MASTER OF ENGINEERING

ENGINEERING DESIGN

CURRICULUM AND SYLLABUS



GOVERNMENTCOLLEGEOFTECHNOLOGY,

 COIMBATORE-641013

***AnAutonomousInstitution-AnnaUniversity***

Curriculum&

Syllabus

**CANDIDATES ADMITTED DURING 2016 - 2017 AND ONWARDS**

MASTER OF ENGINEERING

ENGINEERING DESIGN

CURRICULUM AND SYLLABUS





GOVERNMENTCOLLEGEOFTECHNOLOGY, COIMBATORE-641013

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Curriculum&

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**CANDIDATES ADMITTED DURING 2016 – 2017 AND ONWARDS**

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Candidates

CurriculumforPartTime

Candidates



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SyllabusforCore

Subjects

SyllabusforElective

Subjects

**VISION AND MISSION OF THE INSTITUTION**

**VISION**

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind

**MISSION**

* To achieve Academic excellence through innovative teaching and learning practices.
* To enhance employability and entrepreneurship
* To improve the research competence to address societal needs
* To inculcate a culture that supports and reinforces ethical, professional behaviors for a harmonious and prosperous society

**Vision**

To drive towards a Global knowledge hub, striving continuously in pursuit of excellence in Mechanical Engineering Education, Entrepreneurship and Innovation.

**Mission**

* To impart total quality education through effective hi­tech teaching ­learning techniques and department­ industries collaboration.
* To mold the young dynamic potential minds to emerge as full-­fledged future professionals so as to achieve top ten ranking status in the national level.
* To achieve international standards to fulfill the Government’s "Make in India" industrial policy through innovation and research.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

Enable the students to

1. develop an aptitude to use engineering principles and concepts to create, test and evaluate designs for local and global needs.
2. become effective and excellent need based engineer, participating in efforts to provide solutions to social and technical challenges.
3. develop innovative technologies and find solutions to contemporary issues in Engineering Design using basic principles in combination with latest tools and concepts.
4. pursue advanced research and development and other innovative efforts in their career.

# PROGRAMME OUTCOMES (POs):

On successful completion of the programme the graduates will,

* 1. demonstrate knowledge of mathematics, science and engineering for practical usage.
	2. demonstrate the ability to identify, formulate and solve design problems by critical thinking.
	3. demonstrate an ability to design a system, component or process as per the requirements.
	4. demonstrate ability to develop new systems by using research skills.
	5. demonstrate an ability to design and conduct experiments, analyze and interpret data in the area of design engineering by applying latest techniques.
	6. demonstrate skills to use modern engineering tools, software and equipment to analyze multidisciplinary problems.
	7. develop and implement new projects with basic knowledge in project financing.
	8. demonstrate the ability to communicate their ideas through documentation and oral presentations
	9. develop confidence for self-education and ability for life-long learning and research.
	10. demonstrate knowledge of professional, ethical and social responsibilities in the field of mechanical design.
	11. Demonstrate knowledge on mechanical design and be able to do individual activities by reflective learning

**M.E.DEGREE:FULLTIME&PARTTIME-ENGINEERING DESIGN Page:1**

**CURRICULUM**

MASTEROFENGINEERING

**ENGINEERING DESIGN**

**FULLTIME**

**CURRICULUM**



***(FullTimeCandidatesadmittedduring2016-2017andonwards)***

**FIRSTSEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDFC01 | [APPLIED MATHEMATICS FOR ENGINEERING DESIGN](#APPLIEDMATHEMATICSFORENGINEERINGDESI) | FC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 2. | 16EDFC02 | CONCEPTS OF ENGINEERING DESIGN | FC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | 16EDPC01 | [QUALITY CONCEPTS IN DESIGN](#QUALITYCONCEPTSINDESIGN) | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 4. | 16EDPC02 | [TRIBOLOGY](file:///C%3A%5CUsers%5Cdesign%5CDEPARTMENT%5CSyllabusMFG%5CME%20MANUFACTURING%20CURRICULUM.doc#MF9113) IN DESIGN | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 5. | 16EDPC03 | Finite Element Methods in Mechanical Design | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 6 | 16EDPC04 | COMPOSITE MATERIALS AND MECHANICS | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  |  | **TOTAL** |  |  |  | **600** |  |  |  | **21** |

**SECONDSEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDPC05 | [VIBRATION ANALYSIS AND CONTROL](#FiniteElementMethodsinMechanicalDes)  | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 2. | 16EDPC06 | DESIGN AND SYNTHESIS OF MECHANISMS | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 3. | 16EDPC07 | MECHANICS OF MATERIALS | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 4. | E1 | ELECTIVE 1 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 5. | e2 | ELECTIVE 2 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 6. | e3 | ELECTIVE 3 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| PRACTICAL |
| 7 | 16EDPC08 | ANALYSIS AND SIMULATION LAB | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
|  |  | **Total** |  |  |  | **700** |  |  |  | **23** |

**ENGINEERING DESIGN**

**FULLTIME**

**CURRICULUM**



***(FullTimeCandidatesadmittedduring2016-2017andonwards)***

**THIRDSEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | E4 | elective 4 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | E5 | elective 5 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | E6 | elective 6 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 4. | 16EDEE01 | PROJECT – PHASE I | EEC | 100 | 100 | 200 | 0 | 0 | 12 | 6 |
|  |  | **tOTAL** |  |  |  | **500** |  |  |  | **15** |

**FOURTH SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem** **Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDEE02 | PROJECT- PHASE II | EEC | 200 | 200 | 400 | 0 | 0 | 24 | 12 |
|  |  | **TOTAL** |  |  |  | **400** |  |  |  | **12** |

**LIST OF ONE CREDIT COURSES**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem** **Marks** | **Total****Marks** |  |  |  |  |
|  |  | **L** | **T** | **P** | **C** |
| 1 | 16EDOC01 | TECHNICAL SEMINAR | OC | 100 | - | 100 | 0 | 0 | 2 | 1 |
| 2 | 16EDOC02 | ENTREPRENEURSHIP SKILLS | OC | 100 | - | 100 | 0 | 0 | 2 | 1 |
| 3 | 16EDOC03 | HUMAN VALUES AND PROFESSIONAL ETHICS | OC | 100 | - | 100 | 1 | 0 | 0 | 1 |

**ENGINEERING DESIGN**

**PARTTIME**

**CURRICULUM**



***(PartTimeCandidatesadmittedduring2016-2017andonwards)***

**FIRST SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDFC01 | [APPLIED MATHEMATICS FOR ENGINEERING DESIGN](#APPLIEDMATHEMATICSFORENGINEERINGDESI) | FC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 2. | 16EDFC02 | CONCEPTS OF ENGINEERING DESIGN | FC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | 16EDPC01 | [QUALITY CONCEPTS IN DESIGN](#QUALITYCONCEPTSINDESIGN) | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  |  | **TOTAL** |  |  |  | **300** |  |  |  | **10** |

**SECOND SEMESTER**

**FOURTHS**

**EMEST**

**ER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDPC05 | [VIBRATION ANALYSIS AND CONTROL](#FiniteElementMethodsinMechanicalDes)  | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 2. | 16EDPC06 | DESIGN AND SYNTHESIS OF MECHANISMS | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 3. | 16EDPC07 | MECHANICS OF MATERIALS | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 4. | 16EDPC08 | ANALYSIS AND SIMULATION | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
|  |  | **TOTAL** |  |  |  | **400** |  |  |  | **14** |

**THIRD SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **CourseTitle** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDPC02 | [TRIBOLOGY](file:///C%3A%5CUsers%5Cdesign%5CDEPARTMENT%5CSyllabusMFG%5CME%20MANUFACTURING%20CURRICULUM.doc#MF9113) IN DESIGN | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 2. | 16EDPC03 | Finite Element Methods in Mechanical Design | PC | 50 | 50 | 100 | 3 | 2 | 0 | 4 |
| 3. | 16EDPC04 | COMPOSITE MATERIALS AND MECHANICS | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  |  | **TOTAL** |  |  |  | **300** |  |  |  | **11** |

**ENGINEERING DESIGN**

**PARTTIME**

**CURRICULUM**



***(PartTimeCandidatesadmittedduring2016-2017andonwards)***

**FOURTH SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | E1 |  ELECTIVE 1 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | e2 | ELECTIVE 2 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | e3 | ELECTIVE 3 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  |  | **TOTAL** |  |  |  | **400** |  |  |  | **9** |

**FIFTH SEMESTER**

**FOURTHS**

**EMEST**

**ER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | E4 | ELECTIVE 4 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | E5 | ELECTIVE 5 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | E6 | ELECTIVE 6 | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 4. | 16EDEE01 | PROJECT - PHASE I | EEC | 100 | 100 | 200 | 0 | 0 | 12 | 6 |
|  |  | **TOTAL** |  |  |  | **500** |  |  |  | **15** |

**SIXTH SEMESTER**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem Marks** | **Total****Marks** |  |
| **L** | **T** | **P** | **C** |
| 1. | 16EDEE02 | PROJECT- PHASE II | EEC | 200 | 200 | 400 | 0 | 0 | 24 | 12 |
|  |  | **TOTAL** |  |  |  | **400** |  |  |  | **12** |

**LIST OF ONE CREDIT COURSES**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** | **Category** | **CA****Marks** | **End Sem** **Marks** | **Total****Marks** |  |  |  |  |
|  |  | **L** | **T** | **P** | **C** |
| 1 | 16EDOC01 | TECHNICAL SEMINAR | OC | 100 | - | 100 | 0 | 0 | 2 | 1 |
| 2 | 16EDOC02 | ENTERPRENEURSHIP SKILLS | OC | 100 | - | 100 | 0 | 0 | 2 | 1 |
| 3 | 16EDOC03 | HUMAN VALUES AND PROFESSIONAL ETHICS | OC | 100 | - | 100 | 1 | 0 | 0 | 1 |

**ENGINEERING DESIGN**



***(FullTimeandPartTimeCandidatesadmittedduring2016-2017andonwards)***

**LISTOFELECTIVESUBJECTS**

|  |  |  |
| --- | --- | --- |
| **S. No** | **Subject****Code** | **Course Title** |
|
|  | 16EDPE01 | SYSTEMATIC DESIGN APPROACH |
|  | 16EDPE02 | COMPUTER APPLICATIONS IN DESIGN |
|  | 16EDPE03 | OPTIMIZATION IN DESIGN |
|  | 16EDPE04 | MECHANICAL BEHAVIOUR OF MATERIALS |
|  | 16EDPE05 | PRINCIPLES OF PRODUCT DESIGN |
|  | 16EDPE06 | FLUID POWER CONTROL AND AUTOMATION |
|  | 16EDPE07 | CREATIVITY IN DESIGN |
|  | 16EDPE08 | COMPUTATIONAL FLUID DYNAMICS |
|  | 16EDPE09 | ADDITIVE MANUFACTURING |
|  | 16EDPE10 | CONDITION MONITORING AND VIBRATION CONTROL |
|  | 16EDPE11 | LIFE CYCLE DESIGN |
|  | 16EDPE12 | MECHANICS OF FRACTURE |
|  | 16EDPE13 | WEAR ANALYSIS AND CONTROL |
|  | 16EDPE14 | VALUE AND REENGINEERING |
|  | 16EDPE15 | ADVANCED MACHINE TOOL DESIGN |
|  | 16EDPE16 | MANUFACTURING CONSIDERATIONS IN DESIGN |
|  | 16EDPE17 | SENSORS FOR INTELLIGENT MANUFACTURING |
|  | 16EDPE18 | DESIGN OF MATERIAL HANDLING EQUIPMENTS |
|  | 16EDPE19 | EXPERIMENTAL STRESS ANALYSIS |
|  | 16EDPE20 | VEHICULAR VIBRATION |

L:LectureHours P:PracticalHours

T:TutorialHours C:NumberofCredits

|  |
| --- |
| **16EDFC01 APPLIED MATHEMATICS FOR ENGINEERING DESIGN** |
|  | L | T | P | C |
|  | 3 | 2 | 0 | 4 |
| **COURSE OBJECTIVES:** |
| * *To acquire knowledge of means, variances, correlation and regression related to bivariate probability distributions.*
* *To develop the skill of solving ANOVA based experimental design problems oriented with engineering design and analysis of statistical quality control*
* *To gain the knowledge of solving system of equations numerically.*
* *To attain the fluency to solve ordinary and partial differential equations.*
 |
| **COURSE OUTCOMES:***Upon completion of the course, student will be able to* |
| 1. *Understand the constants of probability for joint probability distributions and analysis and conclusions for design of experiment problems.*
2. *Evaluate control limits using control charts to determine whether the product is within control.*
3. *Understand numerical solution to system of linear equations, first order ordinary differential equations and second order partial differential equations.*
 |
| **TWO DIMENSIONAL RANDOM VARIABLES**  | **(9)** |
| Joint distributions-Marginal and Conditional distributions- Conditional means and variances – Covariance, Correlation and Regression. |
| **DESIGN OF EXPERIMENTS AND STATISTICAL QUALITY CONTROL**  | **(9)** |
| Randomized Block Design- Completely Randomized Block Design-Latin Square Design. Control charts for variables – Control charts for attributes. |
| **NUMERICAL SOLUTION OF EQUATIONS, LINEAR SYSTEM AND INVERSE OF MATRIX**  | **(9)** |
| Newton-Raphson method for single variable and simultaneous equations with two variables- Solution of linear system by Gauss elimination, Gauss-Jordan Crout’s and Gauss Seidal Methods – Matrix inversion: Gauss elimination and Gauss-Jordan methods. |
| **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** | **(9)** |
| Single step methods: Taylor’s series method – Euler’s method – Modified Euler’s method – Runge - Kutta method of fourth order - Multi step methods: Miline’s Predictor and Corrector methods: Adam Bashforth predictor and corrector method. Numerical solution of ordinary differential equation by finite difference method. |
| **NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS** | **(9)** |
| Finite difference solution for two dimensional Laplace equation: Gauss Jacobi and Gauss Seidal methods – Poisson equation. Finite difference method for one dimensional heat equation: Parabolic equation – Hyperbolic Equation. **Lecture: 45 Periods Tutorial:30 Periods Practical:0 Periods Total: 75 Periods** |
| ***References :*** |
| 1. *Veerarajan T, “Probability and Random Processes(with Queueing Theory and Queueing Networks)”, McGraw Hill Education(India)Pvt Ltd., New Delhi, Fourth Edition 2016*
2. *S.C. Gupta and V. K. Kapoor,* ***“Fundamentals of Mathematical Statistics”****, Sultan Chand & Sons, New Delhi – 2014*
3. *P.Kandasamy, K.Thilagavathy, K.Gunavathy,* ***“Numerical Methods”****, S.Chand and Company Ltd.,Ramnagar, New Delhi, 2010.*
4. *S.R.K.Iyengar, R.K.Jain,* ***“Numerical Methods”****, NewAge International Publishers, New Delhi, 2009.*
 |

COURSE ARTICULATION MATRIX

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | \*\*\* | \* | - | - | \* | - | - | - | \* | - | \* |
| CO2 | \*\*\* | \* | \* | \* | \*\* | - | - | - | \* | - | - |
| CO3 | \*\*\* | - | - | - | - | - | - | - | \* | - | - |

|  |
| --- |
| **16EDFC02 CONCEPTS OF ENGINEERING DESIGN** |
|  | L | T | P | C |
|  | 3 | 0 | 0 | 3 |
| **COURSE OBJECTIVE:** |
| *To impart the ability to design reliable products to satisfy the customer needs using appropriate design techniques through proper material selection and process considerations.* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| *CO1: apply appropriate design strategies complying with established standards in devising systems for customer needs**CO2: apply design techniques to solve real life problems through proper material selection and manufacturing process creatively**CO3: apply various design and analysis tools for improving the quality, reliability of products performance* |
| **FUNDAMENTALS IN DESIGN** | **(8)** |
| **I**mportance of design - design process - considerations of Good Design – Morphology of Design –Organization for design – Designing to codes and standards – Concurrent Engineering – Product and process development cycles – Technological Forecasting – Market Identification – Competition Bench marking. |
| **DESIGN FOR CUSTOMER NEEDS** | **(10)** |
| **I**dentification of customer needs - customer requirements - Quality Function Deployment - Product Design Specifications - Human Factors in Design – Ergonomics, Aesthetics and Societal consideration – Product liability – Patenting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Design for ecological - future trends in interaction of engineering with society. |
| **DESIGN TECHNIQUES** | **(10)** |
| Creativity and Problem Solving – Creativity methods-Theory of Inventive Problem Solving (TRIZ) – Conceptual decomposition - Generating design concepts - Axiomatic Design – Evaluation methods-Embodiment Design - Product Architecture - Configuration Design - Parametric Design - Role of models in design - Mathematical Modelling – Simulation – Geometric Modelling  |
| **MATERIAL SELECTION PROCESSING IN DESIGN** | **(9)** |
| Material Selection Process – Economics – Cost Vs Performance – Weighted Property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly – Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure. |
| **PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY** | **(8)** |
| Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance - Robust Design - Failure mode Effect Analysis. **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods** |
| ***References :*** |
| 1. *Dieter, George E., “****Engineering Design - A Materials and Processing Approach****”, McGraw Hill, International Editions, Singapore, 2000.*
2. *Pahl, G, and Beitz, W.,”****Engineering Design****”, Springer – Verlag, NY. 1984.*
3. *Ray, M.S., “****Elements of Engg. Design****”, Prentice Hall Inc. 1985.*
4. *Suh, N.P., “****The principles of Design****”, Oxford University Press, NY.1990.*
5. *5. Karl T. Ulrich and Steven D. Eppinger “****Product Design and Development****” McGraw Hill Edition 2000.*
 |

COURSE ARTICULATION MATRIX

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | \* | \*\*\* | \*\*\* | \*\* | \*\* | \*\*\* | \* | - | \* | \* | \*\* |
| CO2 | \* | \*\*\* | \*\* | \*\*\* | \*\* | \*\* | \* | - | \*\*\* | \* | \*\* |
| CO3 | \* | \*\* | \* | \*\*\* | \*\*\* | \*\*\* | - | - | \* | \* | \* |

|  |
| --- |
| **16EDPC01 QUALITY CONCEPTS IN DESIGN** |
|  | L | T | P | C |
|  | 3 | 0 | 0 | 3 |
| **COURSE OBJECTIVE:** |
| *To expose the students to the principles of design of experiments and advanced quality concepts in design* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *plan and conduct experiments considering customer requirements in design and optimization.*
2. *apply the principles of embodiment for reliable product design.*

*CO3: utilize the concepts of statistics and six sigma for solving engineering problems.* |
| **DESIGN FOR QUALITY** | **(9)** |
| Quality Function Deployment **-**House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating |
| **BASIC METHODS** | **(9)** |
| Refining geometry and layout, general process of product embodiment- Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling-Case study- computer monitor stand for a docking station. |
| **DESIGN OF EXPERIMENTS** | **(9)** |
| Design of experiments-Basic methods- Two factorial experiments-Extended method- reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing-Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method. |
| **STATISTICAL CONSIDERATION AND RELIABILITY** | **(9)** |
| Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts –Matrix plots and 3- D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distributions. |
| **DESIGN FOR SIX SIGMA** | **(9)** |
| Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production –Lean SIX SIGMA and services |
|  **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| *Kevin Otto and Kristin Wood, “Product Design Techniques in Reverse Engineering and New Product Development”, Pearson Education (LPE), 2001.**Logothetis, N. “Managing for total quality from Deming to Taguchi and SPC”, PHI, 1997.*1. *James R. Evens, William M Lindsay “The Management and control of Quality” -6 th edition - Pub:son south-western(www.swlearning.com)*
2. *AmitavaMitra, “Fundamentals of Quality control and improvement” 2nd edition, Pearson Education Asia, 2002.*

*Park S.H.,”Robust design and analysis for quality Engineerin” Chapman and Hall, London, 1996* |

COURSE ARTICULATION MATRIX

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
| CO1 | \* | \*\*\* | \*\*\* | \*\* | \*\* | - | \* | - | \* | - | \* |
| CO2 | \* | \*\* | \*\* | \* | \*\* | \* | - | - | - | - | \* |
| CO3 | \*\* | \* | \* | - | \* | \*\*\* | - | \* | \* | \* | - |

|  |
| --- |
| **16EDPC02 TRIBOLOGY IN DESIGN** |
|  | L | T | P | C |
|  | 3 | 2 | 0 | 4 |
| **COURSE OBJECTIVE:** |
| *To impart knowledge on the theory of friction, wear and lubrication, design of bearings, condition monitoring techniques and seals* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *apply knowledge of friction, wear and lubrication in engineering applications*
2. *design hydrostatic and hydrodynamic bearings for machineries and equipments.*
3. *monitor the conditions of mechanical systems and appreciate the usage of various types of seals*
 |
| **SURFACES, FRICTION AND WEAR** | **(7)** |
| Nature of surfaces and contact, surface topography, friction control and wear prevention, boundary lubrication, tribological properties of bearing materials and lubricants, theories of friction and wear, instabilities and stick-slip motion, sources of measurement of friction. |
| **LUBRICANTS AND LUBRICATION REGIMES** | **(10)** |
| Lubricants and their physical properties - Viscosity and other properties of oils - Additives and selection of Lubricants, Lubricants standards ISO,SAE,AGMA, BIS standards - Lubrication Regimes - Solid Lubrication - Dry and marginally lubricated contacts - Boundary Lubrication - Hydrodynamic lubrication - Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication - Hydro static lubrication - Gas lubrication. |
| **HYDRODYNAMIC BEARINGS** | **(10)** |
| Fundamentals of fluid film formation, Reynold’s equation; hydrodynamic journal bearings - sommerfeld number performance parameters - optimum bearing with maximum load capacity - friction - heat generated and heat dissipated. Hydrodynamic thrust bearings - fixed and tilting pads, single and multiple pads. |
| **HYDROSTATIC BEARINGS** | **(10)** |
| Thrust bearings - pad coefficients - optimum film thickness - journal bearings - design procedures. Aerostatic bearings: thrust bearings and journal bearings - design procedure. Hydrostatic lubrication of pad bearing - Pressure, flow, load and friction calculations - Stiffness considerations - restrictors - types of flow restrictors in hydrostatic bearings, selection of pump, filters, piping design, oil changing and oil conservation. |
| **CONDITION MONITORING AND SEALS** | **(8)** |
| Various condition monitoring techniques of Mechanical Systems. Seals- mechanical seals, lip seals, packed glands, soft piston seals, mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves - selection of mechanical seals. |
| **Lecture: 45 Periods Tutorial:30 Periods Practical:0 Periods Total: 75 Periods*****References :*** |
| 1. *Rabinowicz.E, “****Friction and Wear of materials****”, John Willey &Sons ,UK,1995*
2. *Cameron, A. “****Basic Lubrication Theory****”, Ellis Herward Ltd., UK, 1981*
3. *Halling, J. (Editor) – “****Principles of Tribology****”, Macmillian – 1984.*
4. *Williams J.A. “****Engineering Tribology****”, Oxford Univ. Press, 1994.*
5. *S.K.Basu, S.N.Sengupta&B.B.Ahuja ,”****Fundamentals of Tribology****”, Prentice –Hall of India Pvt Ltd , New Delhi, 2005*
6. *G.W.Stachowiak& A.W .Batchelor ,* ***Engineering Tribology,*** *Butterworth-Heinemann, UK, 2005*
7. *Sushil Kumar Srivastava, “****Tribology in Industries****”, S.Chand& Company Ltd, New Delhi.*
8. *Moore, D.F, “* ***Principles and Application of Tribology****”, Pregamon Press, New York.*
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COURSE ARTICULATION MATRIX

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| **16EDPC03 FINITE ELEMENT METHODS IN MECHANICAL DESIGN** |
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| **COURSE OBJECTIVE:** |
| *To develop a thorough understanding of the basic principles of finite element analysis techniques for solving practical design problems in engineering* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *create mathematical models of physical systems and solve using numerical techniques*
2. *appreciate the usage of the types of elements and apply them suitably for specific applications*
3. *solve structural dynamics and non-linear problems through appropriate techniques*
 |
| **INTRODUCTION & ONE-DIMENSIONAL PROBLEMS** | **(9)** |
| Relevance of finite element analysis in design - Variational principles and methods –Weighted Integral statements – Weak formulations – Ritz method – Method of weighted residuals – Applications of FEA - Finite element modeling – Coordinates and shape functions - Potential energy approach – Galerkin’s approach – One dimensional finite element models in Solid mechanics and Heat transfer – Finite element model for beams. |
| **TWO-DIMENSIONAL PROBLEMS** | **(9)** |
| Poisson equation – Laplace equation – Weak form – Element matrices for triangular and rectangular elements – Evaluation of integrals – Assembly – Axi-symmetric problems – Applications – Conduction and convection heat transfer – Torsional cylindrical member – Transient analysis - Theory of elasticity – Plane strain – Plane stress – Axi-symmetric problems – Principle of virtual displacement. |
| **ISOPARAMETRIC ELEMENTS** | **(9)** |
| Introduction – Bilinear quadrilateral elements – Quadratic quadrilaterals – Hexahedral elements - Numerical integration – Gauss quadrature – Static condensation – Load considerations – Stress calculations – Examples of 2D and 3D applications. |
| **STRUCTURAL DYNAMICS APPLICATIONS** | **(9)** |
| Dynamic equations – Mass and damping matrices – Natural frequencies and modes – Reduction of number of DOFresponse history – Model methods – Ritz vectors – Component mode synthesis – Harmonic response – Direct integration techniques – Explicit and implicit methods. |
| **NON-LINEAR PROBLEMS & ERROR ESTIMATES** | **(9)** |
| Introduction – Material non-linearity – Elasto Plasticity – Plasticity – Visco plasticity – Geometric non-linearity – Large displacement – Error norms and convergence rates – H-refinement with adaptivity – adaptive refinement. |
| **Lecture: 45 Periods Tutorial:30 Periods Practical:0 Periods Total: 75 Periods*****References :*** |
| 1. *Reddy J.N.,* ***“An Introduction to the Finite Element Method”****, McGraw Hill, International Edition, 1993.*
2. *Logan D.L,* ***“A First Course in the Finite Element Method”****, Third Edition, Thomson Learning,*

*2002.*1. *Cook, Robert Davis et al* ***“Concepts and Applications of Finite Element Analysis”****, Wiley, John & Sons, 1999.*
2. *Segerlind L.J.,* ***“Applied Finite Element Analysis”****, John Wiley, 1984.*
3. *S.S.Rao,* ***“Finite Element Analysis”****, 2002 Edition.*
4. *Zienkiewicz, O.C. and Taylor, R.L.,* ***“The Finite Element Method”****, Fourth Edition Vol 1 & 2, McGraw Hill International Edition, Physics Services, 1991.*
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COURSE ARTICULATION MATRIX

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| **16EDPC04 COMPOSITE MATERIALS AND MECHANICS** |
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| **COURSE OBJECTIVE** |
| *To understand the fundamentals of composite material strength and its mechanical behaviour* |
| **COURSE OUTCOMES** |
| *On completion of this course, the students will be able to*1. *appreciate mechanical performance and select suitable composite or smart materials for specific applications*
2. *identify suitable manufacturing methods for composite materials*
3. *design and analyse products made of composite materials for engineering applications*
 |
| **INTRODUCTION** | **(10)** |
| Review of Materials and Metallurgy - Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron. Definition – Need – General Characteristics, Applications of Fibers – Glass, Carbon, Ceramic and Aramid fibers. Characteristics of fibers and matrices. Smart materials – Types and Characteristics,  |
| **MECHANICS AND PERFORMANCE** | **(9)** |
| Characteristics of fiber – reinforced lamina – Laminates – Interlaminar stresses – Static Mechanical Properties – Fatigue and Impact Properties – Environmental effects – Fracture Behavior and damage Tolerance. |
| **MANUFACTURING** | **(9)** |
| Bag Moulding – Compression Moulding – Filament winding – Other Manufacturing Processes – Quality Inspection methods. |
| **ANALYSIS** | **(9)** |
| Stress Analysis of Laminated composites Beams, Plates and Shells – Vibration and Stability Analysis – Reliability of Composites – Finite Element Method of Analysis – Analysis of Sandwich Structures. |
| **DESIGN** | **(8)** |
| Failure Predictions – Laminate Design Consideration – Bolted and Bonded Joints design Examples. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. *Mallick, P.K., Fiber – “Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 1993.*
2. *Halpin, J.C.,* ***“Primer on Composite Materials, Analyis”****, Techomic publishing Co., 1984.*
3. *Agarwal, B.D., and Broutman L.J.,* ***“Analysis and Performance of Fiber Composites”****, John Wiley and Sons, New York, 1990.*
4. *Mallick, P.K. and Newman, S., (edition),* ***“Composite Materials Technology: Processes and Properties”****, Hansen Publisher, Munish, 1990.*

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|  **16EDPC05 VIBRATION ANALYSIS AND CONTROL** |
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| **COURSE OBJECTIVE:** |
| *To gain knowledge on sources of vibration and to reduce vibration to improve the life and performance of components* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *identify the reasons for vibrations in engineering systems*
2. *design and analyse single and multi degree vibratory systems*
3. *apply vibration measuring instruments, vibration control and analysis techniques in the engineering field.*
 |
| **FUNDAMENTALS OF VIBRATION** | **(8)** |
| Differential equation, complex exponential method of solution, energy method, power relations, phase relations, Nyquist diagram– Impulse Response function – System Identification from frequency response – Transient Vibration – Laplace transformation formulation. |
| **SINGLE DEGREE OF FREEDOM SYSTEMS** | **(7)** |
| Simple harmonic motion, definition of terminologies, Newton’s Laws, D’Alembert’s principle, Energy methods. Free vibrations, free damped vibrations, and forced vibrations with and without damping, base excitation.. |
| **MULTI-DEGREES OF FREEDOM SYSTEMS** | **(10)** |
| Two degrees of freedom systems, Static and dynamic couplings, eigen values, eigen vectors and orthogonality conditions of eigen vectors, Vibration absorber, Principal coordinates, Principal modes. Hamilton’s Principle, Lagrangean equation and their applications. |
| **VIBRATION CONTROL** | **(10)** |
| Specification of Vibration Limits –Vibration severity standards- Vibration as condition Monitoring tool-Vibration Isolation methods - Dynamic Vibration Absorber, Torsional and Pendulum Type Absorber- Damped Vibration absorbers-Static and Dynamic Balancing-Balancing machines-Field balancing – Vibration Control by Design Modification- - Active Vibration Control |
| **EXPERIMENTAL METHODS IN VIBRATION ANALYSIS** | **(10)** |
| Vibration Analysis Overview - Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments-. System Identification from Frequency Response -Testing for resonance and mode shapes |
| **Lecture: 45 Periods Tutorial:30 Periods Practical:0 Periods Total: 75 Periods*****References :*** |
| 1. *Timoshenko, S. “****Vibration Problems in Engineering****”, John Wiley & Sons, Inc., 1987.*
2. *Meirovitch, L. “****Elements of Vibration Analysis****”, McGraw-Hill Inc., 1986.*
3. *Thomson W.T, Marie Dillon Dahleh, “****Theory of Vibrations with Applications****”, Prentice Hall, 1997.*
4. *F.S. Tse., I.F. Morse and R.T. Hinkle, “****Mechanical Vibrations****”, Prentice-Hall of India, 1985.*
5. *Rao.J.S. and Gupta.K. “****Theory and Practice of Mechanical Vibrations****”, Wiley Eastern Ltd., New Delhi, 1999.*
6. *Fung, Y.C., “****An Introduction to the Theory of Aeroelasticity****”, John Wiley & Sons Inc., New York, 1985.*

COURSE ARTICULATION MATRIX

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| **16EDPC06 DESIGN AND SYNTHESIS OF MECHANISMS** |
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| **COURSE OBJECTIVE:** |
| *To develop an understanding of the various mechanisms, its design and synthesis for practical applications.* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *design, synthesize and analyze advanced mechanisms for practical applications.*
2. *perform static and dynamic analysis of machines*
3. *devise mechanisms for robotic applications.*
 |
| **VELOCITY AND ACCELERATION ANALYSIS OF MECHANISMS** | **(9)** |
| Review of kinematic analysis-mobility, displacement, velocity and acceleration analysis of mechanisms – Plane Complex mechanisms – Goodman Analysis – Auxiliary point method. |
| **PATH CURVATURE THEORY** | **(9)** |
| Fixed and Moving centrodes, Inflection points and Inflection circle. Euler Savary equation, Graphical constructions – Cubic of stationary curvature. |
| **KINEMATIC SYNTHESIS** | **(9)** |
| Kinematic synthesis - Function generation, path generation and rigid body guidance – Type synthesis, Number Synthesis – Cognate Linkage – Coupler curve synthesis – Algebraic methods – application of instant centre in linkage design. |
| **DYNAMICS OF MACHINES**  | **(9)** |
| Static force analysis with friction – Inertia force analysis – combined static and inertia analysis. |
| **SPATIAL MECHANISM AND ROBOTICS**  | **(9)** |
| Kinematic analysis of spatial RSSR mechanism – Denavit – Hartenberg parameters. Forward and inverse kinematics of robotic manipulators. |
| **Lecture: 45 Periods Tutorial: 30 Periods Practical:0 Periods Total: 75 Periods*****References :*** |
| 1. *George N. Sandor and A.G. Erdman,* ***“Advanced Mechanism Design analysis and Synthesis”****, Vol.1 and 2, Prentice Hall of India, 1984.*
2. *Shigley J.E and Uicker J.J.,* ***“Theory of Machines and Mechanisms”****, McGraw Hill, 1995*
3. *Hall,* ***“Kinematics and Linkage Design”****, Prentice Hall, 1964.*
4. *Robert L. Norton,* ***“Design of Machinery”****, McGraw Hill, 2003*
5. *Hartenberg and Denavit,* ***“Kinematics and synthesis of linkages”****, McGraw Hill, 1964*
6. *J.Hirschhorn,* ***“Kinematics and Dynamics of Plane Mechanisms”****, McGraw Hill, 1962*
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| **16EDPC07 MECHANICS OF MATERIALS** |
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| **COURSE OBJECTIVE:** |
| *To know the fundamentals of mechanics of materials under various loading conditions.* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *appreciate the governing differential equations describing the elastic behavior of three dimensional systems*
2. *determine the stresses in cases of unsymmetrical bending and curved flexible members (or) Formulate analytical techniques in determining the stresses in cases of unsymmetrical bending and curved flexible members*
3. *comprehend the elastic theories in determining the stresses relating to contact bodies, non circular shafts and rotary sections.*
 |
| **ELASTICITY** | **(7)** |
| Stress-Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook’s law - St. Venant’s principle - plane stress-Airy’s stress function. |
| **SHEAR CENTER AND UNSYMMETRICAL BENDING** | **(10)** |
| Location of shear center for various sections - shear flows. Stresses and deflections in beams subjected to unsymmetrical loading-kern of a section. |
| **CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES** | **(12)** |
| Circumference and radial stresses - deflections-curved beam with restrained ends-closed ring subjected to concentrated load and uniform load-chain links and crane hooks. Stresses in circular and rectangular plates due to various types of loading and end conditions, buckling of plates. |
| **TORSION OF NON-CIRCULAR SECTIONS** | **(7)** |
| Torsion of rectangular cross section - S.Venants theory - elastic membrane analogy Prandtl’s stress function torsional stress in hollow thin walled tubes. |
| **STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES** | **(9)** |
| Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness. Methods of computing contact stress-deflection of bodies in point and line contact applications. |
| **Lecture: 45 Periods Tutorial: 30 Periods Practical:0 Periods Total: 75 Periods*****References :*** |
| 1. *Seely and Smith, “****Advanced Mechanics of Materials****”, John Wiley International Edn, 1952.*
2. *Sadhusingh,* ***“Theory of Elasticity”,*** *Khanna Publishers, 2003.*
3. *Timoshenko and Goodier, “****Theory of Elasticity****”, McGraw Hill, 2010*
4. *Wang, “****Applied Elasticity****”, McGraw Hill, 1963*
5. *Cas, “****Strength of Materials****”, Edward Arnold, London 1957.*
6. *Robert D. Cook, Warren C. Young, “****Advanced Mechanics of Materials****”, Mc-millan pub. Co., 1985.*
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| **16EDPC08 ANALYSIS AND SIMULATION LAB** |
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| **COURSE OBJECTIVE:** |
| *To impart practical training on simulation and analysis of mechanical systems using advanced software tools.* |
| **COURSE OUTCOMES:***On completion of this course, students will be able to* |
| 1. *perform static and dynamic analysis of structures.*
2. *perform steady state and transient thermal analysis.*
3. *perform flow simulation analysis of fluid systems.*

Analysis of Mechanical Components – Use of FEA Packages like ANSYS and CFD. Exercises shall include analysis ofi) Machine elements under Static loads ii) Thermal Analysis of mechanical systems iii) Modal Analysis iv) Machine elements under Dynamic loads v) Non-linear systems vi) Fluid flow |

**Lecture: 0 Periods Tutorial:0 Periods Practical: 60 Periods Total: 60 Periods**

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| **16EDEE01 PROJECT- PHASE I** |
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| **OBJECTIVES:** |
| To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature and to develop the methodology to solve the identified problem then publish paper at least in conference. |
| **SYLLABUS:**1. The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest.
2. The student can select any topic which is relevant to the area of Engineering Design. The topic may be theoretical or case studies.
3. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work and report on the preliminary study conducted.
4. The students will be evaluated through a viva-voce examination.

**Lecture: 0 Periods Tutorial: 0 Periods Practical: 180 Periods Total: 180 Periods** |
| **OUTCOME:***On completion of this course, students will be able to***CO1:** Identify the project work scientifically in a systematic way**CO2:** Analyze the problem and data of literatures clearly to explore the ideas and methods.**CO3:** Formulate the objectives and methodology to solve the identified problem. |

COURSE ARTICULATION MATRIX

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| **16EDEE02 PROJECT- PHASE II** |
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| **OBJECTIVES:** |
| To solve the identified problem based on the formulated methodology and to develop skills to analyze and discuss the test results, and make conclusions. |
| **SYLLABUS:**1. The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor.
2. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department.
3. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

**Lecture: 0 Periods Tutorial:0 Periods Practical:360 Periods Total: 360 Periods** |
| **OUTCOME:***On completion of this course, students will be able to* **CO1:** Execute the project work on challenging practical problem in a structured manner**CO2:** Investigate the findings and infer observations logically**CO3**: Evaluate the results and confirm the solution to the practical application and social benefit |

COURSE ARTICULATION MATRIX

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| **16EDPE01 SYSTEMATIC DESIGN APPROACH** |
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| **COURSE OBJECTIVE** |
| To study the systematic design concepts, analysis, synthesis and reliability of real world system. |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| *CO1: Apply concurrent design approach in system design and analyze the system failures.**CO2: Select the suitable materials and manufacturing processes for engineering systems.**CO3: Apply the knowledge of probability distributions and reliability concepts for real world systems.* |
| **SYSTEM CONCEPTS** | **(9)** |
| Concurrent design approach - Life Cycle Design (LCD), Life Cycle Costs (LCC); Introduction to three phases of design - Conceptual, Embodiment and Detailed Design stage; Conceptual Design Stage (CDS) - Feasibility phase of design- Customer requirements / Need analysis, Social status, Market survey, political based; Analysis of Product Concept hunt - actual needs, Problem formulation, Innovation, creativity, Brain storming, Feasibility analysis, physical reliability, Economic viability, Financial and Social acceptability; Evaluation of concepts- decision making methods, Weighted sum method, Fuzzy decision making serviceability, safety, recycling / disposal / reuse.  |
| **SYSTEM ANALYSIS** | **(9)** |
| Reliability Analysis - Failure rate, Reliability of mechanical and Mechatronic systems, Reliability of series and parallel systems, Reliability modelling, Redundancy; , Linear modelling and nonlinear modelling, Reliability of new and old systems, weight and cost at conceptual design stage; Maintainability Analysis - Diagnosability, Identification and Isolation of Faults, Failure cause analysis, (FCA), Fault tree analysis (FTA), Failure mode and effects analysis (FMEA), and Failure mode, effects and criticality analysis (FMECA) through functions. |
| **SYSTEM SYNTHESIS** | **(9)** |
| Synthesizing - use of space, components and assembly packaging, use of tables for determining relationship for synthesis with examples such as hospital rooms; Synthesis of small systems - Heat convector, Washing machine. Detailed design stage - prototyping, Pilot plant level, Documentation, Drawings, Trouble shooting. |
| **MATERIAL SELECTION**  | **(9)** |
| Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure. |
| **PROBABILITY CONCEPTS IN SYSTEM DESIGN** | **(9)** |
| Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability Centered Maintenance - Robust Design - Failure mode Effect Analysis. |
| **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods*****References :*** |
| 1. *Pahl, G. and Beitz,W., “Engineering Design,” Springer Verlag, London, 1984.*
2. *Ullman, D.G., “The Mechanical Design process,” McGraw Hill, N.Y. 1992.*
3. *Suh,N.P., “ The Principles of Design”, Oxford University Press, N.Y.1990.*
4. *Newton, D. and Broomley, R., “Practical Reliability Engineering,” John Wiley & Sons India, 2002.*
5. *Karl T. Ulrich and Steven D. Eppinger “Product Design and Development” McGraw Hill Edition 2000.*
6. *Ray, M.S., “Elements of Engg. Design”, Prentice Hall Inc. 1985.*
7. *Logothetis, N. “Managing for total quality from Deming to Taguchi and SPC”, PHI, 1997.*
8. *Dale H. Besterfield, “Total Quality Management” , Prentice Hall Inc. 2003.*
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COURSE ARTICULATION MATRIX

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| **16EDPE02 COMPUTER APPLICATIONS IN DESIGN** |
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| **COURSE OBJECTIVE** |
| *To impart knowledge on computer graphics which are used commonly in distinct areas such as engineering, medicine and science.* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *use the computer graphics knowledge in design*
2. *appreciate visual realism through modeling techniques*
3. *develop and assemble mechanical systems and document the related information*
 |
| **INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS**  | **(9)** |
| Output primitives (points, lines, curves etc.,), 2-D transformation (Translation, scaling, rotators) windowing, and view ports clipping transformation. |
| **INTRODUCTION TO CAD SOFTWARE** | **(9)** |
| Writing interactive programs to solve design problems and production of drawings, using any languages like Auto LISP/ C/FORTRAN etc. , creation of surfaces, solids etc., using solid modeling pack (prismatic and revolved parts). |
| **VISUAL REALISM** | **(9)** |
| Hidden - Line - Surface - solid removal algorithms shading - coloring. Introduction to parametric and variational geometry based on software’s and their principles creation of prismatic and lofted parts using these packages |
| **ASSEMBLY OF PARTS** | **(9)** |
| Assembly of parts, tolerance analysis mass property calculations, mechanism simulation. |
| **SOLID MODELING** | **(9)** |
| Solid modeling - Rapid prototyping - Data exchange - Documentation - Customizing - solid modeling system. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *William .M. Neumann and Robert .F. Sproul “Principle of Computer Graphics “,McGraw Hill Book Co. Singapore, 1989.*
2. *Donald Hearn and .M. Pauline Baker “Computer Graphics “ Prentice Hall, Inc., 1992.*
3. *Mikell .P. Grooves and Emory .W. Zimmers Jr. “CAD/CAM Computer — Aided Design and Manafacturing” Prentice Hall, Inc., 1995.*
4. *Ibrahim Zeid “CAD/CAM — Thoery and Practice” - McGraw Hill, International Edititon , 1998*
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|  **16EDPE03 OPTIMIZATION IN DESIGN** |
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| **COURSE OBJECTIVE** |
| *To impart knowledge on conventional and non-traditional optimization techniques and methods for designing static and dynamic systems* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *solve engineering problems through constrained and unconstrained optimization techniques*
2. *identify and apply suitable advanced optimization techniques for solving combinatorial engineering problems*
3. *make optimized design of static and dynamic systems*
 |
| **UNCONSTRAINED OPTIMIZATION TECHNIQUES** | **(9)** |
| Introduction to optimum design - General principles of optimization – Problem formulation and their classifications Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods. |
| **CONSTRAINED OPTIMIZATION TECHNIQUES**  | **(9)** |
| Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming |
| **ADVANCED OPTIMIZATION TECHNIQUES** | **(9)** |
| Multi stage optimization – dynamic programming; stochastic programming; Multi-objective optimization, Genetic algorithms, Simulated Annealing algorithm andparticleswarmoptimization algorithm; Neural network principles in optimization. |
| **STATIC APPLICATIONS** | **(9)** |
| Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs |
| **DYNAMIC APPLICATIONS** | **(9)** |
| Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2000.*
2. *Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 1990.*

Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 1995.Goldberg, D.E., “Genetic algorithms in search, optimization and machine”, Barnen, Addison Wesley, New York, 1989.Chan and Tiwari,”Swarm Intelligence – Focus on Ant and Particle Swarm Optimization”, Wiley, John & Sons, 2003.COURSE ARTICULATION MATRIX

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| **16EDPE04 MECHANICAL BEHAVIOUR OF MATERIALS** |
|  | L | T | P | C |
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| **COURSE OBJECTIVE** |
| *To impart knowledge on the mechanical behaviour of metallic and non-metallic materials under different loading and temperature conditions, and the strengthening mechanisms of materials* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *appreciate the behaviour of materials and to select the materials for engineering application*
2. *design engineering systems under static and dynamic loading conditions*
3. *predict hardness of materials under different environments so as to avoid critical failures*
 |
| **PLASTIC DEFORMATION OF MATERIALS** | **(9)** |
| Concepts of crystals, Plastic deformation by slip and twinning, Slip systems in FCC, BCC and HCP lattices, Critical resolved shear stress for slip, Theoretical shear strength of solids, Stacking faults and deformation bands. Observation of dislocations, Climb and cross slip, Dislocations in FCC and HCP lattice, Partial dislocations, Stress fields and energies of dislocations, Forces between dislocations, Interaction of dislocations, Dislocation sources and their multiplications. |
| **STRENGTHENING MECHANISM AND FRACTURE IN MATERIAL** | **(9)** |
| Strengthening from grain boundaries, Grain size measurements, Yield point phenomenon, Strain aging, Solid solution strengthening, Strengthening from fine particles, Fiber strengthening, Cold working and strain hardening, Annealing of cold worked metal. Fracture in metals, Griffith theory of brittle fracture, Metallographic aspects of fracture, Fractography, Dislocation theories of brittle fracture, Ductile fracture, Notch effects, Strain energy release rate in fracture, Fracture toughness and design. |
| **BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES** | **(9)** |
| Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stresslife,strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis. |
| **CREEP AND SELECTION OF MATERIALS** | **(9)** |
|  Creep and stress rupture, Creep curve, Stress rupture test, Mechanism of creep deformation, Activation energy for steady state creep, Super plasticity, Fracture at elevated temperature, Creep resistant alloys, Creep under combined stresses. Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing |
| **BEHAVIOR OF MATERIALS UNDER TENSION AND HARDNESS**  | **(9)** |
| Tension test, Stress-strain curves, Instability in tension, Ductility measurement, Effect of strain rate, temperature and testing machine on flow properties, Stress relaxation testing, Notch tensile test, Anisotropy of tensile properties. Hardness test, Brinnel, Rockwell and Vickers hardness, flow of metal under the indenter, relationship between hardness and flow curve, micro hardness testing, Hardness at elevated temperatures. |
| **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods*****References :*** |
| 1. *George E.Dieter,” Mechanical Metallurgy”, McGraw Hill, 2001*
2. *Thomas H. Courtney,” Mechanical Behavior of Materials”, (2nd edition), McGraw Hill,2000*
3. *Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., “Selection and use of engineering materials”, (34d edition), Butterworth-Heiremann, 1997.*
4. “*Deformation and fracture mechanics”, Richard W Hertzberg John Wiley & Sons*
5. *“Mechanical behaviour of Materials”, Frank A Mcclinock and Ali S Argon*
6. *“Physical Metallurgy Principles”, Reed Hill and Robert E, East West Press*
7. *“Structure and properties of Materials”, Hyden W. M. Vol. 3, McGraw Hill*

*8. ” Plastic deformation of Metals” ,Honeycombe, Arnold Press.* |

COURSE ARTICULATION MATRIX

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| **16EDPE05 PRINCIPLES OF PRODUCT DESIGN** |
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| **COURSE OBJECTIVE** |
| *To impart the concepts in product design, development and prototyping techniques* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *apply the concept of collaborative product design and development in engineering*
2. *develop products according to the customer requirements*
3. *design different experimentation and prototyping techniques*
 |
| **BASIC CONCEPTS** | **(7)** |
| Product lifecycle management-concepts, benefits, value addition to customer. Lifecycle models- creation of projects and roles, users and project management, system administration, access control and its use in life cycle. Product development process and functions. |
| **COLLABORATIVE PRODUCT DESIGN** | **(8)** |
| Data transfer - Variants of e-commerce - Multisystem information sharing. Workgroup collaboration - Development of standard classification for components and suppliers. Model assembly process - link product and operational information. Customization factors - creation of business objects, user interfaces, search facile ties as designed by the enterprise. |
| **PRODUCT DEVELOPMENT** | **(10)** |
| Quality function deployment - quality project approach and the problem solving process. Design creativity-innovations in design alternatives. Industrial design principles. Product development versus design, types of design and redesign, modern production development process, reverse engineering and redesign product development process, examples of product development process, scoping product development – S-curve, new product development.  |
| **PRODUCT TEAR DOWN AND EXPERIMENTATION** | **(10)** |
| Gathering customer needs, organizing and prioritizing customer needs, establishing product function, FAST method, establishing system functionality. Tear down method, post teardown report, benchmarking and establishing engineering specifications, product portfolios. |
| **GENERATING CONCEPTS AND PHYSICAL PROTOTYPES**  | **(10)** |
| Information gathering, brain ball, C-sketch/6-3-5 method, morphological analysis, concept selection, technical feasibility, ranking, measurement theory, DFMA, design for robustness. Types of prototypes, use of prototypes, rapid prototyping technique scale, dimensional analysis and similitude, physical model and experimentation-design of experiments, statistical analysis of experiments. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| *1. John W Gosnay and Christine M Mears, “Business Intelligence with Cold Fusion”, Prentice Hall India, New Delhi, 2000.**2. David S Linthicum, “B2B Application Integration”, Addison Wesley, Boston, 2001.**3. Alexis Leon, “Enterprise Resource Planning”, Tata McGraw Hill, New Delhi, 2002.**4. David Ferry and Larry Whipple, “Building and Intelligent e-business”, Prima Publishing, EEE Edition, California, 2000.**5. David Bedworth, Mark Hederson and Phillip Wolfe, “Computer Integrated Design and Manufacturing” McGraw Hill Inc., New York, 1991.**6. Kevin Otto and Kristin Wood, “Product Design – Techniques in Reverse Engineering and New Product Development”, Pearson Education, New Delhi, 2004.**7. Karl T Ulrich and Stephen D Eppinger, “Product Design and Development”, McGraw Hill, New York, 1994.* |

COURSE ARTICULATION MATRIX

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| **16EDPE06 FLUID POWER CONTROL AND AUTOMATION** |
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| **COURSE OBJECTIVE** |
| *To impart knowledge on the basics and application of hydraulics and pneumatics to develop low cost automation systems* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *select appropriate hydraulic and pneumatic control elements for specific industrial requirements*
2. *develop hydraulic systems/ circuits to execute specific tasks*
3. *develop logical and sequential pneumatic circuits for low power applications*
 |
| **OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS** | **(8)** |
| Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics. |
| **CONTROL AND REGULATION ELEMENTS** | **(8)** |
| Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems. |
| **HYDRAULIC CIRCUITS** | **(10)** |
| Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits- hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components. |
| **PNEUMATIC SYSTEMS AND CIRCUITS** | **(10)** |
| Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design. |
| **INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS**  | **(9)** |
| Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation -Robotic circuits. Software for pneumatic / hydraulic systems simulation. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Antony Espossito, “Fluid Power with Applications”, Prentice Hall, 1980.*
2. *Dudleyt, A. Pease and John J. Pippenger, “Basic fluid power”, Prentice Hall, 1987.*
3. *Michael J., Pinches and John G.Ashby, “Power Hydraulics”, Prentice Hall, 1989.*
4. *Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.*
5. *Joji P., “Pneumatic Controls”, Wiley India Pvt. Ltd., New Delhi, 2008.*
6. *Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.*
7. *http:// www.pneumatics .com*
8. *http:// www.fluidpower.com.tw*

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|   **16EDPE07 CREATIVITY IN DESIGN** |
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| **COURSE OBJECTIVE** |
|  *To expose the students to practice different levels of design, thinking, visualization, creativity and innovation.* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *apply the concepts of different levels of design and creative thinking for solving real life problems.*
2. *utilize the principles of spatial relationships, animation aerodynamics and data management in design.*
3. *obtain solutions for engineering problems by applying different methods of creativity and innovation models.*
 |
| **BASICS OF DESIGN** | **(8)** |
| Process Design, Emotional Design – Three levels of Design – Viceral, Behavioral and Reflective. Recycling and availabilityCreativity and customer needs analysis. Innovative product and service designs, future directions in this application of creativity thinking in quality management.Need for design creativity – creative thinking for quality – essential theory about directed creativity. |
| **THINKING** | **(6)** |
| Definitions and theory of mechanisms of mind heuristics and models: attitudes, Approaches and Actions that support creative thinking - Advanced study of visual elements and principles like line, plane, shape, form, pattern, texture gradation, color symmetry. |
| **VISUALIZATION OF MECHANISM** | **(7)** |
| Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Unifying principle of data management for scientific visualization - Visualization benchmarking |
| **CREATIVITY** | **(12)** |
| Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – stimulation of new ideas – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and the rewards of innovativeness – Applying Directed Creativity to the challenge of quality management |
| **INNOVATION**  | **(12)** |
| Achieving Creativity – Introduction to TRIZ methodology of Inventive Problem Solving - the essential factors – Innovator’s solution – creating and sustaining successful growth – Disruptive Innovation model – Segmentive Models – New market disruption - Commoditation and DE-commoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Rousing Creativity: Think New, NowFloydHurr, ISBN 1560525479, Crisp Publications Inc. 1999*
2. *Geoffrey Petty,” How to be better at Creativity”, The Industrial Society 1999*
3. *Donald A. Norman,” Emotional Design”, Perseus Books Group New York , 2004*
4. *Clayton M. Christensen Michael E. Raynor,” The Innovator’s Solution”, Harvard Business School Press Boston, USA, 2003*
5. *Semyon D. Savransky,” Engineering of Creativity – TRIZ”, CRC Press New York USA,” 2000*
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| **16EDPE08 COMPUTATIONAL FLUID DYNAMICS** |
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| **COURSE OBJECTIVE** |
| *To expose the students to the concepts of Computational Fluid Dynamics and application of fluid flow algorithms* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to*1. *select and apply appropriate discretization methods for flow simulation*
2. *appreciate and apply stability criteria for convection-diffusion problems*
3. *apply advanced algorithms for solving fluid flow problems*
 |
| **INTRODUCTION** | **(9)** |
| 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. |
| **BASIC EQUATIONS OF FLUID DYNAMICS** | **(9)** |
| Potential flow, Nonlinear Potential flow, In-viscid flows and viscous flows.Navier-Stokes Equations. Primitive variable and conservation form. Dimensional form andNondimensional form. |
| **NUMERICAL METHODS FOR CONVECTION-DIFFUSION** | **(9)** |
| Up winding and central difference schemes.Stability condition in terms of Courant number. |
| **NUMERICAL METHODS FOR INVISCID FLOWS** | **(9)** |
| Characteristic form of equations. Flux difference splitting. Application to 2-D flows such as flow through a nozzle. |
| **TWO DIMENSIONAL RANDOM VARIABLES** | **(9)** |
| The continuity equation divergence constraint.Poisson eqn. for pressure.Schemes such as SIMPLE due to Patankar and Spalding. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 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 Fluid 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.*
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| **16EDPE09ADDITIVE MANUFACTURING** |
|  | L | T | P | C |
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| **COURSE OBJECTIVE** |
| *To understand the concepts of rapid product development, apply acquired knowledge to meet global challenges in changing design in time compressed mode* |
| **COURSE OUTCOMES** |
| *At the end of the course the learner should be able to* *CO1. Apply the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development.**CO2. Apply the rapid tooling and software for rapid manufacturing to meet international needs* *CO3. Select appropriate process for production of a part/component that meet international standards of quality.* |
| **INTRODUCTION** | **(7)** |
| Need for the compression in product development, History of RP systems, Digital prototyping – Virtual prototyping. Survey of applications, Growth of RP industry, Principle of RP technologies and their classification of RP systems. |
| **LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS** | **(10)** |
| Stereo lithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations - Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications - Case studies. |
| **POWDER BASED RAPID PROTOTYPING SYSTEMS** | **(10)** |
| Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, LaserEngineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes,materials, products, advantages, applications and limitations – Case Studies |
| **RAPID TOOLING**  | **(9)** |
| Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metaltooling, etc. Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, ProMetal, Sand casting tooling, Laminate tooling, soft tooling vs hard tooling |
| **SOFTWARE FOR RAPID PROTOTYPING** | **(9)** |
| STL files, Overview of Solid view, Magics, mimics, magics communicator, etc. Internet based softwares, Collaboration tools. RAPID MANUFACTURING PROCESS OPTIMIZATION -Factors influencing accuracy, Data preparation errors, Part building errors, Errors infinishing, Influence of part build orientation. ALLIED PROCESSES - Vacuum Casting,Surface Digitizing, Surface Generation from point cloud, Surface modification, data transfer to solid models. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *C K Chua, K F Leong, C S Lim,* ***Rapid Prototyping Principles and Applications,*** *World Scientific, New Delhi, 2010.*
2. *Frank W.Liou,* ***Rapid Prototyping and Engineering Applications****, CRC Press, UK, 2011.*
3. *Terry wohlers,* ***“Wohlers Report 2000”****, Wohlers Associates, USA, 2000.*
4. *Chua Chee Kai and Leong Kah Fai, 1997,* ***“Rapid Prototyping: Principles and Applications in Manufacturing”*** *,John Wiley & Sons*
5. *Paul F. Jacobs, 1996,* ***“Stereo-lithography and Other RP & M Technologies: from Rapid Prototyping to Rapid Tooling”****, SME/ASME*
6. *D. Faux and M. J. Pratt, 1979,* ***“Computational Geometry for design and manufacture”****, John Wiley & Son**s*
7. *Pham, D.T. &Dimov.S.S.,* ***“Rapid manufacturing”****, Springer-Verlag, London, 2001.*
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| **16EDPE10 CONDITION MONITORING AND VIBRATION CONTROL** |
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| **COURSE OBJECTIVE** |
| *To impart knowledge in vibration control and use condition monitoring techniques for machineries* |
| **COURSE OUTCOMES** |
| *On completion of this course, the students will be able to* 1. *obtain vibration characteristics of mechanical systems*
2. *control vibration using active and passive control techniques*
3. *design and develop dynamically balanced systems with condition monitoring setup*
 |
| **INTRODUCTION** | **(11)** |
| Review of fundamentals of single degree freedom systems – Two degree freedom systems, Multi Degree Freedom systems, Continuous systems, Determination of Natural frequencies and mode shapes, Numerical methods in vibration Analysis. |
| **VIBRATION CONTROL** | **(12)** |
| Introduction – Reduction of vibration at the source – control of vibration – by structural design – Material selection – Localized additions – Artificial damping – Resilient isolation, Vibration isolation, Vibration absorbers. |
| **ACTIVE VIBRATION CONTROL** | **(6)** |
| Introductions – Concepts and applications, Review of smart materials – Types and characteristic review of smart structures – Characteristic Active vibration control in smart structures |
| **CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS** | **(10)** |
| Introduction – condition monitoring methods – The design of Information system, Selecting method of monitoring, Machine condition monitoring and diagnosis – Vibration severity criteria – Machine Maintenance Techniques – Machine condition monitoring techniques – Vibration monitoring techniques – Instrumentation systems – choice of monitoring parameter. |
| **DYNAMIC BALANCING AND ALLIGNMENT OF MACHINERY** | **(6)** |
| Introduction, Dynamic balancing of Rotors, Field Balancing in one plane, Two planes and in several planes, Machinery alignment, Rough alignment methods, The face peripheral dial indicator method, Reverse indicator method, shaft-tocoupling spool method. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Timoshenko, S. “****Vibration Problems in Engineering****”, John Wiley & Sons, Inc., 1987.*
2. *Meirovitch, L. “****Elements of Vibration Analysis****”, McGraw-Hill Inc., 1986.*
3. *Thomson W.T, Marie Dillon Dahleh, “****Theory of Vibrations with Applications****”, Prentice Hall, 1997.*
4. *F.S. Tse., I.F. Morse and R.T. Hinkle, “****Mechanical Vibrations****”, Prentice-Hall of India, 1985.*
5. *Rao.J.S. and Gupta.K. “****Theory and Practice of Mechanical Vibrations****”, Wiley Eastern Ltd., New Delhi, 1999.*
6. *Fung, Y.C., “****An Introduction to the Theory of Aeroelasticity****”, John Wiley & Sons Inc., New York, 1985.*
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COURSE ARTICULATION MATRIX

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| **16EDPE11 LIFE CYCLE DESIGN** |
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| **COURSE OBJECTIVE** |
| *To understand the concepts of Product Data Management and Life Cycle Management and make suitable design modifications*  |
| **COURSE OUTCOMES** |
| *On completion of this course, the students will be able to*1. *analyze and apply the concept of product- life cycle management and PDM*
2. *manage data related to generic products and variants*
3. *investigate the changes in market needs and suitably make the life cycle design of the product*
 |
| **INTRODUCTION** | **(8)** |
| Introduction to PDM-present market constraints-need for collaboration - internet anddevelopments in server-client computing.Base lines-product structure-configuration management-case studies. |
| **COMPONENTS OF PDM** | **(9)** |
| Components of a typical PDM setup-hardware and software-documentmanagement-creation and viewing of documentscreating parts-versions and versioncontrol of parts and documents-case studies |
| **PROJECTS AND ROLES** | **(12)** |
| Creation of projects and roles-life cycle of a product- life cycle management automating information flow-work flows creation of work flow templates-life cycle workflow integration-case studies. |
| **CHANGE MANAGEMENT** | **(6)** |
| Change issue- change request- change investigation- change proposal – change activity - case studies. |
| **GENERIC PRODUCTS AND VARIANTS** | **(10)** |
| Data Management Systems for FEA data - Product configurator – comparison between sales configuration and product configurator-generic product modeling inconfiguration modeller - use of order generator for variant creation-registering of variants in product register-case studies. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *1. David Bed worth. Mark Henderson & Phillip Wolfe.* ***“Computer Integrated Design and Manufacturing “****. McGraw Hill Inc...1991.*
2. *2. Terry Quatrain.* ***“Visual Modeling with Rational Rose and UML”****. Addison Wesley...1998.*
3. *3. Kevin Otto, Kristin Wood,* ***“Product Design”****, Pearson, 2001.*
4. *4. Daniel Amor,* ***“The E-Business Revolution”****, Prentice-Hall, 2000.*
5. *Wind-Chill R5.0 Reference Manuals...2000.*

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| **16EDPE12 MECHANICS OF FRACTURE** |
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| **COURSE OBJECTIVE** |
| *The course will treat linear and nonlinear fracture mechanics principles and their applications to structural design. Fracture phenomena in metals and non-metals will be discussed and testing methods will be highlighted.*  |
| **COURSE OUTCOMES** |
| *On completion of this course, the student will be able to,*1. *appreciate the principles of solid mechanics and analyze material behavior*
2. *estimate failure conditions and determine the life of structures*
3. *Identify fracture and fatigue nature of materials*
 |
| **ELEMENTS OF SOLID MECHANICS** | **(5)** |
| The geometry of stress and strain, elastic deformation, plastic and elastic-plastic deformation – limit analysis. |
| **STATIONARY CRACK UNDER STATIC LOADING**  | **(10)** |
| Two dimensional elastic zone fields – Analytical solutions yielding near a crack front – Irwin’s approximation – Plastic zone size – Dugdaale model – J integral and its relation to crack opening development. |
| **ENERGY BALANCE AND CRACK GROWTH**  | **(8)** |
| Griffith analysis – Linear fracture mechanics – Crack opening displacement – Dynamic energy balance – Crack arrest. |
| **FATIGUE CRACK GROWTH CURVE** | **(10)** |
| Empirical Relation describing crack growth by fatigue – life calculations for a given load amplitude – effects of changing the load spectrum – Effects of Environment. |
| **ELEMENTS OF APPLIED FRACTURE MECHANICS**  | **(12)** |
| Examples of crack- growth Analysis for cyclic loading – leak before break – crack Initiation under large scale yielding – Thickness as a Design parameter – crack instability in Thermal or Residual – Stress fields. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. *David Broek,* ***“Elementary Engineering Fracture Mechanics”****, Fifthoff and Noerdhoff International Publisher, 1978.*
2. *KAreHellan,* ***“Introduction of Fracture Mechanics”****, McGraw-Hill Book Company, 1985.*
3. *Preshant Kumar,* ***“Elements of Fracture Mechanics”****, Wheeler Publishing, 1999.*

***Web References :***[www.elsevier.com/locate/engfracmech](http://www.elsevier.com/locate/engfracmech)COURSE ARTICULATION MATRIX

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| **16EDPE13 WEAR ANALYSIS AND CONTROL** |
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| **COURSE OBJECTIVE** |
| *To know the fundamentals of mechanism, prediction and control of wear under different working conditions* |
| **COURSE OUTCOMES** |
| *On completion of this course, the student will be able to*1. *appreciate wear behavior of materials under different environment*
2. *diagnose and control wear in metallic parts*
3. *assess wear in different mechanical components*
 |
| **INTRODUCTION TO WEAR** | **(8)** |
| Types of wear, Adhesive wear, two-body and three-body abrasive wear, erosive wear, cavitation wear, wear due to surface fatigue – chemical reaction. |
| **SURFACE ROUGHNESS AND WEAR MEASUREMENTS** | **(10)** |
| Tribo systems and tribo-elements, Measurement of Surface roughness Re, Rz, Experimentalstudies on friction on various tribo systems using pin-on-ring (POR) and pin-on-disc (POD)machines. Sample preparation, wear measurement of various tribo-elements, using POR andPODmachines.Calculation of wear volume and wear coefficient, comparison with existing data. |
| **WEAR IN LUBRICATED CONTACTS** | **(9)** |
| Rheological lubrication regime, Functional lubrication regime, Fractional film defect,Load sharing in lubricated contacts, Adhesive wear equation, Fatigue wear equation, Numerical example. |
| **DIAGNOSIS AND CONTROL OF WEAR** | **(9)** |
| Diagnosis of wear mechanisms using optical microscopy and scanning electron microscopy,Wear resistant materials, wear resistant coatings, eco-friendly coatings designing for wear, systematic wear analysis, wear coefficients, filtration for wear control. |
| **WEAR IN MECHANICAL COMPONENTS** | **(9)** |
| Component wear, bushings, lubricated piston rings and cylinder bore wear, dry piston rings,rolling bearings, seal wear, gear wear, gear couplings, wear of brake materials, wear of cutting tools, chain wear. |

**Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods**

***References :***

*1. Czichos, H.,* ***“Tribology:A system approach to the science & technology of friction,lubrication and wear”,*** *Series 1, Elsevier Publications,1982.*

*2. Glaeser,W. A.,* ***“Tribology series – Vol. 20,”*** *Elsevier Publications,1992.*

*3. Neale, M.J.,* ***“The Tribology Hand Book,”*** *Butterworth Heinemann, London, 1995.*

*4. Peterson, M. B., Winer, W.O.,* ***“Wear Control Handbook,”*** *ASME, NY. 1980.*

*5. Stolarski.T.A.* ***“Tribology in Machine Design”****Buttorworth Heinemann, Oxford, 2000.*

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| **16EDPE14 VALUE AND REENGINEERING** |
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| **COURSE OBJECTIVE** |
| *To impart knowledge about the principles of value and reengineering for industrial applications* |
| **COURSE OUTCOMES** |
| *On completion of this course, the students will be able to*1. *apply the principles and techniques of value engineering to enhance productivity*
2. *evaluate the ideas for better function analysis and for effective decision making*
3. *Apply reengineering for process improvement*
 |
| **FUNDAMENTALS OF VALUE ENGINEERING**  | **(8)** |
| Value- Types – Organizing the value engineering study- Value Engineering concepts, Advantages, Applications, Problem recognition, and role in productivity criteria for comparison, element of choice. |
| **VALUE ENGINEERING TECHNIQUES** | **(10)** |
| Selecting products and operation for VE action, VE programmes, determining and evaluating functions assigning rupee equivalents - developing alternate means to required functions - decision making for optimum alternative - Use of decision matrix - Queuing theory and Monte Carlo method, make or buy, Measuring profits - Reporting results - Follow up, Use of advanced technique like FAST (Function Analysis System) Tech. |
| **ORGANISATION AND ANALYSIS OF FUNCTION**  | **(9)** |
| Level of VE in the organization- Size and skill of VE staff-small plant VE activity - Unique and quantitative evaluation of ideas-Anatomy of the function, Use esteem and exchange values- Basic Vs secondary Vs. unnecessary functions. |
| **REENGINEERING PRINCIPLES** | **(9)** |
| The 6 R’s of organizational transformation and reengineering – process reengineering - preparing the workforce – Methodology – PMI leadership expectation – Production and service improvement model – Process improvement |
| **IMPLEMENTATION OF REENGINEERING** | **(9)** |
| Process analysis techniques – Work flow analysis – Value analysis approach – Nominal group technique – Fish bone diagram – Pareto analysis – team building – Force fields analysis – Implementation. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. *S.S.Iyer,* ***“Value Engineering”****, New Age Information, 1996.*
2. *Del L. Younker,* ***“Value Engineering”*** *Marcel Dekker, Inc. 2003*
3. *M.S.Jayaraman and Ganesh Natarajan,* ***“Business Process Reengineering”****, Tata McGraw*

*Hill, 1994.*1. *Dr.Johnson, A.Edosomwan,* ***“Organizational Transformation and Process reengineering”,*** *British Library Cataloguing in publication data, 1996*

*5. Miles, “Techniques of Value Analysis and Engineering”,Tata McGraw Hill Publications* |

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| **16EDPE15 ADVANCED MACHINE TOOL DESIGN** |
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| **COURSE OBJECTIVE** |
| *Expose students to the art of designing machine tools with control over vibration and meeting technical standards* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to* |
| 1. *Evaluate force distribution and deflection in different parts of machine tools.*
2. *Design machine tool structures and allied components meeting technical standards.*

*CO3: Use appropriate methods for vibration measurement and its control.* |
| **STATIC AND DYNAMIC STIFFNESS, FORCE ANALYSIS** | **(9)** |
| Static stiffness and compliance- deformation caused by weight, Forces- deformation caused by cutting forces - forced vibrations, self-excited vibrations, Force distribution in different parts of Lathe, Drilling machine, Milling machine. |
| **DESIGN OF STRUCTURES** | **(9)** |
| Beds, columns and housing for maximum strength and rigidity – cast and welded construction – CNC machine tools structure – main drive and feed drive- ball screws- automatic tool changers- chip conveyors- tool magazines- tool turrets. |
| **DESIGN OF SLIDE WAYS** | **(9)** |
| Selection of materials- integrated and attached ways- hydro-static guide ways,aero-static guide ways- antifriction guide ways- design of friction guide ways- plastic inserted guide ways and LM guide ways. |
| **DESIGN OF MACHINE TOOL SPINDLES AND DRIVES**  | **(9)** |
| Design requirements – standards – selection of spindle bearings- materials for spindles- typical spindle design - design consideration of Electrical, Mechanical and Hydraulic drives in machine tools. |
| **MACHINE TOOL CHATTER** | **(9)** |
| The Dynamics of cutting process - physical causes of chatter- theory of machine tool chatter- chatter in different types of machine tools- milling machines, lathes and grinding machines - the theory of chatter with several degree of freedom - chatter suppression. Design of control mechanisms – selection of standard components - dynamic measurement of forces and vibrations in machine tools - use of vibration dampers |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Mehta. N.K,* ***“Machine Tool Design”*** *Tata McGraw Hill, 1989*
2. Koenisberger.F. “Design principles of Metal cutting Machine Tools”.Pergamon press, 1964.
3. *Acherkan.N.,****”Machine Tool Design”****. Vol. 3 & 4, MIR Publishers, Moscow, 1968.*
4. *Sen.G. and Bhattacharya.A.,****”Principles of Machine Tools”****. Vol.2, NCB. Calcutta, 1973.*
5. *Tobias.S.A.,****”Machine tool Vibration”*** *Blackie and Son Limited, London,1965.*

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| **16EDPE16 MANUFACTURING CONSIDERATIONS IN DESIGN** |

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| **COURSE OBJECTIVE** |
| *To expose the students on manufacturing considerations in design and to create an environment friendly perspective for energy efficiency focusing towards global need.*  |
| **COURSE OUTCOMES** |
| *On completion of this course, the student will be able to*1. *formulate design features in manufacturing arena and smart development in manufacturability.*
2. *develop new concepts and methods for re-design of castings and machining focusing towards energy efficiency.*
3. *develop environment friendly designs to meet the global issues.*
 |
| **INTRODUCTION** | **(9)** |
| General design principles for manufacturability –Factors influencing design-Types of problems to be solved-, evaluation of customer’s requirements-Systematic working plan for the designer-Types of problems to be solved-Possible solutionsEvaluation method- Process capability - Feature tolerances -Geometric tolerances - Assembly limits -Datum features Tolerance stacks-Interchangeable part manufacture and selective assembly. |
| **FACTORS INFLUENCING FORM DESIGN** | **(9)** |
| Materials choice - Influence of basic design, mechanical loading, material, production method, size and weight on form design- form design of welded members and forgings. |
| **CASTING-DESIGN CONSIDERATION** | **(9)** |
| Casting-General design consideration-Specific design consideration- Characteristics of sand cast part- Design recommendation in sand casting, Investment casting: Design consideration of investment casting- Effect of shrinkage- Suitable materials. Design recommendations –Redesign of casting based on parting line considerations- Minimizing core requirements- machined holes , Redesign of cast members top obviate cores |
| **MACHINING- DESIGN CONDSIDERATION** | **(10)** |
| Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability Design for economy - Design for clampability - Design for accessibility - Design for assembly.Identification of uneconomical design - Modifying the design - group technology -Computer Applications for DFMA. |
| **GREEN DESIGN FOR ENVIRONMENT** | **(8)** |
| Introduction – Importance of DFE –Green design methods and tools - Environmental objectives – Global issues – Regional and local issues– Design guidelines for DFE –Lifecycle assessment – EPS system - AT&T’s environmentally responsible product assessment - Weighted sum assessment method –Techniques to reduce environmental impact – Design to minimize material usage –Design for disassembly – Design for recyclability – Design for remanufacture –Design for energy efficiency  |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. *Boothroyd, G,* ***“ Design for Assembly Automation and Product Design”****, New York, Marcel Dekker.1980*
2. *Bralla, “****Design for Manufacture handbook****”, McGraw hill, 1999.*
3. *Boothroyd, G, Heartz and Nike, “****Product Design for Manufacture****”, Marcel Dekker, 1994.*
4. *Dickson, John. R, and Corroda Poly, “****Engineering Design and Design for Manufacture and Structural Approach****”, Field Stone Publisher, USA, 1995.*
5. *Fixel, J. “****Design for the Environment****”, McGraw hill. 1996.*
6. *Kevien Otto and Kristin Wood, “****Product Design****”, Pearson Publication, 2004.*
7. *Dr.ING.RobertMatouslk,”****Engineering Design****”.Blackie& son limited,1962.*
8. *Harry peck, “****Designing for manufacture****”, Pitman publishing.*
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|  **16EDPE17 SENSORS FOR INTELLIGENT MANUFACTURING** |
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| **COURSE OBJECTIVE** |
| *To expose the students to the various sensors and their applications in manufacturing systems*  |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to** 1. *appreciate the capabilities of various sensors and apply them in condition monitoring.*
	2. *apply advanced sensor based systems for identification and inspection functions in shop floor.*
	3. *appreciate and use special type of sensors for hi-tech manufacturing systems.*
 |
| **INTRODUCTION** | **(9)** |
| Introduction – role of sensors in manufacturing automation – operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, Electro optical and vision sensors. |
| **CONDITION MONITORING OF MANUFACTURING SYSTEMS** | **(9)** |
| Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques |
| **ACOUSTIC EMISSION SENSORS** | **(9)** |
| Acoustic emission – principles and applications – concepts of pattern recognition. Sensors for CNC machine tools – linear and angular position and velocity sensors. |
| **MACHINE VISION SENSORS** | **(9)** |
| Automatic identification techniques for shop floor control – bar code scanners, radio frequency systems – optical character and machine vision sensors. |
| **ADAPTIVE CONTROL OF MACHINE TOOLS** | **(9)** |
| Smart / intelligent sensors – integrated sensors, Robot sensors, Micro sensors, Nano sensors.Adaptive control of machine tools. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. ***“Sensors: Hand Book”*** *by SabrieSoloman ; McGraw Hill*
2. ***“Thermal Sensors: Vo. IV, Sensors: A Comprehensive Survey” by JorgScholz (Editor), John wiley& Sons***
3. ***“Mechanical Sensors: Vo. VII, Sensors: A Comprehensive Survey” by H.H. Bau (Editor), John wiley& Sons***
4. ***“Sensor Technology & Devices” by LjubisaRistia (Editor), Artech House Publishers.***
5. ***”Sensors and control system in manufacturing” by SabrieSoloman,The McGraw-Hill Companies, Inc.***

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| **16EDPE18 DESIGN OF MATERIAL HANDLING EQUIPMENTS** |
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| **COURSE OBJECTIVE** |
| *To know the need for use, application and design of different material handling techniques, equipments and machines for common use and in industrial sector* |
| **COURSE OUTCOMES** |
| *On completion of this course the students will be able to*1. *to select suitable material handling equipment.*
2. *to design material handling equipment for industrial applications*
3. *handle various loads in varied equipments.*
 |
| **MATERIALS HANDLING EQUIPMENT** | **(8)** |
| Introduction – Importance of material handling – Principle of material handling – Factors influences the choice of material handling - Types - Selection and applications –Scope of material handling |
| **DESIGN OF HOISTS** | **(10)** |
| Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types. |
| **DRIVES OF HOISTING GEAR** | **(9)** |
| Hand and power drives - Travelling gear - Rail travelling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings. |
| **CONVEYORS** | **(9)** |
| Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors. |
| **ELEVATORS** | **(9)** |
| Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :***1. *Rudenko, N.,* ***“Materials handling equipment”****, ELnvee Publishers, 1970.*
2. *Spivakovsy, A.O. and Dyachkov, V.K.,* ***“Conveying Machines”****, Volumes I and II,*
3. *Alexandrov, M.,* ***“Materials Handling Equipments”****, MIR Publishers, 1981.*
4. *Boltzharol, A.,* ***“Materials Handling Handbook”****, The Ronald Press Company, 1958.*
5. *P.S.G.Tech.,* ***“Design Data Book”****, KalaikathirAchchagam, Coimbatore, 2003.*
6. *Lingaiah. K. and NarayanaIyengar,* ***“Machine Design Data Hand Book”****, Vol. 1 & 2, Suma Publishers, Bangalore, 1983*

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| **16EDPE19 EXPERIMENTAL STRESS ANALYSIS** |
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| **COURSE OBJECTIVE** |
| *To expose the students to the concepts of stress, vibration, fluid flow, distress measurements and NDT methods.* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to*1. *familiarize the student with various techniques for the measurement of force, strain, vibrations acoustic and wind flow.*
2. *To make the student acquaint with distress measurements and their methods.*
3. *To familiarise the student with principles and methods of non destructive testing.*
 |
| **FORCES AND STRAIN MEASUREMENT** | **(9)** |
| Strain gauge, principle, types, performance and uses. Photo elasticity – principleand applications - Moire Fringe - Hydraulic jacks and pressure gauges –Electronic load cells – Proving Rings – Calibration of Testing Machines. |
| **VIBRATION MEASUREMENTS** | **(9)** |
| Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems. |
| **ACOUSTICS AND WIND FLOW MEASURES** | **(9)** |
| Principles of Pressure and flow measurements – pressure transducers – sound level meter – venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis |
| **DISTRESS MEASUREMENTS** | **(9)** |
| Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition. |
| **NON DESTRUCTIVE TESTING METHODS** | **(9)** |
| Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Sadhu Singh –* ***“Experimental Stress Analysis”****, Khanna Publishers, New Delhi, 1996.*
2. *JW Dalley and WF Riley,* ***“Experimental Stress Analysis”****, McGraw Hill Book Company, N.Y. 1991*
3. *L.S.Srinath et al,* ***“Experimental Stress Analysis”****, Tata McGraw Hill Company, New Delhi, 1984*
4. *R.S.Sirohi, HC Radhakrishna,* ***“Mechanical Measurements”****, New Age International (P)*

*Ltd. 1997*1. *F.K Garas, J.L. Clarke and GST Armer,* ***“Structural assessment”****, Butterworths, London, 1987*
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COURSE ARTICULATION MATRIX

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| **16EDPE20 VEHICULAR VIBRATION** |
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| **COURSE OBJECTIVE** |
| *To expose the students to concepts of vibration and control in vehicular systems* |
| **COURSE OUTCOMES** |
| *On completion of this course, students will be able to*1. *Analyze the vibrations occurring in various vehicular systems.*
2. *Perform the vibration analysis in various parts of a vehicle and evaluate the performance of the vehicle.*
3. *Apply the concept of suspension for controlling the vehicular vibrations.*
 |
| **BASIC OF VIBRATION** | **(9)** |
| Classification of vibration, definitions, mechanical vibrating systems, mechanical vibration and human comfort. Single degree of freedom, free, forced and damped vibrations. Magnification factor and transmissibility, Vibration absorber, Vibration measuring instruments, Two degree of freedom system, modal analysis. |
| **TYRES** | **(9)** |
| Tire forces and moments, rolling resistance of tires, relationship between tractive effort and longitudinal slip of tyres, cornering properties of tyres, ride properties of tyre. |
| **PERFORMANCE CHARACTERISTICS OF VEHICLE** | **(9)** |
| Equation of motion and maximum tractive effort, Aerodynamics forces and moments, Power plant and transmission characteristics, Prediction of vehicle performance - Braking performance. |
| **HANDLING CHARACTERISTICS OF VEHICLES** | **(9)** |
| Steering geometry, Steady state handling characteristics, Steady state response to steering input, Transient response characteristics,Directional stability of vehicle. |
| **DYNAMICS OF SUSPENSION SYSTEM** | **(9)** |
| Requirements of suspension system, Spring mass frequency, wheel hop, Wheel wobble, wheel shimmy, choice of suspension spring rate. Calculation of effective spring rate, Vehicle suspension in fore and aft, Hydraulic dampers and choice of damping characteristics. Compensated suspension systems, Human response to vibration, vehicle ride model, Load distribution, Stability on a curved track, banked road and on a slope. |
| **Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods*****References :*** |
| 1. *Groover, “****Mechanical Vibration****”, 7th Edition, Nem Chand &Bros, Roorkee, India, 2003.*
2. *W.Steeds, ‘****Mechanics of road vehicle’****Illiffe Books Ltd, London 1992.*
3. *JG.Giles,* ***“Steering, Suspension tyres”****, Illife Books Lid London 1975.*
4. *P.M.Heldt, “****Automotive chassis”****, Chilton Co ., Newyork, 1982.*
5. *J. R. Ellis,* ***“Vehicle Dynamics”****, Business Books, London, 1969.*
6. *J.Y.Wong,* ***“Theory of ground vehicle”****, John Wiley and Sons Inc., Newyork, 1978.*
7. *Dr. N. K. Giri, “****Automobile Mechanics****”, Seventh reprint, Khanna Publishers, Delhi, 2005.*
8. *Rao J.S and Gupta. K “****Theory and Practice of Mechanical Vibrations****”, Wiley Eastern Ltd., 2002.*
9. *Thomas D. Gillespie “****Fundamentals of Vehicle Dynamics****” Society of Automotive Engineers HandBook.*
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COURSE ARTICULATION MATRIX

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| **16EDOC01 TECHNICAL SEMINAR** |
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**COURSE OBJECTIVE:**

To work on a specific technical topic in engineering fields in order to acquire the skills of oral presentation.

**COURSE OUTCOMES:**

Learners will be able to

**CO1:** Comprehend concepts and methods adequate to apply inductive and deductive reasoning for enhancing the problem solving skills.

**CO2:** Develop communicative capabilities in speaking, listening, reading and writing

**COURSE CONTENT**

1. Prepare on the specific topic related to developments and innovations in engineering
2. Present the seminar for fifteen minutes to thirty minutes on the technical topic
3. Engage in group discussion with the learners
4. Interact with learners and answer the queries on the topic
5. Submit the summary of discussions
6. Evaluation based on the technical presentation, the report and on the interaction during the seminar

**Lecture: Periods Tutorial:0 Periods Practical:30 Periods Total: 30 Periods**

COURSE ARTICULATION MATRIX

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| **16EDOC02 ENTREPRENEURSHIP SKILLS** |
|  | L | T | P | C |
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| **OBJECTIVE:** |
| To provide learners with skills needed to effectively organize, develop, create, evaluate and manage an event or business.**OUTCOME:**Learners influenced and enhanced with skill development on self-employability and able to achieve attitudes necessary to become successful in business or event management. |
| **COURSE CONTENT:**1. Event management and entrepreneurship, communication and interpersonal skills,
2. Economics,trading and project related business ownerships.
3. Developing an enterprise, computer and technology applications, real and simulated occupational experiences.
4. Developing leadership abilities, expand workplace- readiness skills, and broaden opportunities for personal and professional growth

 **Lecture: 45 Periods Tutorial:0 Periods Practical: 30 Periods Total: 30 Periods** |
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COURSE ARTICULATION MATRIX

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| **16EDOC03 HUMAN VALUES AND PROFESSIONAL ETHICS** |
|  | L | T | P | C |
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| **OBJECTIVES:** |
|  To provide learners 1. Engineering Ethics and Human Values
2. Social responsibility of an Engineer
3. Ethical dilemma while discharging duties in Professional life.

**OUTCOMES:** Upon completion of this course the students will be able to CO1: Understand and appreciate Human Values, exhibit self-confidence and develop good characterCO2: sense engineering ethics, professional roles and valuing time, co-operation and commitment.CO3: understand and practice code of ethics.CO4: assess safety and risk thereby capable of doing risk benefit analysis.CO5: develop and exhibit moral leadership qualities in exercising Engineering Consultations without compromising environmental, legal and ethical issues.**COURSE CONTENT:****ENGINEERING ETHICS (5)**Senses of Engineering Ethics- variety of moral issues- types of inquiry – moral dilemmas- moral autonomy- Kohiberg’s Theory- Gilligen’s Theory- Consensus and controversy- Models of Professional roles- theories about right actions- self-interest – customs and religion – uses of ethical theories- Valuing time- cooperation- commitment.**ENGINEERING AS SOCIAL EXPERIMENTATION (5)** Engineering as experimentation- engineers as responsible experimenters- codes of ethics- a balanced outlook on law – the challenger case study – engineers as managers – consulting engineers – Moral leadership.**SAFTY, RESPONSIBILITIES, RIGHTS AND GLOBAL ISSUES (5)** Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the three mile island and Chernobyl case studies – Environmental ethics – computer ethics – weapons development – Multinational corporations – engineers as expert witness and advisors. **Lecture: 15 Periods Tutorial:0 Periods Practical:0 Periods Total: 15 Periods**References:1. Mike Martin and Roland Schinzinger, ‘Ethics in Engineering , McGraw Hill, New York, 1996
2. M. Govindarajan, S. Natarajan and V.S. Senthil Kumar, “Engineering Ethics(including human values)”, Eastern Economy Edition, Printice Hall of India Ltd.,2004
3. Charles D.Fleddermann, “Engineering Ethics”, Pearson Education, 2004
4. Edmund G Seebauer and Robert L. Berry,’ Fundementals of Ethics for Scientists and Engineers’, 2001, Oxford University Press
5. Charles E. Harris, Micheal S. Protchard and MichealJ.Rabins, “Engineering Ethics- Concepts and Casses”, Thomson Leaning , 2000.
6. John R. Boatright, “Ethics and Conduct of Business”, Pearson Education, 2003.
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COURSE ARTICULATION MATRIX

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