DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO. ACAD / NP /M.E./M.Tech./97/2012

It is hereby notified for the information of all concerned that, the **Academic Council at its meeting held on 06-07-2012 has accepted the following New Syllabi** under the Faculty of Engineering & Technology **as appended herewith** :-

Sr. No.	Syllabi.
[1]	M.E. Mechanical,
[2]	M.E. Mechanical [Design Engineering],
[3]	M.E. [Thermal],
[4]	M.E. [Biotechnology],
[5]	M. Tech. [Computer Science and Technology],
[6]	M.Tech. [Food Processing Tech.].

This is effective from the academic year 2012-2013 and onwards.

All concerned are requested to note the contents of this circular for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.ACAD/ NP/ M.TECH./
2012/20668-72

A.C.S.S. I.No.84

Date:- 03-08-2012.

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Director,
Board of College and
University Development.

Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Superintendent, [Eligibility Unit],
4] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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S/030812/-*

Dr BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

New Structure and Syllabus OF

M.E.

MECHANICAL

EFECTIVE FROM - 2012-13 & ONWARDS

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Faculty of Engineering and Technology

Syllabus of

Master of Engineering (Mechanical)

w. e. f. Year 2012-2013

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical)

w. e. f. Year 2012-2013

Semester I

Course Code	Name of Subject	Teaching hrs/week Lectures	Tutorials	Total hours	Examination scheme-marks Theory	Term work	viva voce	Total
ME 501	Advanced Optimization Techniques	03	01	04	100	25	--	125
ME 502	Modern Engineering Materials	03	01	04	100	25	--	125
ME 503	Advanced I.C Engines	03	01	04	100	25	--	125
ME 504	Elective –I	03	01	04	100	--	--	100
ME 505	Elective- II	03	01	04	100	--	--	100
ME 506	Lab- I	--	06	06	--		50	050
ME 507	Seminar- I	--	04	04	--		25	025
	Total	15	15	30	500	75	75	650

*Elective Subjects

Elective	Group A: Design	Group B: production	Group C: Heat and Power
Elective I	(ME504 A) Computational modeling And simulation	(ME504 B) Maintenance and Reliability Engineering	(ME 504 C) Advanced Thermodynamics
Elective II	(ME 505 A) Machine stress Analysis	(ME 505 B) Productivity management	(ME 505 C) Advanced Heat Transfer

*NOTE : Candidates are required to opt the elective subjects (Elective I, II, III and IV) from the same group as mentioned above.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical)

w. e. f. Year 2012-2013

Semester II

Course Code	Name of Subject	Teaching hrs/week Lectures	Tutorials	Total hours	Examination scheme-marks Theory	Term work	viva voce	Total
ME 511	Advanced Machine Design	03	01	04	100	25	--	125
ME 512	Advanced Manufacturing Techniques	03	01	04	100	25	--	125
ME 513	Engineering Experimental Techniques	03	01	04	100	25	--	125
ME 514	Elective – III	03	01	04	100	--	--	100
ME 515	Elective- IV	03	01	04	100	--	--	100
ME 516	Lab- II	--	06	06	--		50	050
ME 517	Seminar- II	--	04	04	--		25	025
	Total	15	15	30	500	75	125	650

*Elective Subjects

Elective	Group A: Design	Group B: production	Group C: Heat and Power
Elective III	(ME 514 A) Finite Elements Methods (FEM)	(ME 514 B) Computer aided design (CAD)	(ME514 C) Computational Fluid Dynamics (CFD)
Elective IV	(ME 515 A) Mechanical Vibrations	(ME 515 B) Computer Integrated manufacturing (CIM)	(ME 515 C) Refrigeration and Cryogenic Systems

*NOTE : Candidates are required to opt the elective subjects (Elective I, II, III and IV) from the same group as mentioned above.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Teaching/Examination Scheme for the degree of Master of Engineering (Mechanical)
w. e. f. Year 2012-2013

Semester III

Course Code	Name of Subject	Institutional hrs/week			Examination scheme-marks			
		Counseling	Dissertation work	Total hours	Theory	Term work	viva voce	Total
ME521	Dissertation part I	04	20	24	--	50	50	100
	Total	04	20	24	--	50	50	100

Semester IV

Course Code	Name of Subject	Institutional hrs/week			Examination scheme-marks			
		Counseling	Dissertation work	Total hours	Theory	Term work	viva voce	Total
ME 531	Dissertation part II	04	20	24	--	50	150	200
	Total	04	20	24	--	50	150	200
	Grand Total							1600

(ME 501) ADAVANCED OPTIMIZATION TECHNIQUES

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Introduction: Optimal problem formulation, engineering optimization problems, optimization algorithms.

Single Variable Optimization Algorithms: Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient base, root finding using optimization techniques. **(8)**

Multivariable Optimization Algorithms: Optimality criteria, unidirectional search, direct search methods, gradient based methods, computer programs on above methods. **(8)**

Constrained Optimization Algorithms: Kuhn-Tucker conditions, transformation methods,sensitivity analysis, direct search for constrained minimization, linearised search techniques, feasible direction method, generalized reduced gradient method, gradient projection method, computer programs on above methods . **(8)**

Special Optimization Algorithms: Integer programming, Geometric programming, Genetic Algorithms, Simulated annealing, global optimization, Computer programs on above methods. **(8)**

Optimization in Operations Research: Linear programming problem, simplex method, artificial variable techniques, dual phase method, sensitivity analysis **(8)**

Reference Books:

1. Deb Kalyanmoy, "Optimization in Engineering Design", PHI, New Delhi.
2. Rao S.S. "Engineering Optimization", John Wiley, New Delhi.
3. Deb Kalyanmoy, "Multi-objective Algorithms using Evolutionary Algorithms", John Wiley, New Delhi.
4. Paplambros P.Y. and Wilde D.J., "Principles of Optimum Design: Modeling and Computation", Cambridge University Press, UK
5. Chandrupatla, "Optimization in Design", PHI, New Delhi.

(ME 502) MODERN ENGINEERING MATERIALS

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Ferrous material: Mechanical Properties, heat treatment and application; stainless steel and heat resisting steel, participation hardenable steels, valve steels, high strength and low alloy steels(HSLA), micro alloyed steels, ball bearing steels, high nitrogen steels, alloy cast iron. **(8)**

Nonferrous Material: Mechanical properties, heat treatment and applications; copper alloys(Brasses and Bronzes), Al-alloys(Al-Mg-Si, Al-Cu, Al-Si), designation system in Al- alloy. **(8)**

Composites: Classification, Properties, Application of composites, Polymer Matrix Material, carbon materials, fiber Reinforcement s, types of fiber, whiskers, laminar composites, filled composites, particulate reinforced composites. **(8)**

Design of composites materials: Hybrid composites, angle plied composites, mechanism of composites, calculation of properties, unidirectional fiber composites, critical volume fraction, discontinuous fiber composites, rule of mixtures equation, critical angle. Analysis of an Orthotropic Lamina, strength of orthotropic lamina, analysis of laminated composites, stress strain variations in laminates. **(8)**

Organic material: classification, properties, application of polymer, plastics and elastomers. **(3)**

Ceramics: classification, properties, structure of refractories, abrasive material, electronic ceramics, cement and concrete. **(5)**

Reference Book:

1. Jastrezebski Z. D., " The Nature and Properties of Engineering Materials"
2. Avner S. H., "Introduxtion to Physical Metallurgy"
3. Sharma S. C.,"Composite Material"
4. DeGarmo E. P., Black J. T., Kosher R. A. " Material and processes in manufacturing"
5. Rajput R. K. "Materials Science and Engineering"
6. Chawla K. K. "Composite Materials"
7. Nayar Alok, " The Metals Data Book"
8. Fried Joel R., "Polymer Science And Technology"
9. Agrawal B. D., Broutman L. J.,"Analysis and Performance of Fiber composites", John Wiley New York.
10. ASM Handbook- Volume 10 material Characteization.

(ME503) ADVANCED I.C. ENGINES

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Spark Ignition Engines: Mixture requirements, Fuel Induction systems, Stages of combustion, Normal and abnormal combustion, factors affecting knock, Combustion chambers. **(8)**

Compression Ignition Engines: Stages of combustion in C.I. Engine, Direct and indirect Injection systems, Combustion chambers, Fuel spray behavior, spray structure, spray Penetration and evaporation, air motion, Turbo charging and Supercharging **(8)**

Scavenging & super charging: Scavenging process & efficiencies in 2-stroke engines, super charging power required & effects on engine performance, different types of turbo-charges. **(8)**

Engine Emissions & Control: Air pollution due to IC engines, norms, Emissions, HC, CO, NOx, particulates, other emissions, emission control methods, Exhaust gas recirculation, modern methods, crankcase blowby. **(8)**

Modeling & Simulation Technique: Combustion models, Basic concepts of engine simulation techniques.Recent trends in Engine Technology & alternative fuels **(8)**

Reference Books:

1. E.F. Obert, "Internal Combustion Engines and Air Pollution", Intext Educational Publishers, 1973
2. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw Hill, 1989
3. M.L. Mathur and R.P.Sharma, "A course in internal Combustion Engines", Dhanapat Rai Publications, New Delhi
4. V. Ganesan, "Int. Combustion Engines", II Edition, TMH, 2002.
5. Ganesan V., "Computer simulations of spark ignition process", University press, Hyderabad 1993.
6. Ganesan V., "Computer simulations of compression ignition engines", Orient Long man 2000.
7. Plint Michael and Martyr Anthony "Engine Testing Theory and Practice", Second Edition, SAE International,(1999)
8. Ramos J.I., " I.C. Engine Modeling", Hemisphere Publishing Corporation (T&F Group) NY

(ME 504-A) COMPUTATIONAL MODELLING AND SIMULATION

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Introduction to Simulation: System and system environment, components of the system, types of systems, types of models, steps in simulation, study advantages and disadvantages of simulation, concept of discrete simulation, time advance mechanisms, components and organization of discrete-event simulation model. **(8)**

Statistical model in simulation: useful statistical models, distribution, continuous distribution, Poisson process, empirical distribution. **(4)**

Queuing Models: characteristics of queuing system, queuing notations, long run measures of performance of queuing systems, steady state behavior finite population model.Random number generation: properties of random numbers, generation of pseudo random numbers, techniques of random numbers generation, tests for random numbers. **(8)**

Random vitiate generation: inverse transform techniques, convolution method, acceptance rejection techniques. **(4)**

Input Modeling: data collection, identifying the distribution of data, parameter estimation, goodness of fit tests, selection of input model without data, multivariate and time series input model. **(4)**

Verification and validation of simulation model: length of simulation runs, validation. **(3)**

Output analysis for single model: types of simulation with respect to output analysis, stochastic nature of output data, measure of performance and their estimation, output analysis of terminating simulators, output analysis for steady state simulation. Case studies in simulation, orientation of simulation software such as GPSS. **(9)**

Reference Books:

1. Law A. W., Kelton D., "Simulation Modeling and Analysis", Tata McGraw Hill, 2003.
2. Goedon Geoffrey, "System Simulation", 2nd Ed. PHI, New Delhi, 1990.
3. Deo Narsingh, " System Simulation with Digital Computers", PHI, New Delhi, 1989
4. Zeigler B., Prachofer H., Kim T. G., " Theory of Modeling and Simulation", Academic Press
5. Body Donald W., "System Analysis and Modeling", Academic Press Harcourt India.
6. Banks Jerry, Carson John, Nelson Barry, Nicole David, "Discrete Event System Simulation"
7. Kelton W. D. Sadowski R., Sadoski D., "Simulation With Arena"' McGraw Hill Publications.

(ME 504-B) MAINTENANCE AND RELIABILITY ENGINEERING

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Introduction: Reliability concepts and patterns of failure, reliability Management, reliability, for system effectiveness.
Reliability and hazard rates: Failure data, reliability function, failure rate and hazard rate, common distributions in failure mechanisms – experimental, Welbull, gamma, Normal, log normal, extreme value, model selection for components failure, failure analysis. **(10)**

Reliability prediction and analysis: reliability prediction based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism. **(6)**

Reliability design: Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability **(6)**

Maintenance in context: maintenance and profitability, terro-technology, application of terro-technology.
Principles: the structure of plant, reason for nature of maintenance work, the production maintenance system a dynamic model. **(8)**

Establishing a maintenance plan-preliminary consideration: items, classification of items,maintenance procedure, guidelines for machine procedures to items.
Maintenance planning and control: Basic requirements, Management information, labor costs, computer based Management information system, work planning and work control, basic rules for success. **(10)**

Reference Books:

1. L. S. Srinath, "Concepts in Reliability in Engineering", Affiliated East West Press.
2. K. C. Kapur and L. R. Lumbersome, "Reliability in Engineering Design", John Willey and sons.
3. C. Singh and B. S. Dhillon, "Engineering Reliability-New Techniques and Applications", John Wiley and sons.
4. F. J. Henley, "Designing for reliability and safety control",
5. Hiromitsu Kumamoto, "System reliability", PHI Pub.
6. B Bhadury and S.K. Basu, "Terotechnology: Reliability Engineering and Maintenance Management", Asian Books, New Delhi 2002.
7. Kelly, "Maintenance Planning and Control", A Buttersworth & Co.
8. Krishnan G., "Maintenance and Spare parts Management", Prentice Hall 1991
9. A.K.Gupta, "Reliability Maintenance and Safety Engineering", Laxmi Pub.

(ME 504-C) ADVANCED THERMODYNAMICS

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Equation of State: State postulate for Simple System and equation of state, Ideal gas equation,Deviation from ideal gas, Equation of state for real gases, generalized Compressibility chart, Law of corresponding states
Properties of Pure Substances: Phase change process of pure substances, PVT surface, P-v &PT diagrams, Use of steam tables and charts in common use **(8)**

Laws of thermodynamics, 2nd law Analysis for Engg. Systems, Entropy flow & entropy generation, Increase of entropy principle, entropy change of pure sub, T-ds relations, entropy generation, thermo electricity, Onsager equation. Energy analysis of thermal systems, decrease of Exergy principle and Exergy destruction **(8)**

Thermodynamic Property Relations: Partial Differentials, Maxwell relations, Clapeyron equation, general relations for du, dh, ds, and Cv and Cp, Joule Thomson Coefficient, Δh, Δu, Δs of real gases. **(6)**

Chemical Thermodynamics Chemical reaction - Fuels and combustion, Enthalpy of formation and enthalpy of combustion, First law analysis of reacting systems, adiabatic flame temperature Chemical and Phase equilibrium - Criterion for chemical equilibrium, equilibrium constant for ideal gas mixtures, some remarks about Kp of Ideal-gas mixtures, fugacity and activity, Simultaneous relations, Variation of Kp with Temperature, Phase equilibrium, Gibb's phase rule, Third law of thermodynamics, Nerst heat theorem and heat death of universe **(8)**

Gas Mixtures – Mass & mole fractions, Dalton's law of partial pressure, Amagat's law, Kay's rule.
Statistical Thermodynamics- Fundamentals, equilibrium distribution, Significance of Lagrangian multipliers, Partition function for Canonical Ensemble, partition function for an ideal monatomic gas, equipartition of energy, Bose Einstein statistics, Fermi- Dirac statistics, **10)**

Reference Books:
1. Cengel, "Thermodynamics", TMH
2. Nag P.K., "Basic & Applied Thermodynamics", TMH, New Delhi.
3. Kalyan Annamalai, Ishwar K. Puri, "Advanced Thermodynamics Engineering", CCRC PRESS
4. Holman, "Thermodynamics", 4th edition, McGraw Hill
5. Rao, Y.V.C., "Postulational and Stastistical thermodynamics", Allied Pub. Inc.
6. Jones and Hawkings, "engineering Thermodynamics", John Wiley & Sons, Inc. USA
7. Faires V. M. and Simmag, "Thermodynamics", McMillan Pub. Co. Inc. USA
8. Stephen Turns, "Thermodynamics- Concepts and Applications", Cambridge University Press

(ME 505-A) MACHINE STRESS ANALYSIS

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Theory of Elasticity: Plane stresses and plane strain: plane stress, plane strain, and stress and strain at a point, differential equations of equilibrium, boundary conditions, compatibility equations, Airy's stress function.

Two-dimensional problems in rectangular coordinates: Solutions by polynomials, endeffects, Saint Venant's principle. Two-dimensional problems in polar coordinates: General equations in polar coordinates, stress distribution symmetrical about axis, strain components in polar coordinates. **(8)**

Applications of Energy Methods: First and second theorems, Castigliano's theorems,applications for analysis of loaded members to determine deflections and reactions at supports.

Theory of Torsion: Torsion of prismatic bars of non-circular cross sections, Thin walled hollow and rectangular cross sections, Saint Venant's theory, Prandtle's membrane analogy,Kelvin's fluid flow analogy, warping of the cross sections. **(8)**

Experimental Stress Analysis: Stress analysis by – mechanical, optical and electrical strain gauges, strain rosette, whole field methods, Moire fringe method, brittle coatings for strain indication. (8)

Shear Center and Unsymmetrical Bending: Shear center for beams of different cross sections, bending and deflections of beams subjected to unsymmetrical bending. **(8)**

Contact Stresses: Hertz's contact stresses, expression for principle stresses, deflection of bodies in point contact, stress in bodies in point and line contacts. **(8)**

Reference Books:

1. Timoshenko and Young, "Theory of Elasticity", TMH Publications.
2. Seely and Smith, " Advanced Mechanics of Materials", John Wiley, New York
3. Den Hartog J. P., "Advanced Strength of Materials", McGraw Hill Publications.
4. Nash W., "Strength of Materials", Schaum's outline series, McGraw Hill

(ME 505-B) PRODUCTIVITY MANAGEMENT

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Introduction: Productivity concepts – Macro and Micro factors of productivity, productivity benefit model, productivity cycles.
Productivity concepts and definitions: Productivity, Importance, role of productivity. Productivity improvement factors-internal factors of enterprises productivity (hard and soft factors), external factors affecting productivity. **(6)**

Productivity Models: Productivity Measurement at International, National and organization level, total productivity models. Productivity Management in manufacturing and service sector. Productivity evaluation models, productivity improvement model and techniques.
Productivity analysis: An approach to productivity appraisal, total productivity, labor productivity,
Productivity analysis in the enterprises: The Kurosawa structural approach, Lawlor's approach, Gold's approach, quick productivity appraisal approach (QPA), inter-firm comparison (IFC), some problems on productivity analysis. **(10)**

Improving Productivity
Managing organization effectiveness: general consideration, productivity improving strategy, productivity improvement programs (PIP), organizational approach to productivity improvement programs.
Productivity Improvement Techniques: Industrial engineering techniques and economic analysis, work study, work simplification, Pareto analysis, JIT, management through analysis, cost benefit analysis, zero base budgeting, **(8)**

Method Study: Method and Method Study – Need for Method Study – Procedure of Method Study – Principles of Motion Economy Behavior Techniques- brainstorming, force field analysis
Business Process Reengineering: Concept of BPR, process of BPR, prerequisites for effective BPR implementation, application of BPR in productivity improvement. **(8)**

Work Measurement: Techniques of Work Measurement including Estimating, Stopwatch Time Study, Predetermined Time Standards, Synthetic Estimates of Work Times, and Activity Sampling. Computation of Standard Time – Elements – Types of Elements – Performance Rating– Allowances – Need for Allowances – Types of Allowances, MOST
Effective Human Resource Management:
Management of People, The role of Management, Manpower motivation, productivity training
TPM: Meaning and objectives of TPM; Methodology of TPM, gains of TPM **(8)**

Reference Books:

1. Sumanth, D.J., "Productivity engineering and management", Tata McGraw-Hill, New Delhi 1990.
2. Edsomwan, J.A., "Organisational transformation and process re-engineering", British Library Cataloging in Pub. data 1996.
3. Joseph Prokopenko, "Productivity Management-A practical Handbook", ILO Geneva
4. Prem Vrat, G.D.Sardana, B.S.Sahay, "Productivity Management-A system approach", Narosa Publication.
5. John G., Jr. Belcher, "Productivity Plus: How Today's Best Run Companies Are Gaining the Competitive Edge", Butterworth-Heinemann
6. H. James Harrington, "Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity and Competitiveness", McGraw-Hill
7. Carl G. Thor, "Handbook for Productivity Measurement and Improvement", Productivity Press
8. Rastogi, P.N., "Re-engineering and re-inventing the enterprise", Wheeler publications, New Delhi 1995.
9. Work Study-ILO

(ME 505-C) ADVANCED HEAT TRANSFER

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Brief introduction to different modes of heat transfer and the basic laws of heat conduction, convection and radiation. Heat transfer applications. One-dimensional steady state heat conduction. Extended surfaces. Design and analysis of fins. Fins of constant and variable cross section. Two dimensional steady state heat conduction in semi-infinite and finite flat plates. Graphical method and relaxation method for solving 2D heat conduction problems. Conduction shape factor. **(10)**

Transient heat conduction. Lumped heat capacity systems. Response of thermocouple. Use of Heisler charts for solving one dimensional unsteady state heat transfer problems in infinite plates, cylinders and spheres. Periodic heat flow. **(6)**

Convective heat transfer. Concept of velocity and thermal boundary layers. Laminar and Turbulent flow. Differential convection equations. Non dimensional convection equations.Analogy between momentum and heat transfer for laminar and turbulent flow. External forced convection, Parallel flow over a flat plate, Flow over cylinders, spheres and tube banks. Mixed boundary layer considerations Internal forced convection, Thermal analysis and convection correlations for laminar and turbulent flow in circular and non circular tubes, Constant heat flux and constant wall temperature conditions. Heat transfer enhancement Free Convection, Empirical correlations for external free convection flows for various geometries and orientations, free convection within parallel plate channels. Empirical correlations for enclosures Combined free and forced convection **(6)**

Boiling heat transfer. The pool boiling curve. Modes of pool boiling and correlations. Transition boiling and system influences. Forced convection boiling in tubes. Two phase flow in horizontal tubes. Limiting heat fluxes in flow boiling. Condensation heat transfer phenomenon. Condensation number, laminar film condensation on a vertical plate, Correlations for condensation inside and outside a vertical tube, on inclined plates, on outer surface of horizontal tube, on horizontal tube bank, turbulent film condensation, Drop wise condensation. Design considerations of Heat pipe **(8)**

Principles of thermal radiation. Greenhouse effect. Atmospheric and Solar radiation. Radiation exchange between black and non black surfaces. Direct method (Matrix method) and Network method for solving radiation heat transfer problems. Radiation shields. Radiation exchange with emitting and absorbing gases. Radiation effect on temperature measurement. Multimode heat transfer **(10)**

Reference Books:

1. Yunus Cengel, "Heat Transfer: A Practical Approach", 3 (2007), Tata McGraw-Hill
2 Holman J.P., "Heat transfer", Tata McGraw Hill,
3 Hottel H.G.& Sarofim A.F., "Radiative Heat Transfer", McGraw Hill
4 Michael Modest, "Radiative Heat Transfer", McGraw Hill
5 Sukhatme S.P., "Heat transfer", University Press
6 Sarit K. Das, "Engineering Heat & Mass Transfer", Dhanpat Rai

(ME 506) LAB – I

Teaching Scheme:
Tutorials: 06 h/week

Examination Scheme:
Viva – voce: 50 Marks.

Lab-I consists of two parts as below:
Part A: The candidate will deliver an industrial case study in front of two examiners (one internal and other appointed by the university).
Part B: Optimization related programming in C

(ME 507) Seminar – I

Teaching Scheme:
Tutorials: 04 h/week

Examination Scheme:
Viva – voce: 25 Marks.

Seminar –I: It shall be based on the literature survey on any topic, which may lead to dissertation in that area. It will be submitted as a report.

The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(ME 511) ADVANCED MACHIE DESIGN

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Fundamentals of Design Considerations: Principal planes and Principal stresses, tri-axial State of stresses, Mohr's circle for tri-axial state of stresses and strains, volumetric strains, Principal stresses computed from Principal strains, Principal strains due to perpendicular stresses & shear stresses. **(8)**

Mechanical Springs: Design of square or rectangular bar helical springs, Belleville springs, ring springs, torsion bar springs, theory of square or rectangular bars helical springs under axial loading, cone or flat disc spring theory. **(8)**

Cams: Basic curves, cam size determination, calculating cam profiles, advance curves, polydyne cams, dynamics of high speed cam systems, surface materials, stresses and accuracy, ramps. **(8)**

Fracture and Creep: Fracture Mechanics approach to design. Causes and interpretation of failures; Creep behavior; rupture theory; creep in high temperature low cycle fatigue; designing against creep. **(8)**

Computer Aided Machine Design: Philosophy of Computer Aided Machine Design, Interactive design software, Basic advantages of analysis Software, Design of machine components (springs, gears, temporary fasteners, permanent fasteners, belts and ropes) through interactive programming. **(8)**

Reference Books:

1. L S Srinath, "Advanced Solid Mechanics", Tata McGraw-Hill
2. V Ramamurti, "Computer Aided Mechanical Design and Analysis", (Third Edition), Tata McGraw-Hill
3. Wahl A.M., "Mechanical Springs"
4. Rothbart John, "Cams", Wily & sons
5. Sidebottom Borosi, "Advance Mechanics of materials", John Wily & sons Pub
6. Smith Seely, "Advanced Mechanics of materials", John Wily & sons Pub
7. Timoshenko , "Strength of Materials"
8. Kocanda, "Fatigue Failure of Metals", Sijthoff & Noordhoff International Publication
9. Behan & Crawford, "Mechanics of Engineering Materials", John Wily & sons Pub
10. Spotts M.F., "Mechanical Design Analysis", PHI Publications, New Delhi
11. R. C. Juvinall, "Fundamentals of Machine Component Design"

(ME-512) ADVANCED MANUFACTURING TECHNIQUES

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Advances in Casting Process: Rapid Casting Development, design for casting: manufacturability 'health checks'; guidelines for improving casting design; web-based collaboration, rapid tooling development: rapid prototype patterns; rapid tooling methods, benchmarking of RP&T route for casting application, casting process planning: process selection; selection of steps and process parameters, casting coat estimation. Sheet moulding casting V process, flask less moulding, evaporate casting, plaster mould casting, design for plaster mould casting, quality, accuracy, uniformity in casting moulding. **(10)**

Manufacturing by Machining: Analysis of tool-chip interface- Geometry and models of tool wear, tool-life and tool-temperature, tool-chip interface friction, tool condition monitoring, importance and various techniques used, precision and surface finishing operations, lapping, honing, super finishing, polishing, buffing, de burring, precision grinding. **(9)**

Chip less metal removal process: Non-traditional manufacturing processes, abrasive jet machining, water jet machining, magneto abrasive finishing, Wire EDM, Micro drilling by different processes like laser beam, electro jet, electro stream drilling, non-traditional de burring processes. **(7)**

Plastic manufacturing processes: compression molding, transfer molding, injection molding, extrusion molding, thermo forming, blow molding, roto molding, structured form molding. **(6)**

Metallic coating: importance, principle application of- chemical vapor deposition, physical vapor deposition, thermal spray coating, electroplating, electro less coating. **(8)**

Reference books:

1. Benjamin W., Niebel A., "Modern Manufacturing Process Engineering", Tata-McGraw Hill Publications.
2. Bedict G. F., Dekker," Nontraditional Manufacturing Processes", Marcel Inc. New York.
3. HMT, "Production Technology Hand Book", Tata-McGraw Hill Publications.
4. Ravi B., "Metal Cating: Computer-Aided Design and Analysis" Prentice-Hall of India, 2005.
5. Weller E. J., "Non-traditionl Machining Process", Society of Manufacturing Engineers, Dearban Michigan.
6. Amsteal, Philip, begman, "Manufacturing processes", John Willey and Sons, 8th EDITION.
7. Mishra P. K., "Non-traditional machining processes", Narosa publications.
8. Heine R. W., Loper C. R., Rosenthal P. C., " principles of Metal Casting", and Tata-McGraw Hill, New Delhi,1991.
9. Mukherjee P. C., "Metal Cating Technology", Oxford and IBH, 1979.
10. Ghosh A., Mallik A. K., "Manufacturing Science", East-West Press, 1985.

ME513: ENGINEERING EXPERIMENTAL TECHNIQUES

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	Tern Work : 25 Marks

Basic concept: Definition of terms, Calibration, Standards, Dimensions and units, the generalized measurement system, basic concepts in dynamic measurements, system response, distortion, impedance matching, experimental planning. **(8)**

Analysis of experimental data: Causes and types of experimental errors, uncertainty analysis, evaluation of uncertainties for complicated data reduction, statistical analysis of experimental data, probability distribution, the Gaussian, normal error distribution, probability graph paper, the chi-square test of goodness of fit, the method of least square, the correlation coefficient, standard deviation of mean, t-distribution, Graphical Analysis ang curve fitting. General consideration in data analysis. **(10)**

Force Torque and Strain Measurements: Mass balance measurement, elastic elements of force measurement, torque measurement, stress strain measurement, various types of strain gauges, **(8)**

Motion and Vibration Measurement: Simple vibration instruments, practical considerations of seismic instruments, sound measurements. **(6)**

Data Acquisition and Processing: The general Data Acquisition System, Signal Conditioning, data transmission, analog to digital and digital to analog conversions, data storage and display, the program as substitute for wired logic. **(8)**

Reference Book:

1. Holman J. P., "Experimental Methods of Engineers", 6th ED, McGraw Hill Publications.
2. Jain R. K., "Mechanical Instruments", Khanna Publishers, New Delhi.

(ME 514-A) FINITE ELEMENT METHODS

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches. **(8)**

Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements. **(8)**

Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bending problems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems. Idealisation of stiffness of beam elements in beam slab problems **(8)**

Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems **(8)**

FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis. **(8)**

Reference Books:

1. O.C. Zienkiewicz and R.L. Taylor, "The Finite Element Method", McGraw Hill
2. J. N. Reddy, "An Introduction to Finite Element Method", McGraw Hill
3. K.J. Bathe, "Finite Element Procedure in Engineering Analysis", McGraw Hill
4. C.S. Krishnamoorthy, "Finite Element Analysis", Tata McGraw Hill
5. R.D. Cook, D.S. Malcus and M.E. Plesha, "Concepts and Application of Finite Element Analysis", John Wiley
6. T.R Chandragupta and A.D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall India
7. O.C. Zenkiewicy & Morgan, " Finite Element and Approximation"

(ME-514 B) COMPUTER AIDED DESIGN

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Product design process: Importance of design, design process, technological innovation and the design process, Team behavior and tools; Embodiment design: Product architecture, configuration of design, parametric design, Industrial design, Human factors design, Design for X (DFX) **(4)**

CAD: Introduction, Role of CAD, CAD system architecture, Hardware and software for CAD, Software modules, ICG, Graphics Software, Ground rules for design of GS, functions of GS, modeling and simulation, Solid modeling methods **(4)**

An overview of modeling software: like UG/NX, Solid Works, Autodesk Inventor, Professional, **AutoCAD, PRO/E, CATIA:** Capabilities, Modules, Coordinate systems, Sketching tools, solid modeling tools, surface modeling tools, expression/parameters toolbox, data exchange tools, API and customization facilities **(8)**

Geometric transformations: 2D and 3D; transformations of geometric models like translation, scaling, rotation, reflection, shear; homogeneous representations, concatenated representation; Orthographic projections **(4)**

CAD/CAM Data exchange and data storage: Introduction, graphics and computing standards, data exchange standards like IGES, STEP, Model storage - Data structures - Data base considerations – Object oriented representations - Organizing data for CIM applications - Design information system **(4)**

Mathematical representations of solids: Fundamentals, Solid models, Classification of methods of representations, half spaces, boundary representation, CSG, sweep representations, Octree representations, primitive instancing, cell decomposition, spatial occupancy enumeration. **(6)**

Mathematical representations of curves and surfaces: Curve representation, Parametric representation of analytic and synthetic curves; Surface models, Surface representations, Parametric representation of analytic and synthetic surfaces Assembly modeling: Representation, mating conditions, representation schemes, generation of assembling sequences

AI approaches and applications in CAD, Knowledge Based Engineering, OpenGL, Introduction to Advanced visualization topics in CAD like Modern representation schemes like FBM, PM, Feature recognition, Design by features, Tolerance modeling, System customization and design automation, Open Source CAD like Open CASCADE **(10)**

Reference Books

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addision Wesley England, Second Edition, 2000.
2. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi,1992.
3. Dieter George, Engineering Design – A materials and processing approach, McGraw Hill Publishers,2000
4. Ibrahim Zeid, Matering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
5. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY,1989
6. P.Radhakrishnan, S.Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd.,New Delhi.
7. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
8. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi,

(ME 514 C) COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Introduction: CFD as the third dimension of fluid mechanics. Numerical Discretization methods such as Finite Difference, FEM and FVM, Why FVM as preferred method in CFD. **(8)**

Basic Equations of fluid Dynamics: Potential Flow, Nonlinear potential flow, inviscid flows and viscous flows, Navier Stocks Equations, Primitive Variable Vs. Conservation Form, Dimensional Form Vs. Non-Dimensional form. **(8)**

Numerical Methods for Convection- Diffusion equations: Upwinding and central Difference schemes, stability condition in terms of Courant number. **(8)**

Numerical Method For Inviscid Flows: Characteristics form of equations, Flux Difference spitting, Application To 2-d Flow such as flow through nozzle. **(8)**

Numerical Method For Incompressible flows: The continuity equation divergence constraint. Poisson equation for pressure, Schemes such as Simple due to Patankar and Spalding. **(8)**

Reference Books:

1. Veersteeg and Malalasekara, CFD:The Finite Volume Method, Prentice Hall, 1996.
2. Anderson, Tannehill and Pletcher, Computational Fluid Mechanics and Heat Transfer, Hemisphere Publishers, 1984.
3. C A J Fletcher, computational methods for fluied dynamics: Vol 1 and 2. Springer Verlag, 1987
4. C. Hirsch, Numerical Computation Of Internal and External Flows Vol.1 and 2.
5. D C Wilcox, Turbulence Modeling for CFD, DCW Industries.

(ME 515-A) ADVANCED MECHANICAL VIBRATIONS

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Introduction: Characterization of engineering vibration problems, Review of single degree freedom systems with free, damped and forced vibrations **(8)**

Two-degree of Freedom Systems: Principal modes of vibration, Spring coupled and mass coupled systems, Forced vibration of an undamped close coupled and far coupled systems, Undamped vibration absorbers, Forced damped vibrations, Vibration isolation. **(8)**

Multi-degree Freedom systems: Eigen-value problem, Close coupled and far coupled systems, Orthogonality of mode shapes, Modal analysis for free, damped and forced vibration systems, Approximate methods for fundamental frequency- Rayleigh's, Dunkerely, Stodola and Holzer method, Method of matrix iteration, Finite element method for close coupled and far coupled systems. **(8)**

Continuous systems: Forced vibration of systems governed by wave equation, Free and forced vibrations of beams/ bars **(10)**

Transient Vibrations: Response to an impulsive, step and pulse input, Shock spectrum
Non-linear Vibrations: Non-linear systems, Undamped and forced vibration with non-linear spring forces, Self-excited vibrations. **(6)**

Reference Books:

1. J.S. Rao and K. Gupta, "Theory and practice of Mechanical Vibrations", New Age International
2. G.K. Groover, "Mechanical Vibrations", Nem Chand & Brothers.
3. V. Ramamurti, "Mechanical Vibration", Practice, Narosa Publications
4. V.P. Singh, "Mechanical Vibrations", Dhanpat Rai & sons
5. R.V. Dukkipati & J. Srinivas, "Textbook of Mechanical Vibrations", Prentice Hall of India

(ME 515-B) COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme:
Lectures: 03 h/week
Tutorials: 01 h/week

Examination Scheme:
Theory Paper: 100 Marks (3 h)

Introduction: The meaning and origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management. **(8)**

Group Technology and Computer Aided Process Planning : History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. – cellular manufacturing. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning - variant approach and generative approaches - CAPP and CMPP process planning systems. **(8)**

Shop Floor Control and Introduction of FMS: Shop floor control-phases -factory data collection system -automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -computer control systems-application and benefits. **(8)**

CIM Implementation and Data Communication: CIM and company strategy – system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA) - manufacturing enterprise wheel-CIM architecture- Product data management-CIM implementation software. Communication fundamentals- local area networks -topology -LAN implementations – network management and installations. **(8)**

Open System and Database For CIM: Open systems-open system inter connection -manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases - database terminology- architecture of database systems-data modeling and data associations - relational data bases - database operators - advantages of data base and relational database. **(8)**

Reference Books:

1. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
2. Yorem Koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.
3. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2001.
4. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 1986.
5. Roger Hanman "Computer Intergrated Manufacturing", Addison – Wesley, 1997.
6. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., New Delhi-1, 1998.
7. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
8. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition New Age International (P) Ltd., New Delhi, 2000.

(ME 515-C) REFRIGERATION AND CRYOGENIC SYSTEMS

Teaching Scheme:	**Examination Scheme:**
Lectures: 03 h/week	Theory Paper: 100 Marks (3 h)
Tutorials: 01 h/week	

Vapour Compression refrigeration: system:- Simple systems, Multi-evaporator system; Multi expansion system; Cascade systems; Study of P-h; T-s; h-s and T-h charts for various refrigerants, Concept of Heat Pump

Refrigerant: Designation, selection, desirable properties, refrigerant blends, secondary refrigerants, refrigerant recycling, reclaim and charging, alternative refrigerants, Refrigerant lubricant mixture behavior, ODP, GWP concepts (8)

Vapour absorption refrigeration: Standard cycle and actual cycle, thermodynamic analysis, Li Br-water, NH3-water systems, Three fluid absorption systems, half effect, single effect, single double effect, double effect, and triple effect system.

Non-convention refrigeration system (Principle and thermodynamic analysis only):
Thermoelectric refrigeration, thermo-acoustic refrigeration, adsorption refrigeration, steam jet refrigeration, vortex tube refrigeration, and magnetic refrigeration. (8)

Compressor rating and selection- Hermetic, reciprocating, screw, Scroll and centrifugal Compressors based on applications.

Evaporators: types, thermal design, effect of lubricants accumulation, draining of Lubricants, selection and capacity control

Condenser: types, thermal design, purging, selection and capacity control **(8)**

Introduction to Cryogenics: Importance of cryogenics , Development history of cryogenics, Application areas of cryogenics', Material properties at Cryogenic Temperatures, super conductivity applications, Cryogenics in space Industries. Cryogenics in Aviation and Aerospace Industry, Cryobiology. **(8)**

Liquefaction systems : Carnot Liquefaction system, F.O.M. and Yield of Liquefaction system, Inversion Curve – Joule Thomson Effect. Linde system, Linde-Hampson System, Pre cooled Linde Hampson System, Claudes system, Dual pressure System, Kapitza system, Heylandt system, Philips machine. **(8)**

Reference books :

1. R.J. Dossat, "Principles of refrigeration", Pearson Education Asia
2. C.P. Arora, "Refrigeration and Air Conditioning", McGraw-Hill
3. W.F. Stoecker, "Industrial Refrigeration Handbook", McGraw-Hill
4. P.C. Koelet, "Industrial Refrigeration: Principles, design and applications", Mcmillan
5. ASHRAE Handbook (i) Fundamentals (ii) Refrigeration
6. ISHRAE handbooks
7. Mamata Mukhopadhyay, "Fundamentals of Cryogenic Engineering", PHI Learning Private Ltd.
8. R. Baron, "Cryogenic Systems", Oxford University Press.
9. A Bose and P. sengupta, "Cryogenics applications and progress", McGraw-Hill

(ME 516) LAB – II

Teaching Scheme:
Tutorials: 06 h/week

Examination Scheme:
Viva – voce: 50 Marks.

Lab-II consists of two parts as below:
Part A: The candidate will deliver an industrial case study in front of two examiners (one internal and other appointed by the university).
Part B: Optimization related programming in C

(ME 517) Seminar – II

Teaching Scheme:
Tutorials: 04 h/week

Examination Scheme:
Viva – voce: 50 Marks.

Seminar –II: It shall be based on the literature survey on any topic, which may lead to dissertation in that area. It will be submitted as a report.

The candidate will have to deliver a seminar presentation before the examiners, one of them will be guide and the other will be examiner appointed by the university.

(The Dissertation consist of two parts as Part-I and Part-II)

(ME 521) Dissertation Part – I

Teaching Scheme:
Counseling: 4 h/week
Dissertation work: 20 h/week

Examination Scheme:
Term Work: 50 Marks.
Viva – voce: 50 Marks.

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The report must include comprehensive literature work on the topic selected for dissertation.

Term work:
The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:
The dissertation part I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be an external examiner.

(ME 531) Dissertation Part – II

Teaching Scheme:
Counseling: 4 h/week
Dissertation work: 20 h/week

Examination Scheme:
Term Work: 50 Marks.
Viva – voce: 150 Marks.

The dissertation part - II will be in continuation of dissertation part - I and shall consist of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and / or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of department and the Principal, that the work has been satisfactorily completed.

Term work:
The dissertation will be assessed by two internal examiners appointed by the Institute, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-voce:
It shall consist of a defense presented by the examinee on his work in the presence of examiners appointed by the university, one of whom will be the guide and other will be an external examiner.