NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR
JAMSHEDPUR (JHARKHAND) - 831014
DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS FOR CIDM

ME501 Advanced Mechanics of Solids   (3-1-0) 4

Analysis of Stresses: Rectangular and polar coordinates, Cauchy's formula, Invariants, Principal stresses, 3D Mohr's Circle, Octahedral, Hydrostatic and Deviotric state of stress, Differential equations of equilibrium, Analysis of strain: linear and plane strain, compatibility conditions, Generalized Hooke's law, Energy Methods: Bending of symmetric and unsymmetrical straight beams, Bending of Plates. Torsion: Non circular bar, membrane analogy. Introduction to Photometry/ photo-elasticity. Strain measurement: Using Electric circuit and light

Text books:
- L.S. Srinath, Advanced Mechanics of Solids, 3rd edition, TMH, 2009.
- Advance Mechanics of Materials by H. Ford & J.M. Alexander from John Wiley & Sons

References:
- Advance Mechanics of materials by H. Ford & J. M. Alexander from John Willey and Sons
- Mechanics of Deformable Solids, Irving H. Shames, Krieger Pub Co, 2008
- Experimental Stress Analysis by L.S. Srinath

ME502 Design of Machine Elements   (3-1-0) 4

Introduction to Design of Machine Elements, Review of materials & process for machine elements. Case studies of Design of Machine Elements failures. Review of static strength failure analysis –theories of failure including von-mises theory based strength design. High cycle and low cycle fatigue. Fatigue Strength Design of Mech. Equipment Elements. Exercises of fatigue design of shafting and gears. Surface fatigue design failures. Exercises of surface fatigue design of rolling contact bearing including linear bearings. Stiffness based design. Design for Creep. combined creep and fatigue failure prevention. Design to prevent buckling and instability. Tribodesign with applications to design of sliding bearings and mechanical seals. Selection of lubrication systems. Design for corrosion, wear, hydrogen embrittlement, fretting fatigue and other combined modes of mechanical failure. Dynamically sound designs of machine elements like springs and shafts. Introduction to dynamic design of mech. equipment and its implementation.

Text books:

- Joseph Edward Shighley, Mechanical Engineering Design, Mcgraw Hill. 2008, 8th Edition.

References:

- T. Krishna Rao, Design of Machine element Vol-1 & 2, I.K. International Pvt. Ltd.

- Donaldson. C, Tool design, Tata Mc-graw hill & co.
- A.S. HALL, A.R. HOLOWENKO, AND H.G. LAUGHLIM, Theory And Problems In Machine Design Schaum's series
- HALL AND ALLEN. S. Machine Design, Schaum's Series. 2008, TMH.
- M.F. Spolts, Design of Machine Elements, Pearson Eduction, 2005, 7th Edition.
- Gitin M. Maitra, Hand Book of Mechanical Design, 2nd Edition.
- T.V. Sundarajamoorthy and Shanmugam, Machine Design,

ME503 Computational Methods in Engineering (3-1-0) 4

Introduction to Structure Programming, Object Oriented Programming and Data Structure. Computer Arithmetic: Floating-points and constants, errors and approximation.
Introduction to Linear Algebra: Solutions of systems of linear equations, Gauss elimination method and Gauss-seidel iterative method, determination of Eigen values of matrix, Tri-diagonal matrix method
Numerical solution of Non-linear Equations: Newton-Raphson method, Bisection methods, method of false position.
Interpolation: Interpolation formulas of Newton and Lagrange, Spline interpolation, Interpolation for functions of two or more variables.
Numerical Integration and Differentiation: Numerical integration, Newton-codes, formulas (Trapezoidal), Simpson's rule, Weddle rule, Error estimate, Gaussian integration formulae,
Numerical Solution of Ordinary Differential Equations: Euler's Picard's and Taylors series methods, Runge-Kutta methods, Predictor-correction methods.
Classification and Numerical Solution of Partial Differential Equations: Numerical solutions of Elliptic, parabolic and hyperbolic partial differential equations.
Application of softwares

ME504 System Optimisation and Management (3-1-0) 4

Linear programming: Assignment problem, transportation problem, Modi method, Vogel's approximation method, Simplex technique, Duality
Non-linear programming: Kuhn-Tucker condition, Simulation and Monti-CarloTechnique, generation of random numbers.
Reliability Centred Total Productive Maintenance (TPM): Productivity, losses, measurement of overall performance, Pillars of TPM, autonomous maintenance, continuous improvements (KAIZEN), maintenance prevention, safety and hygiene, preventive maintenance, predictive maintenance and time based maintenance, Why-Why analysis, failure-mode and evaluation of critically analysis.
Value engineering: Type of value, cost vs quality, FAST diagram, phases of VE, application & benefits of VE.

HS5   Technical Communication (3-1-0) 4

Introduction to Effective Technical Communication - Process, Cycle, Levels, Flow, Networks; **Cross-Cultural Communication**; **Non-Verbal Communication**; **Barriers to Communication**; **Effective Listening and Speaking** - Traits of a good listener - Phonetics - Basic Sounds of English – Word Accent – Intonation - Achieving confidence, clarity and fluency

as a speaker - Paralinguistic features; **Effective Presentation Strategies** - Planning, Outlining and Structuring - Choosing the mode of delivery - Guidelines for effective delivery, Body Language and Voice - Visual Aids; **Interviews and Group Discussions**; **Meetings and Conferences**; **Effective Technical writing** – Language – Grammar - Style – Techniques; **Words, Phrases and Sentences, Paragraphs and Essays**; **The Art of Condensation**; **Letters, Resumes, Memos, and Emails**; **Reports and Proposals**; **Research Paper, Dissertation, Thesis** with reference to Style, Presentation, Referencing, Style Manuals- MLA and APA.

ME507 Computer Aided Design   (3-1-0)4

Introduction: CAD/CAM definition, product cycle, Automation Computer Technology: CPU, types of memory, input/output. Sequence control and Programmable controllers: Logic control and sequencing, logic control elements, sequencing of elements, ladder logic diagrams, and programmable logic controllers Programming fundamentals-: Data types, operation Experiments in C++, Central flow, Function, Arrays, Strings, Structure Concept of Inheritance, Polymorphism, operator overloading, etc. Fundamentals of CAD: Introduction, design process, application of computers for design, benefits of computer aided design, some examples. Hardware in Computer Aided Design: Introduction, design work station, graphics terminal, operator input devices, plotters and other output devices, CPU, Secondary storage. Implementing a CAD system: Introduction, Turnkey CAD system, selection criteria, evaluation of alternative systems

Text books:
- Computer Aided Design and Manufacture-State of report, by S.A.R. Scrivener (Editor) from Pergamon Infotech Ltd.
- Mastering CAD/CAM by I. Zeid from Tata McGraw Hill

References:

- Anupam Saxena, and Birendra Sahay, Computer Aided Engineering Design, Anamaya and Springer, 2006.
- Faux I. D. and Pratt M. J., Computational Geometry for Design and Manufacture, Ellis Harwood Limited, West Sussex, England, 1979.
- M. Groover E. Zimmers CAD/CAM: Computer-Aided Design and Manufacturing, Pearson publication, 2006.

ME508 Finite Element Methods   (3-1-0) 4

Introduction to finite element methods, general description, and concept of finite elements, discretization and interpolation function, steps of finite element analysis procedure. Calculus of variation: functions and functional, Euler Langrage equation, boundary conditions, determination of function for plane and axisymmetric elastic problems and heat conduction problems. Finite elements: one, two and three dimensional elements, generalized local, global and natural co-ordinate systems. Isoperimetric, interpolation function, field variable model for displacement and temperature. Direct, variational and Galerkin methods.Equations of single elements and assembly of elements and solutions. Application to plane and axisymmetric elastic problem and heat conduction problems.

Texts book:
- David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill, New Delhi 2010.

References:
- Olek C Zienkiewicz, Robert L Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals: Its Basis and Fundamentals, Mcgraw Hill, 2013.
- Saeed Moaveni, The Finite Element Analysis, 3rd Edition, Pearson, 2013
- T.R. Chandrupatla and A.D. Belegundu, Introduction to Finite Elements in Engineering, Pearson Education Limited, 2014.
- J. N. REDDY, An Introduction to The Finite Element Method, McGraw-Hill Education, 2005.

MFG7112 Product Design and Development (3-1-0) 4

Introduction, development processes and organizations, opportunity identification, product planning, identifying customer needs, product specifications, concept generation, concept selection, concept testing, product architecture, industrial design, design for environment, design for manufacturing, prototyping, robust design, patents and intellectual property, product development economics, managing projects

Text Books:
1. Geoffrey Boothroyd, Assembly Automation and Product Design, Marcel Dekker Inc., NY, 3rd Edition, 2010.
2. Geoffrey Boothroyd, Hand Book of Product Design, Marcel Dekker Inc., NY, 1992.

MEG7231 Engineering Materials (3-1-0) 4

Orientation & Introduction to Engineering materials: Electronic and atomic structure of materials, Introduction and review of simple bonding models, Metallic Crystal Structures, Ceramic crystal structures, others structures, Miller indices, various polymer structures, Imperfections in crystals. Diffusion, Mechanical properties of metals, Mechanical properties of other materials, Deformation & strengthening mechanism, phase diagrams, Phase transformations, Electrical properties of materials, Application of engineering materials.

Text books:

- Structure of materials-An introduction to crystallography, Diffraction & Symmetry, Marc De Groet, Michael Mc Henry (2nd Edition, 2012)Cambridge University Press
- Engineering materials; Properties & Selection, 9th Edition K.G. Budinski, M.K. Budinski, PHI

References:

- Structure & Bonding in Crystalline materials, Gregory S. Rohrer, Cambridge University Press.
- Callisters Materilas Science & Engineering; R. Balasubramanium 2nd Edition, Wiley.
- Materials for high temperature engineering applications, G.W. Meetham, M.H. Vande Voore, Springer.

MEG7222   Mechanism of Robotics   (3-1-0) 4

Introduction, Fundamental of Robot Technology, Analysis and Modeling of Mechanism, Robot Motion Analysis, Kinematics of Manipulator, Robot End Effectors, Differential Motion and Static, Dynamics of Mechanisms, Assembly Tasks, Robot Control, Sensors in Robotics, Robot Programming.

Text books:

- Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.

References:

- Fu, K., Gonzalez, R. and Lee, C. S. G., Robotics: Control, Sensing, Vision and Intelligence¸ McGraw- Hill, 1987

MFG7135CNC Systems   (3-1-0) 4

Introduction, features of NC machine tools, NC part programming, CAM system devices, interpolators for manufacturing systems, control loops of NC systems, computerized numerical control, adaptive control systems, CAD to CAM, CAPP, computer aided production planning & control, computer aided inspection and quality control.

Texts books:

- Mike Mattson, CNC Programming: Principles and Applications, Nelson Education Limited, 2010.
- Boucher, T. O., Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996.

- HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988
- Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, New Delhi, 1994.
- Boltan, W., Mechatronics: electronic control systems in mechanical and electrical engineering, Longman, Singapore, 1999.

References:

MFG7121Manufacturing Planning and Control   (3-1-0) 4

Introduction, operations and manufacturing strategy for competitive advantage, product planning, forecasting, facilities location, process planning and design, layout of facilities,

performance measures and capacity planning, planning and scheduling, material requirements planning and Just-in-time systems, inventory control and manufacturing excellence practices.

Text books:

- Chase R.B. Aquilano N. J. and Jacobs F.R , Production and Operations Management for Competitive advantage , 9th edition, Tata McGraw- Hill Edition, 2001

MFG7111Quality Control, Assurance and Reliability   (3-1-0) 4

Basic concepts of probability and probability distributions, standard probability distribution, sampling and sampling distributions, confidence intervals, testing significance, statistical tolerance, various types of control charts, statistical process control techniques, value analysis, defect diagnosis and prevention, basic concepts of reliability, reliability design evaluation and control, methods of applying total quality management, production process.

Texts/References:

- Statistical Quality Control - A Modern Introduction by Douglas C Montgomery, 7thEdition, John Wiley and Sons, Inc.
- Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M Ross, 3rd edition, Elsevier, Academic Press.

MFG7122Mechatronics and Automation   (3-1-0) 4

Introduction to mechatronics, sensors and transducers, pneumatic and hydraulic actuation systems, mechanical actuation systems, electrical actuation systems, digital logic, microprocessors and programmable logic controllers; Introduction to automation, features of numerical control machine tools, numerical control part programming, control loops for numerical control systems, computerized numerical control, adaptive control systems, industrial robots, automatic identification and data capture, automated production lines and automated assembly systems.Concepts of measurement of electrical and nonelectrical parameters; displacement, force, pressure etc. and related signal conditioning techniques, drives and actuators, concepts of microprocessors/ microcontrollers architecture and programming, memory and I/O interfacing. System design concepts through case studies.

Texts/References:
1. DevdasShetty and Rochand A. Kolk, Mechatronics System Design, PWS Publishing Company, 2000.
2. Michel B. Histand and David G. Alcaiatore, Introduction to Mechatronics and Measuring Systems, Int.Edition, Mc. Graw Hill, 2001.
3. W. Bolton, Mechatronics, Pearson Education, New Delhi, 2002.

MFG7123 Toyota Production Systems (3-1-0) 4

Birth of lean production, lean production system, stability, standardized work, Just-in-time, jidoka, involvement, Hoshin planning, the culture, Toyota Way: world-class power of the Toyota way, business principles of the Toyota way, the right process will produce the right results, add value to the organization by developing your people and partners, continuously solving root problems drives organizational learning, applying the Toyota way in your organization.

Text Books:

1. Principles of Process Planning G. Halevi and R.D. Weill Chapman and Hall

2. Toyota production System-An IntegratedApproach to Just in Time

Yasuhiro Monden CRC Press

Reference Books:

1. Production and Operations Management- S.N. Chary Tata McGraw Hill

2. Operations Management- J.G. Monks McGraw Hill

MFG7124 Manufacturing Systems / CIM (3-1-0) 4

Introduction to Manufacturing Systems, Flexible manufacturing systems, Intelligent manufacturing systems, Lean manufacturing systems, Modeling and analysis of manufacturing systems, Automated Mfg Systems

Text Books/Reference Books:

Mikell P. Grower, Automation, Production Systems and CIM, PHI Pvt. Ltd., 1998
ISBN 3rd Edition

MFG7133 Maintenance Engineering (3-1-0)

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics. Life cycle costs. Markov Models for reliability, Life cycle cost, replacement or repair strategies. Maintainability test Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle – Principles and methods of lubrication TPM. Condition Monitoring Cost comparison with and without CM On-load testing and off-load testing – Methods

MEG7232 Manufacturing Excellence (3-1-0) 4

Introduction, frameworks of manufacturing excellence, practices for manufacturing excellence: leadership and change management, manufacturing strategy, innovative product planning, total

productive maintenance, total quality management, lean manufacturing, customer relations management, green manufacturing, supply chain management, knowledge management and social responsibility.

Texts:
- Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995
- White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979..

References:
- Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 1981
- Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.

List of Electives

Sl. No	Course Code	Name of the Course	L	T	P	C
1	MFG7111	Quality Control, Assurance and Reliability	3	1	0	4
2	MEG7231	Engineering Materials	3	1	0	4
3	MFG7123	Toyota Production Systems	3	1	0	4
4	MFG7135	CNC Systems	3	1	0	4
5	MEG7232	Manufacturing Excellence	3	1	0	4
6	MFG7124	Manufacturing Systems	3	1	0	4
7	MFG7133	Maintenance Engineering	3	1	0	4
8	MMG7211	Material Science and Engineering	3	1	0	4
9	HMG7131	Technical Communication	3	1	0	4

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