu.edu/education_research.html
http://www.ugr.es/~ergocogn/
http://www.sci.sdsu.edu/cerf/darpa/darpa.htm

FM9001 NONFERROUS METALLURGY L T P C
3 0 0 3

UNIT I **6**

Introduction to non ferrous metallurgy – Review of non – ferrous metal industries in India. Recent process developments in non – ferrous metallurgy – flash smelting. The application of the principles of thermodynamics, kinetics, and heat and mass transfer to the extraction and refining of non – ferrous metals. Environmental problems associated with the non-ferrous industry.

UNIT II **9**

COPPER: Principal Ore and Minerals; Matte smelting – Blast furnace, Reverberatory, Electric furnace, Flash; Converting; Continuous production of blister Copper; Fire refining; Electrolytic refining; Hydro –Metallurgical copper extraction; Leaching process, Recovery of copper from leach solutions; Electro – Winning.

ZINC: General Principles: Horizontal and vertical retort processes: Production in a Blast furnace: Leaching purification: Electrolysis, Refining

UNIT III **9**

MAGNESIUM: Production of a hydrous Magnesium chloride from sea water and magnetic. Electro winning practice and problem, refining, Pidgeon and Hansgrige processes.

TITANIUM: Upgrading of ilmenite, chlorination of Titania, Kroll's process. Refining.

LEAD: Blast furnace smelting, Refining of lead bullion.

UNIT IV **9**

ALUMINIUM: Micro structure of alloys – Aluminum – Silicon alloys, metallographic techniques for aluminum alloys, metallographic – micro, macroscopic scale – Mechanical, Chemical preparation, grinding, policing. Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM).

UNIT V **12**

PROCESSING & FINISHING OF NON FERROUS METALLURGY:

Alloying elements, cast process – melt & metal treatment – hydrogen removal, inclusions, structure control – grain structure, grain refinement – grain size test. Modification & refinement of hypereutectic Aluminum – Silicon alloys, foundry practices for castings – heat treatment – annealing & quality control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Extraction of Non – Ferrous Metals – HS Ray, KP Abraham and R.Sridhar
2. Metallurgy of Non – Ferrous Metals – W H Dennis.

REFERENCES:

1. Rare Metals Hand book – C.A.Hampel
2. ASM Metal hand Book Vol -15 – castings
3. ASM Metal Hand Book Vol – 1 & 2
4. ASM metal Hand Book – Vol – 7 – Atlas of microstructures of Industrial alloys
5. Metallurgy of Aluminum alloys – Van Lancker .M
   Aluminum properties & Physical metallurgy – Kent Vanhorn.

FM9002 DESIGN OF EXCAVATORS L T P C
3 0 0 3

AIM:

To understand the design, operation and performance of different types of Excavators under various geo-mining environments. Also to study the wear of the excavating tools of various excavators under different operating conditions.

UNIT I PRINCIPLES OF EXCAVATION TECHNIQUES 9

Failure criteria for rock and rockmass. Mechanics of rock fracture. Mechanical rock cutting: basic cutting methods adopted by various excavating equipment, design and selection of tools and cutting heads; parameters influencing cutting performance; determination of cuttability and production rates, Introduction to drilling, design parameters of drilling, evaluation of drill performance, drillability of rocks, mechanism of bit wear.

UNIT II SURFACE EXCAVATION TECHNOLOGY AND EQUIPMENT 9

Classification of Surface Excavating Equipment systems vis-à-vis unit operations. Selection guidelines for different types of equipment.

Theories of rock tool interaction for – Rippers, Dozers, Scrapers, Bucket wheel excavators, Surface Miners, Continuous face miners, Auger drills, Shovel, Draglines, Rock Breakers, Rope Shovels, Hydraulic excavators, Back hoe, and Front-end loaders. Determination of rippability and production rate.

UNIT III UNDERGROUND EXCAVATION EQUIPMENT 9

Introduction to various mining machines used for underground excavation; Borer, ripper and auger type - Roadheading machines – cutting principles, method of excavation, performance, limitations and problems. Theories of rock tool interaction for – Shearers, Ploughs, Roadheaders, Continuous miners and Tunnel and Shaft boring machines; selection criteria for cutting tools; Tunnel and Shaft Boring Machines – Boring methods; parameters influencing boring performance; determination of boreability and production rates.

UNIT IV UNDERWATER EXCAVATORS 9

Dredging methods (Mechanical and hydraulic), Dredgers - various types of bucket, suction, etc. Hydraulic transport of solids including pumps (Centrifugal and Jet) – characteristics of pump, fittings - solid – water slurry flow in pipelines. Selection of pumps for slurry transport.

UNIT V PERFORMANCE AND WEAR CHARACTERISTICS OF EXCAVATORS 9

Drawbar Power, Tractive Efficiency, Coefficient of Traction, Weight to Power Ratio for calculation of Force, Power and efficiency.

Wear in rock cutting and drilling tools; tool material; factors influencing wear; wear mechanism and methods of estimating / predicting tool wear and life.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Wong, J.Y., (1978), Theory of Ground Vehicles, John Wiley & Sons, Inc, New York, p.328.
2. Juvinall, R.C. and Marshek, K.M., (1991), Fundamentals of Machine Component Design, Second Edition, John Wiley and Sons, New York, p.804.

REFERENCES:

1. Peng S. and Chang H. S., (1983), Longwall Mining, John Wiley and Sons Inc
2. Martin, J.W, Martin, T.J, Bennett and Martin, K.M, (1982), Surface Mining Equipment, First Edition, Martin Consultants, Colorado,p.455.
3. Durst, W and Vogt, W, (1988), Bucket Wheel Excavator, Series on Mining Engineering, Vol.7,Trans Tech Publications, Germany, p.375.

FM9003 MACHINABILITY OF MATERIALS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF MACHINING PROCESS 10

Orthogonal and oblique machining – Mechanics of chip formation – Forces, power and stresses in machining – surface finish and surface integrity – Tool nomenclature Tool wear and tool life.

UNIT II CUTTING TOOL MATERIALS AND CUTTING FLUIDS 9

High speed tool steels – Cemented carbides – Cermets – Ceramics – CBN – PCD – coated tools – Properties, Applications and limitations of tool materials – Metal cutting and grinding fluids – Water soluble – semi-synthetic and synthetic fluids

UNIT III MACHINABILITY OF FERROUS MATERIALS 9

Machinability test methods – machinability ratings - machining of (Grey, Malleable and ductile) of cast irons – Effects of alloying and microstructures on machining characteristics – Machining of plain carbon steels, alloy steels, stainless steels recommended tool geometry and machining parameters.

UNIT IV MACHINABILITY OF NON FERROUS MATERIALS 8

Machining of aluminium and high silicon aluminium alloys – machining of copper base alloys, brass and bronze - machining of nickel base alloys.

UNIT V MACHINABILITY OF NON METALLIC MATERIALS 9

Machining of Polymers – Drilling of printed circuit boards – Machining of ceramics – Machining of composites – Glass Fibre, Carbon fibre and Aramid fibre reinforced composites.

TOTAL: 45 PERIODS

TEXT BOOK

1. Winston A Knight and Boothroyd G, Fundamentals of Metal Machining and Machine Tools, 3rd Edition, 2005, Marcel Dekker

REFERENCES

1. Hand book on Machining, ASM Hand Book Vol.16, ASM
2. Davis A Stephenson, Metal Cutting Theory and Practice, 1997, Marcel Dekker
3. Graham T Smith, Cutting Tool Technology – Industrial Handbook, 2008, Springer

FM9004 ENGINEERING AND TECHNOLOGY MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction to Engineering and Technology Management, Knowledge Management, Organization and Human Element, Knowledge and Tools of Technology Management - Economics, Statistics, Accounting & Finance, Decision and Simulation models, Legal Issues & Information Systems.

UNIT II TOOLS FOR TECHNOLOGY MANAGEMENT DECISIONS 9

Tools for Making Effective Engineering and Technology Management Decisions - Discounted Cash Flow Analysis, Depreciation Analysis, Decision Trees, Optimization Techniques, Learning Curve Analysis, Forecasting, Fault tree Analysis & Bayesian decisions, Project Selection and Management- Models, Functions, Project Life Cycle Phases, Project Management Methods

UNIT III MANAGEMENT OF ENGINEERING DESIGN AND PROPOSALS 9

Management of Engineering Design- Design Types and Approaches, Product Costing, Product life cycle costing, New Product Pricing. Management of Proposals and Contracts - Types, Concepts, Mathematical Models for Contracting. Creativity and Innovation – Definition, Classification, Factors, Creative Thinking- Process, Classification & Methods. Warranties, Ethics, and Legal Factors - Government, Commercial, and Consumer Warranties, and Warranties' Comparison, Need for Ethics, Ethical Concerns, Guidelines for Ethical Behavior and Ethics Code, Product Liability and Patents, Copyrights and Trademarks

UNIT IV RE-ENGINEERING 9

Concurrent Engineering – Objective, Principle, Concept, Methodologies, Techniques, Conflicts, Risks & Savings. Value Engineering – Definition, Objectives, Needs, Phases, Application, Techniques & Functions. Reverse Engineering – Definition, Objectives, Methods, Documentations, Software Reverse Engineering, Challenges of Future Reverse Engineering. Reengineering – Definition, Facts, Figures, Various Levels, Methods & Tools, Guidelines & Risks. Maintenance Management – Objectives, Functions, Approach & Elements and Performance Measuring Index.

UNIT V LIFE CYCLE MANAGEMENT 9

Life Cycle Theory, Product Life Cycle Management, Sustainable Product Life Cycle. Application of Industrial Life Cycle Concept. Life Cycle Costing Basics, Economics and Costing models, Cost Estimation Methods, and Configuration Management

TOTAL: 45 PERIODS

REFERENCES:

1. B.S.Dhillon, “Engineering and Technology Management Tools and Applications”, 2002, Arctech House Inc.
2. B.S.Dhillon, “Life Cycle Costing”, 1989, Gordan and Breach Science Publisher.
3. Antti Saaksvuori, Anselmi Immonen, “Product Life Cycle Management”, 2002, Springer Series.
4. Toru Higuchi and Marvin Troutt, “Life Cycle Management in Supply Chains: Identifying Innovations Through the Case of the VCR”, 2008, IGI Publishing Hershey, Newyork.
5. Ed.Richard C.Dorf, “The Technology Management Handbook”, 2000, CRC Press, LCC.
6. R.Keith Mobley, Lindley R.Higgins and Darrin J. Wikoff, “Maintenance Engineering Handbook, Seventh Edition(2008), McGrawHill.

FM 9005 FATIGUE AND DAMAGE ANALYSIS WITH GENETIC ALGORITHMS L T P C
3 0 0 3

UNIT I AN INTRODUCTION TO GENETIC ALGORITHMS 9

Genetic Algorithms revisited-Mathematical Foundations: The Fundamental Theorem, Schema processing at work, Two- armed and k-armed Bandit Problem, The Building block hypothesis.

UNIT II COMPUTER IMPLEMENTATION OF A GENETIC ALGORITHM 9

Reproduction, cross over and Mutation, Fitness Scaling, Codings, Discretization. Some applications of genetic algorithms.

UNIT III ADVANCED OPERATORS AND TECHNIQUES 9

Dominance, Diploidy and Abeyance .Inversion and other reordering operators, Niche and speciation, Knowledge based Techniques, Genetic Algorithms and parallel processors.

UNIT IV TORSIONAL VIBRATION 9

Torsional vibration of one, two and three rotor system. Equivalent shafting. Torsional vibration of a geared system. Torsional vibration with harmonic excitation, Critical speed of a shaft having a single disc with damping

UNIT V DRIVELINE MODELLING 9

Basic driveline equations and model, Modelling of neutral gear, Driveline speed control, Driveline Control for gear shifting, Anti Jerking control for passenger cars.

TOTAL: 45 PERIODS

TEXT BOOK:

1. David E.Goldberg “Genetic Algorithms in search, Optimization & Machine Learning” pearson Education.
2. Rao.J.S. and Gupta K.”Theory and Practice of Mechanical Vibrations”, Wiley Eastern Ltd., New Delhi, 1999
3. U.Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer Verlag , 2000

REFERENCE BOOKS:

1. William B. Langodon, Riccardo Poli,” Foundations of Genetic Programming”
2. P.J.Fleming, A. M. S. Zalzala”Genetic Algorithms in Engineering Systems”
3. David A.Coley, ”An Introductions to Genetic Algorithms for Scientists and Engineers”.
4. Thomason W.T., Marie Dillon Dahleh,”Theory of Vibrations with Applications” ,Prentice Hall,1997
5. Srinivas Jonnalagadda,”Falut diagnosis of drive line system using response optimization”,SAE paper 2007-01-3727
6. Krishna, N.G. Naganathan, R Phadnis, R.V. Dukkipati” Analysis of driveline loads in an automotive power train with multiple Cardan joints”, Proc.I. Mech, Part D, Journal of automobile Engineering, 1996

FM 9006 SOLIDIFICATION ENGINEERING L T P C
3 0 0 3

UNIT I INTRODUCTION TO SOLIDIFICATION 9

Importance solidification, heat extraction, solidification microstructure – formation of columnar and equiaxed, capillarity effects, solute redistribution, equilibrium solidification, zone melting, crystal growth with volatile constituents, growth of single crystals of high perfection.

UNIT II SOLIDIFICATION MICROSTRUCTURE: CELLS AND DENDRITES 9

Micro segregation, macro segregation, formation of inclusion and porosity, cells & cell spacing, constitutional super cooling, dendrites, morphology and crystallography of dendrites-primary spacing of dendrites after directional growth, secondary spacing after directional or equiaxed growth.

UNIT III NUCLEATION AND INTERFACE KINETICS 9

Homogeneous nucleation, heterogeneous nucleation, grain refinement, grain growth, lateral growth, continuous growth, growth by two dimensional nucleation, growth morphology, mushy zone morphology and properties.

UNIT IV PHASE TRANFORMATION IN SOLIDIFICATION 9

Undercooling, constitutional undercooling, solidification of pure metals, solidification of polyphase alloys, eutectic-lamellar & rod solidification, peristectic solidification, composition at the liquid-solid interface, liquid-solid surface energy.

UNIT V PHASE TRANFORMATION IN SOLIDIFICATION 9

Solidification of aluminium, copper and magnesium based alloys, effects of heat transfer rate on microstructure of cast metals, effects of dendrites arm spacing and porosity on properties of alloys, characterization of cast metals.

TOTAL: 45 PERIODS

REFERENCES :

1. ASM Hand book, Vol.15, Casting, 2004
2. M.C. FLEMINGS, Solidification Processing, Tata McGraw Hill, 1976.
3. W.KURZ, D.J.FISHER, Fundamentals of Solidification, Trans Tech Publications, 1985.
4. RONGSHAN QIN, http;//cml.postech.ac.kr/rqin, Pohang University of Science and Technology, POSTECH, Korea.

FM 9007 AUTOMOTIVE SUSPENSION AND SYSTEM DYNAMICS L T P C
3 0 0 3

UNIT I INTRODUCTION TO VEHICLE DYNAMICS 9

Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Modeling and simulation studies – Model of an automobile, one degree of freedom, two degree of freedom system, Free, forced and damped vibrations. Magnification factor and transmissibility, Vibration absorber.

UNIT II SUSPENSION SYSTEM 9

Types of suspension, Factors influencing ride comfort, Types of suspension springs Independent suspension – front and rear, Rubber, pneumatic, hydro elastic suspension, shock absorber. Types of wheels – construction of wheel assembly. Types of tyres and constructional details. Static and rolling properties of pneumatic tyres.

UNIT III DYNAMICS OF SUSPENSION SYSTEM 9

Requirements of spring mass frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension, spring rate. Calculation of effective spring rate. Vehicle Suspension in fore aft. Hydraulic damper and choice of damping characteristics. Compensated suspension systems.

UNIT IV BRAKING SYSTEM 9

Types of brakes, principle of shoe brakes, constructional details – materials, braking torque developed by leading and trailing shoes. Disc brake theory, constructional details, advantages, brake actuating systems, Factors affecting brake performance, Exhaust brakes, power assisted brakes, Testing of brakes.

UNIT V SENSORS AND MICROPROCESSORS IN AUTOMOBILES 9

Basic sensor arrangement. Types of sensors – oxygen sensors, fuel metering/vehicle speed sensor, pressure sensor. Microprocessor and microcomputer controlled devices in automobiles such as Instrument cluster, Voice warning system, keyless entry system, and Automatic transmission. Environmental requirements (vibration, Temperature and EMI)

TOTAL: 45 PERIODS

REFERENCES:

1. P.M. Heldt,'Automotive chassis' Chilton co., Newyork, 1992.
2. W.Steeds,'Mechanics of road vehicle', Illiffe Books Ltd, London, 1990.
3. J.Y.Wong,'Theory of ground vehicle', John wiley sons,New york.
4. Robert N.Brady,Automotive computers & Digital Instrumentation, Prentice Hall,NewJersy,1988.
5. N.K.Giri,'Automobile Mechanics' Khanna publishers, New Delhi, 1999.
6. J.G.Giles,'Steering, Suspension tyres', Illiffe Books London, 1988.
7. Sonde B.S.,'Transducers and display system', Tata Mcgraw Hill, New Delhi, 1977.
8. Walter E., Billiet and Leslie F, Goings,'Automotive Electric systems', American Technical society, Chicago, 1971.
9. RaoV.Dukkipati, J.Srinivas,' Mechanical vibrations' Prentice Hall, New Delhi, 2004.
10. K.K.Ramalingam,'Automobile Engineering Theory and Practice', SciTech publications pvt. Ltd, Chennai, 2001

FM9008 POWDER METALLURGY L T P C
3 0 0 3

UNIT I INTRODUCTION

Steps in Powder metallurgy, scope, advantages, limitations and applications of P/M with specific examples.

POWDER PRODUCTION TECHNIQUES: Classification and brief discussion of important physical, chemical and mechanical methods – characteristic feathers and examples of powders produced by different methods, Detailed discussion on atomization and mechanical Alloying, sol-gel, vapour state condensation

UNIT II POWDER CHARACTERISATION

Basic concepts of sampling and characterization. Techniques for detailed analysis of chemical & physical and mechanical characteristics of metal powders. Scope and limitation of various techniques. Metallurgical Characterization

UNIT III POWDER CONSOLIDATION

Techniques of compaction, Die compaction-equipments-methods, problems, design considerations. High density processing,-Cold Isostatic pressing, powder rolling and powder forging. High temperature consolidation – Hot pressing and Hot Isostatic Pressing (HIP)

UNIT IV SINTERING

Theory of solid state and liquid phase sintering. Stages in sintering, structure and property changes. Sintering mechanisms with examples. Other types of sintering, Spark plasma sintering, Sintering, Sintering furnaces-types. Sintering atmospheres - types, production, properties and applications, Testing of sintered products

UNIT V FINISHING AND SECONDARY OPERATIONS

Machining, plating, heat treatment and infiltration

P/M PRODUCTS: Production of bearing, friction materials, carbide tools, P/M magnetic materials, tools and dispersion strengthened alloys by P/M

IMPORTANT P/M ALLOYS AND APPLICATIONS OF P/M PARTS: Nickel base alloys, titanium base alloys - processing
Applications of commercial P/M Alloys in automobile, aerospace, nuclear and miscellaneous applications of P/M parts

TOTAL: 45 PERIODS

REFERENCES:

1. Metals Handbook volume 7: “Powder Metallurgy “, ASM Metals Park, Ohio, 1989.
2. Sinha A K, “Powder Metallurgy “, Dhanpat Rai & Sons, New Delhi, Second Edition,1992.
3. Randall M German, “Powder Metallurgy of Iron & Steel”, John Wiley & Sons Inc.New York, 1998.
4. Angelo P C and Subramanian R “Powder metallurgy Science, Technology and applications”, Prentice Hall of India, New Delhi 2008.

FM9009 GEOMETRIC DIMENSIONING AND TOLERANCING L T P C
3 0 0 3

AIM:

To provide knowledge on Geometric Dimensioning and Tolerancing systems and its applications in Part design, part modeling, Assembly design and various manufacturing fields.

OBJECTIVE:

Generating a good understanding of GD&T system. History, its development and applications to expose the students to different applications using in Geometric Dimensioning and Tolerance.

UNIT I INTRODUCTION TO G D&T 6

Function of tolerances-Individual and Group tolerance - Symbols, Rules, Charts –Material Condition-Modifiers-radius and controlled radius –Datum plane - Datum Feature - Datum Feature Simulators: Physical and Imaginary -Fixtures, Gages and Virtual Condition Boundaries.

UNIT II DIMENSIONAL MEASUREMENTS 9

Measurement theory: Measurement model-true value-error and uncertainty-precision and accuracy, Statistical techniques: statistical concepts-random Uncertainties-systematic Uncertainty – Uncertainty in definition, Measurement Planning: Functional representation/Design Intent-Derived Geometry-conformance-methods and procedures-link to systems of units

UNIT III INSPECTION AND VERIFICATION 9

Process Planning: Process verification-measurement quality-plan content, Inspection process uncertainty, Tolerance Characteristics and modeling, Setup: Datum Planes-point contact-Axis angularity, Temperature Changes, Equipment Inaccuracies, operator induced uncertainty: Bias-observation-Computation-setup, Free state variation, Recording Inspection Results: Recording setup-recording hole axis angularity-recording tolerances.

UNIT IV TOLERANCE STACK-UP ANALYSIS 12

Tolerance Stack-Up Analysis -Tolerance Stack-Up Analysis for a Fixed Fastener Assembly --Rules -Calculating Gaps; Working the Route -Calculating Inner and Outer Boundary Means and TheirTolerancesToleranceStack-UpAnalysis in a 5-Part Assembly -Determining a MIN GAP in a Rotating Assembly -Factors vs. Non-factors -Alignment -Dealing with Threaded Features -Calculating the Pertinent Numbers -Simplifying the Assembly Drawing -Creating a Line Graph with Numbers to Calculate the Minimum Clearance -Adding the Negative and Positive Designations -Wall Thickness Calculations and Choosing the Pertinent Tolerances-Single Part Analysis -Using Profile.

UNIT V STATISTICAL TOLERANCING 9

Gaussian Frequency Curve, Standard Deviations, Plus or Minus 3 Sigma, Root Sum Square Formula, Steps to Calculate and Apply Statistical Tolerances, Statistical Tolerance Applied to Plus and Minus Tolerances Assemblies, Statistical Tolerancing Applied to Geometric Toleranced Assemblies, When Best to Allow Statistical Tolerances and When it Should Not Be Allowed,The Logic of Statistical Tolerancing Modifying the Root Sum Square Formula with a Safety/Correction Factor, Reintegrating the Statistical Tolerance into the Assembly.

TOTAL: 45 PERIODS

TEXT BOOK

1. James D. Meadows Geometric Dimensioning and Tolerancing – Applications, Analysis & Measurement [per ASME Y14.5-2009] James D. Meadows & Assoc inc,ISBN:0-9714401-6-6.

REFERENCE BOOKS

1. Robert G. Campbell, Edward S.Roth, "Integrated product design and Manufacturing using Geometric Dimensioning & Tolerancing" Marcel Dekker, Inc, New York. Basel,ISBN:0-8247-8890-7.
2. Bryan R. Fischer, Mechanical tolerance stack up and analysis, Marcel Dekker, 2004 - Technology & Engineering
3. G.Henzold,Geometrical dimensioning and tolerancing for design, manufacturing and inspection, Butterworth-Heinemann, 2006 - Technology & Engineering
4. Gene R. Cogorno,Geometric dimensioning and tolerancing for mechanical design, McGraw-Hll, 2006 - Technology & Engineering,

Faculty of Mechanical Engineering **(Approved in 17th AC (Ad hoc) 27.04.2012)** **ITEM NO. FM 17.04(4)**

FM9010	**HIGH SPEED JET FLOWS**	**L T P C**
		3 0 0 3

UNIT I INTRODUCTION

Types of nozzles –over expanded and under expanded nozzle flows - Isentropic flow through nozzles– Interaction of nozzle flows over adjacent surfaces – Mach disk-Jet flows – types- Numerical problems.

UNIT II COMPRESSIBLE FLUID FLOW

One dimensional compressible fluid flow – flow through variable area passage – nozzles and diffusers –normal and oblique shock waves and calculation of flow and fluid properties across the shocks. Expansion fans. Interaction of shocks with solid and fluid surface.

UNIT III FREE SHEAR FLOWS

Introduction to shear layers – Jets, Wakes, Mixing layers – Kelvin –Helmholtz instability – Governing equation for Jet flows – Basic solutions – Tollmien, Goertier solutions – Jet structure in complex geometries.

UNIT IV JET FLOW AND CONTROL

Types of jet control - Single jet, multi jet, co-flow jet, parallel flow jet. Subsonic jets- Theory of Turbulent jets- Mean velocity and mean temperature- Turbulence characteristics of free jets- Mixing length- Experimental methods for studying jets and the Techniques used for analysis- Imperfectly expanded jets- Over expanded, Correctly expanded, Under expanded jets - Control of jets – Active and passive control.

UNIT V JET ACOUSTICS

Introduction to Acoustics – Types of noise – Noise sources , Monopole, Dipole quadrupoles- Noise generation mechanisms - Travelling wave solutions – Standing wave solutions – Noise suppression techniques – applications to problems.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ethirajan Rathakrishnan, "Applied Gas Dynamics", John Wiley, NY, 2010.

REFERENCES:

1. **Shapiro**, AH, "Dynamics and Thermodynamics of Compressible Fluid Flow". Vols. I & II, Ronald Press, New York, 1953.
2. **Rathakrishnan** E., "**Gas Dynamics"**, Prentice Hall of India, New Delhi, 2008.
3. Liepmann and Roshko, "Elements of Gas Dynamics", John Wiley, NY, 1963.
4. Ed Ganesh Raman, "Jet Aeroacoustics", Multiscience publishers.
5. Abromovich G.N., "The theory of turbulent jets", MIT press, Massachusetts, 1963.
6. Rajaratnam N., "Turbulent jets", Elsevier, Amsterdam, 1976.
7. Ed Harrey H.Hubbard, "Aeroacoustics of Flight vehicle Vol. I and II" , Acoustics society of American publications.
8. Ed Ganesh Raman, "Computational Aeroacoustics", Multiscience publishers.

FM9011	**Automobile Engine Lubrication and Condition Monitoring System**	**L T P C 3 0 0 3**

OBJECTIVES

To understand the working of Automobile engine lubrication system and properties of lubricants for the design and condition monitoring of I.C. engines.

UNIT I INTRODUCTION AND FUNDAMENTALS OF LUBRICATION SYSTEM 9

Types of lubrication, splash lubrication system, petro-oil lubrication system, forced feed lubrication system, Lubricants in History, functions of Lubricant, Tribology, Manufacture of lubrication oil base stocks, and manufacture of finished automotive lubricants. Properties of lubricants.

UNIT II TESTING OF LUBRICANTS 9

Introduction- Test for physical properties, Test for chemical properties and performance test. Test on used oils, Test for evaluation of Oil Condition, test for equipment condition, testing statistics of automotive lubricants. Automotive Sensors for condition monitoring, pressure, Level Quality-Predictive, Di-electric constant-cyclic voltammogram, Thermal Conductivity.

UNIT III APPLICATION OF IMAGE BASICS AND TRANSFORMS ON CONDITION MONITORING 9

Application of sampling, quantization, image basis-two dimensional DFT, DCT, waish, hadamard transform, wavelet transform, PCA, ICA, SVD on automobile condition monitoring system.

UNIT IV IMAGE ENHANCEMENT, SEGMENTATION AND COMPESSION 9

Filtering techniques spatial, frequency domain techniques, segmentation- thresholding, edge based and region based, hybrid techniques, shape representation and description, lexture based and region based, hybrid techniques, shape representation and description, texture description and analysis, coding techniques, JPEG, MPEG standards for condition monitoring of engine oil.

UNIT V PATTERN RECOGNITION 9

Linear Discriminate Analysis- Baye's classifier – Neural net – Feed forward, unsupervised learning, Hopfield nets-fuzzy system-optimization techniques in Recognition-Genetic algorithm –Simulated annealing.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ganesan, V., "Internal Combustion Engineering", Tata McGraw-Hill Publishing Co.,
2. M.L. Mathur, R.P.Sharma "A course in internal combustion egines", Dhanpatrai publication, 2003.
3. Roger F.Haycock and john E.Hillier "Automotive Lubricants Reference Book"
4. Gonzalez R.C. and Woods R.E., "Digital image Processing", Prentice Hall third edition 2008.

REFERENCES

1. Brame, J.S.S. and King, J.G. –Fuels – solids, Liquids, Gaseous.
2. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press.
3. Raymond, C.Gunther – Lubrication – Chilton Book Co., - 1971.
4. Physical and Chemical Properties of Engine Oils (SAE J357)
5. Development of n Automatic Engine Oil-Change Indicator System (SAE 870403)
6. Engine Oil viscometer Based on Oil Pressure Sensor (SAE 2006-01-0701)
7. Jain A.K., "Fundamentals of Digital Image Procession", Prentice Hall 1989.
8. William K.Pratt, "Digital Image Processing", John Wiley, 4th edition 2007.
9. Sonka M, "Image Processing, Analysis and Machine vision", Vikas Publishing Home (Thomson) third edition 2007.

Faculty of Mechanical Engineering **(Approved in 17th AC (Ad hoc) 27.04.2012)** **ITEM NO. FM 17.04(6)**

FM9012 PROPELLER AERODYNAMICS L T P C

3 0 0 3

UNIT I AIR SCREW THEORY: 8

Introduction-Non-Dimensional Coefficients-Air screw design-development of airscrew theory. The actuator-disc theory, working states of rotor, Optimum rotor, Efficiency of rotor.

UNIT II THE AXIAL MOMENTUM THEORY: 10

The Rankine-Froude theory-The momentum Equation-Ideal efficiency of a propeller.The general Momentum theory-General equations-constant circulation-approximate solution-minimum loss of energy-constant efficiency.Propeller efficiency-Energy Equation-approximate solution-efficiency-Numerical results.

UNIT III THE BLADE ELEMENT THEORY: 9

Primitive Blade Element Theory-Efficiency of the blade element-Blade interface-The vortex system of a propeller-induced velocity-The airfoil characteristics-Multi plane Interference-cascade of airfoils-Airfoil characteristics in a Cascade.

UNIT IV THE VORTEX THEORY: 9

The Propeller blades- Energy and Momentum-Propeller Characteristics-The application of the Vortex Theory-The effect of solidity and pitch-Approximate method of solution-Effective Aspect ratio of the blades. Propellers of Highest efficiency- Minimum loss of Energy- Lightly Loaded propellers-Effect of profile Drag- The effect of Number of Blades-Application of Prandtl's Formula.

UNIT V EXPERIMENTAL AND SIMULATION APPROACH OF PROPELLERS: 9

Experimental Methods- Wind tunnel interference-Thrust and Torque Distribution-Scale effect-Compressibility Effect. Basics of propeller simulations- Domain selection- Grid independency study- Turbulence model investigation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Durand, W.F., "Applied Aerodynamics- Volume IV", Stanford University, California, 1934.

REFERENCE BOOKS:

1. Seddon, J., "Basic Helicopter Aerodynamics", BSP Professional Books, Oxford London, 1990
2. Kerwin, Justin, "Lecture Notes on Hydrofoils and Propellers", Cambridge, 2001
3. Wald, Q.R., "The Wright Brothers Propeller Theory and Design", AIAA 2001-3386
4. "Propeller/Body Interaction For Thrust And Drag"-ESDU 86017
5. "Modeling Propeller Flow-Fields Using CFD"- AIAA 2008-402
6. Marc Johannes Root, "Numerical Analysis of Turbine Blade cooling Ducts" University Press Facilities, Eindhoven, 1997

FM9013 FLIGHT SIMULATION FOR COMBAT AIRCRAFT SYSTEM L T P C
3 0 0 3

UNIT I INTRODUCTION TO FLIGHT SIMULATION 9

Introduction to Simulation, basics of modeling and simulation, Combat simulation techniques, System Architecture, simulation Roles, Introduction to real time operating system, Simulation standards, Hardware and software requirements

UNIT II COCKPIT SIGNAL AND SIMULATION SYSTEM AND INTERFACES 9

Cockpit, Displays, Ergonomics, Reachability & Controls, Operating Procedure, Cockpit Lighting, Workload assessment, Data Acquisition, B1553, Rs422, Fiber optics, AFDX, STANAG, Real time networks, Analog and discrete I/Os, LVDTs and RVDTs,

UNIT III AVIONICS SYSTEM SIMULATION 9

Navigation, guidance, Man Machine interface, Controls and display usage, Pilot warning management, Mission Management, Built in test and its types, Data bus management, Sensors, Instrument landing system, Flight dynamics model basics, Under carriage model basics, Utility system model basics

UNIT IV ENVIRONMENTAL SYSTEM SIMULATION AND INSTRUCTOR STATION 8

Terrain map generation, Fly through simulation, Pilot views, Special effects, Seamless image generation, culling and Rendering, Control station, Brief and debrief station, Test station, Data Management system, Mission scenario generation and Target models

UNIT V INTEGRATION & CERTIFICATION 10

Transport Delay and Latency Testing Methods, simulator verification and validation, Integration methods, Configuration management, Types of evaluations Conduct of evaluations, simulator qualification, Certification process-Case studies: F-16A Full Mission Simulator, LCA combat simulator, Air Combat Simulators for various air forces

TOTAL: 45 PERIODS

REFERENCES:

1. Robert E.McShea, National Flight Test School, "TEST AND EVALUATION OF AIRCRAFT AVIONICS AND WEAPON SYSTEM", Copyright © 2010 by SciTech Publishing, Raleigh, NC.
2. David Allerton, "PRINCIPLES OF FLIGHT SIMULATION", Department of Automatic Control and Systems Engineering, The University of Sheffield, 2009
3. Brain L.Stevens,Georgia Tech Research Institute and Frank L. Lewis, The University of Texas at Arlington", AIRCRAFT CONTROL AND SIMULATION", Copyright © 1992 by John Wiley & Sons, Inc.,
4. Cary R.Spitzer, "THE AVIONICS HANDBOOK", AvioniCon, Inc., Williamburg, Virginia.
5. Robert L. Shaw, "Fighter Combat: Tactics and Maneuvering", Naval Inst Pr; 6th edition (December 1985)

FM9014 FUNDAMENTALS OF COMBUSTION L T P C
3 0 0 3

UNIT I THERMODYNAMICS OF COMBUSTION: 10

Stoichiometric, Absolute Enthalpy and Enthalpy of Formation, Enthalpy of Combustion and Heating Value, Laws of Thermochemistry, Pressure and Temperature Effect on Enthalpy of Formation, Adiabatic Flame Temperature, Chemical and Equilibrium Products of Combustion, Sample Calculations.

UNIT II PHYSICS AND CHEMISTRY OF COMBUSTION: 8

Fundamentals of transport phenomena, mass conservation equation, momentum equation, specious transport equation, energy equations, Basics of reaction kinetics, elementary reactions, and chain reactions.

UNIT III DETONATION: 8

Detonation Wave and their Characteristics, Deflagration to Detonation Transition, Derivation of Rankine- Hugoniot equation, Chapman- Jouguet States and their Properties, Computation of Detonation Velocity.

UNIT IV PREMIXED AND DIFFUSION FLAMES: 13

One dimensional combustion wave, Laminar premixed flame, Burning velocity methods, Effects of chemical and physical variables on burning velocity, Flame execution, Flammability limits, Flame Stabilization, Ignition.

Introduction of diffusion flame, Gaseous Jet flame, Burke - Schumann development and Flame structure.

UNIT V COMBUSTION OF LIQUID AND SOLID PROPELLANT: 6

Droplet evaporation and Burning, Combustion of Composite Propellants, Combustion of Double-Base Propellants.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Fundamentals of Combustion – Turn, S. R.
2. Principles of Combustion – Kuo, K. K.
3. Understanding Combustion -. H. S. Mukunda.

REFERENCES:

1. Fundamentals of Solid Propellant Combustion – Kuo, K. K.& Summerefied, M.,Progress in Astronautics & Aeronautics, Vol. 90, AIAA.
2. Propellants and Explosives - Naminosuke Kubota, Second Edition 2001, Wiley-VCH Verlag GmbH & Co.KGaA.

FM9015 BIOFUELS AS ENERGY SOURCES L T P C
3 0 0 3

AIM:

To analyze the significance of biofuels as energy sources

OBJECTIVE:

- To analyze the global biofuels scenarios
- To detail about the various biofuels
- To study the implication of combustion, performance, and emissions of biofuels

UNIT I INTRODUCTION 9

Introduction - global biofuels scenarios-energy scenario in India -environmental implications of pollutants-usage of biofuels in transport sector-well to wheel analysis of biofuels

UNIT II BIOHYDROGEN FROM BIOMASS AND ALCOHOLS 9

Biohydrogen from biomass by steam forming- steam reforming process-fuels from bio-syngas via Fisher-Tropsch synthesis (FTS)-primary alcohols as fuels-bioethanol-biomethanol-properties-performance of diesohol and gasohol blends-regulated and unregulated emissions

UNIT III NATURAL GAS 9

Natural gas-processing-depletion-power generation- usage in transport sectors and domestic-fertilizers-aviation-storage and transport of natural gas-environmental implications-safety concerns-energy content-performance of natural gas

UNIT IV VEGETABLE OILS AND BIODIESELS 9

Chemistry of vegetable oils-vegetable oil utilization as fuels in engines-methods of vegetable usage in engines-direct use and blending-micro-emulsions-pyrolysis-transesterification-biodiesel as engine fuel-transesterification process-the effect of reaction temperature, molar ratio, catalyst, reaction time, moisture, and free fatty acids-properties of biodiesel-combustion and performance characteristics of biodiesel-emission characteristics-economy feasibility of biodiesel

UNIT V BIOFUEL POLICY PROCESS IN INDIA 9

Background-Theories of the policy process-Argumentative approach to policy analysis-concepts of policy process as a discourse-biofuel policy context in India-energy economic context-ecological degradation and wasteland-rural livelihood context-central government-private sector in the biofuel discourse-research on socio-economic aspects-discursive shift and cautious approach to biofuel.

TOTAL: 45 PERIODS

REFERENCES

1. Richard L Bechtold, Automotive Fuels Guide Book SAE Publication
2. AyhanDemirbas, Progress and Recent Trends in Biofuels (2007), Progress in Energy and Combustion Science, 33, 1-18.

3. Biodiesel Handling and use Guidelines (2004), Energy Efficiency and Renewable Energy, U.S. Department of Energy. ASM Handbook on “lubrication and Lubricants”
4. Avinash Kumar Agarwal, Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines (2007),), Progress in Energy and Combustion Science, 33, 233-271.

WEBSITES:

1. http://www.ecoinsee.org/fbconf/Sub Theme C/Shailesh Nagar

FM9016 DESIGN, FABRICATION AND TESTING METHODS OF MICROACTUATORS **L T P C 3 0 0 3**

AIM:

The purpose ofthis subject is to understand themechanism involved in the Design and Fabrication ofmicro-actuators.

OBJECTIVE:

Upon completion of this subject, student will be able to:

1. Understand the principle of micro-actuators.
2. Know the different types of micro-actuators and their applications.
3. Enhance his/her knowledge in micro-actuator manufacturing processes.
4. Design and fabrication of micro-actuators using simulation softwares and compare with the mathematical models.

UNIT I INTRODUCTION **9**

Introduction toMacro-actuators – Micro-actuators – Types of Micro-actuators – Materials for Micro-actuators – Application of Micro-actuators–Micro-grippers .

UNIT II DESIGN AND ANALYSIS OF MICRO-ACTUATORS **9**

Design principles of Thermal – Piezoelectric – Electrostatic – Mechanical – Vaccum– Electromagnetic – Simulation Studies.

UNIT III MODELING FOR MICRO-ACTUATORS **9**

Mathematical Modeling of Thermal – Piezoelectric – Electrostatic – Mechanical – Vaccum– Electromagnetic micro actuators.

UNIT IV FABRICATION METHODS OF MICRO-ACTUATORS **9**

Micro electrical discharge machining – Micro wire electrical discharge machining – Mechanical micro machining: Micro milling, Micro turning – Bulk micromachining – Surface micromachining – Microstereolithography.

UNIT V APPLICATION OF MICRO-ACTUATORS **9**

Microgrippers: Design of Micro Collets – Micro Flexural grippers for Rectangular, Square and circular Components – Sensors for Microgrippers – Force Sensors: Capacitive – Piezoresistive – Piezoelectric.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Massood Tabib-Azar, "Micro-actuators: Electrical, Magnetic, Thermal, optical, Mechanical, chemical and smart structures", Kluwer Academic Publishers, 1998.

REFERNCE BOOKS:

1. Manfred Kohl, " Shape Memory Micro-actuators", Springer, Berlin Heidelberg, New York, 2004, ISBN: 3540-20635-3.
2. Jan G. Korvink, Oliver Paul, "MEMS: Practical guide to design analysis and application", William Andrew Inc, 2006, ISBN:0-8155-1497-2.
3. Richard S. Muller, Albert P. Pisano, "Micro-actuators", IEEE, 2000.
4. Muammer Koc, Tugrul Ozel, "Micro–Machining: Design and manufacturing of Micro-products", A John Wiley and Sons, Inc.,Publication, 2011.

FM 9017 NANOFLUIDS HEAT TRANSFER L T P C
3 0 0 3

UNIT I NANO MATERIALS AND SYNTHESIS 9

Nano materials classification, Methods of preparation of nano materials, bottom up and top down approaches, Nanoparticle synthesis techniques, Challenges in Nanotechnology.

UNIT II CHARACTERIZATION TOOLS 9

Electron Microscopy Characterization techniques- X – ray diffraction , Scanning Electron Microscope, Transmission Electron Microscope. Optical Methods Fluorescence Microscopy – Atomic Force Microscopy

UNIT III NANOFLUIDS PREPARATION AND PROPERTIES 9

Nanofluids preparation – Ultrasonication, effect of surfactant, viscosity, thermal conductivity, pH. Factors affecting thermal conductivity, viscosity of nanofluid. Measurement of thermal conductivity, viscosity and pH, Surface Energy.

UNIT IV HEAT TRANSFER ENHANCEMENT 9

Convective heat transfer enhancement of nanofluids- Mechanism of heat transfer- Brownian motion, Interfacial layer –Particle cluster.

UNIT V NANOFLUIDS FOR HEAT TRANSFER APPLICATIONS 9

Applications of nanofluids for heat transfer enhancement in various heat exchangers, merits and demerits, application to electronic cooling, Environmental and safety aspects.

TOTAL : 45 PERIODS

REFERENCES:

1. T.Pradeep, Nano: The Essentials, Tata Mc Graw- Hill Publishing Company Limited, New Delhi.
2. Sarit K Das ,Stephen U S Choi and Wenhua Yu, Nanofluids: Science and Technology, Wiley-Interscience (2007).
3. Guozhong Cao Nanostructures & Nanomaterials, Imperial College press, World Scientific Publishing Co. Pte. Ltd.(2003).
4. Ozisik, M.N., Heat Transfer - A Basic Approach, McGraw-Hill, 1987.

FM9018 PRACTICAL VIBRATION ANALYSIS AND DIAGNOSTICS L T P C
3 0 0 3

OBJECTIVES:

(i) To understand the Fundamentals of Vibration analysis and its practical applications.
(ii) To understand the operations of vibration analyzers and its applications.
(iii) To understand various vibration analysis techniques.

UNIT I INTRODUCTION TO VIBRATION ANALYSIS 8

Introduction – Displacement, Velocity and Acceleration – Vibration theory – Vibration Sources – Vibration analysis overview-Vibration analysis applications.

UNIT II VIBRATION MEASUREMENT AND INSTRUMENTATION 7

Introduction - Vibration Measurement – Instrumentation - Vibration analyzers and their applications - Signal processing.

UNIT III VIBRATION DATA ACQUISITION AND ANALYSIS 10

Introduction - Vibration Transducers Selection - Units of Measurement-Vibration data types and formats – Vibration data acquisition – Vibration analysis techniques – FFT Spectrum analysis – Time waveform analysis.

UNIT IV CONDITION MONITORING USING VIBRATION MEASUREMENTS 10

Introduction - Types of Condition Monitoring Systems - Establishing a Condition Monitoring Program - Vibration generating mechanisms - Real time analysis - Fault detection in Rotating Machinery

UNIT V PREDICTIVE MAINTENANCE TECHNIQUES 10

Maintenance - Maintenance philosophies - Evolution of maintenance philosophies - Plant machinery classification and recommendations - Principles of predictive maintenance - Predictive maintenance techniques - Vibration analysis – a key predictive maintenance technique.

TOTAL: 45 PERIODS

REFERENCES:

1. R. Keith Mobley , “Root Cause Failure Analysis “ , ISBN:0-7506-7158-0, Plant Engineering Maintenance Series, Newnes Publications
2. Harris C.M & Piersol A.G , “Shock and vibration hand book “, ISBN: 0-07-137081-1, McGraw Hill , Fifth Edition ,2002
3. J.S. Rao , “Rotor dynamics “, ISBN: 978-81-224-0977-2,New Age International Publishers, Third edition
4. Paresh Girdhar, “Practical Machinery Vibration Analysis and Predictive Maintenance “, ISBN: 0 7506 6275 1,Newnes,IDC Technologies , Burlington , 2004.