*HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY*

**(An Autonomous Institution Affiliated to Anna University, Chennai)**

**(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)**

**Coimbatore - 641 032.**

# M.E. CAD/CAM

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

## (CHOICE BASED CREDIT SYSTEM)

# Curriculum & Syllabus

# 2018-2019

## VISION OF THE INSTITUTE

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

## MISSION OF THE INSTITUTE

- To provide academic excellence in technical education through novel teaching methods.
- To empower students with creative skills and leadership qualities.
- To produce dedicated professionals with social responsibility.

## VISION OF THE DEPARTMENT

To provide quality technical education in Mechanical Engineering and build holistic professionals who can excel in the engineering establishments and serve for the country with ethical values.

## MISSION OF THE DEPARTMENT

M1: To prepare graduates with good technical skills and knowledge.

M2: To prepare graduates with life-long learning skills to meet the requirements in the higher education and in society.

M3: To prepare graduates as successful entrepreneur with employment skills, ethics and human values.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

## PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: Exhibit their sound theoretical, practical skills and knowledge for Successful employments, higher studies, research and entrepreneurial assignments.

PEO 2: Lifelong learning skills, professional ethics and good communication Capabilities along with entrepreneur skills and leadership, so that they can succeed in their life.

PEO 3: Become leaders and innovators by devising engineering solutions for social issues and problems, thus caring for the society.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * Chairman * HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

## PROGRAMME OUTCOMES

Engineering Graduates will be able to:

**PO 1. Engineering knowledge:**

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2. Problem analysis:**

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3. Design/development of solutions:**

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4. Conduct investigations of complex problems:**

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5. Modern tool usage:**

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6. The engineer and society:**

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7. Environment and sustainability:**

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL
Chairman
HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

**PO8. Ethics:**

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10. Communication:**

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11. Project management and finance:**

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12. Life-long learning:**

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAMME SPECIFIC OUTCOMES

PSO 1: To design, analyze and apply knowledge in complex engineering problems with time effective software solutions.

PSO 2: To understand the relevance of engineering practices with society and environment and become an ethical team oriented effectively communicating individual with managerial skills and sustained learning ability.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL
Chairman
HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

# CURRICULUM

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST
HICET

**Hindusthan College of Engineering and Technology**
(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A' Grade)
Coimbatore, Tamil Nadu.

TÜVRheinland CERTIFIED

## DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

## CBCS PATTERN

## POST GRADUATE PROGRAMMES

## M.E.CAD/CAM (PG)

## REGULATION 2016

**For the students admitted during the academic year 2018-2019 and onwards**

**SEMESTER I**

| S.No. | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | | |
| 1 | 16MA1123 | Advanced Mathematics for Mechanical Engineers | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | 16CC1201 | Computer Aided Design | 3 | 0 | 2 | 4 | 40 | 60 | 100 |
| 3 | 16CC1202 | Integrated Mechanical Design | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 4 | 16CC1203 | Competitive Manufacturing Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | 16CC1204 | Design For Manufacture Assembly and Environment | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | 16CC13XX | Professional Elective I | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICAL** | | | | | | | | | |
| 7 | 16CC1001 | Computer Aided Design Lab | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 8 | 16CC1002 | Computer Aided Engineering Lab | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| **Total** | | | **18** | **2** | **10** | **25** | **340** | **460** | **800** |

**SEMESTER II**

| S.No. | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | | |
| 1 | 16CC2201 | Finite Element Analysis in Manufacturing Engineering | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 2 | 16CC2202 | Integrated Product and Processes Development | 3 | 1 | 0 | 4 | 40 | 60 | 100 |
| 3 | 16CC2203 | Computer Aided Manufacturing | 3 | 0 | 2 | 4 | 40 | 60 | 100 |
| 4 | 16CC2204 | Computer Aided Inspection and Non-Destructive Testing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | 16CC23XX | Professional Elective II | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | 16CC23XX | Professional Elective III | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICAL** | | | | | | | | | |
| 7 | 16CC2001 | Computer Aided Manufacturing Lab | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| 8 | 16CC2002 | Design Project | 0 | 0 | 4 | 2 | 50 | 50 | 100 |
| **Total** | | | **18** | **2** | **10** | **25** | **340** | **460** | **800** |

HINDUSTHAN COLLEGE OF ENGG & TECH ★ ACADEMIC COUNCIL ★ Chairman

## LIST OF PROFESSIONAL ELECTIVES

### SEMESTER I

| S.No. | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 16CC1301 | Computer Control in Process Planning | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | 16CC1302 | Tribology in Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | 16CC1303 | Advanced Strength of Materials | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | 16CC1304 | Composite materials and Mechanisms | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

### SEMESTER II

| S.No. | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 16CC2301 | Advanced Materials science | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | 16CC2302 | Advanced Tool Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | 16CC2303 | Additive Manufacturing | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | 16CC2304 | Industrial Robotics and Expert Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | 16CC2305 | Computational Fluid Dynamics | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | 16CC2306 | Computer integrated Production and inventory system | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | 16CC2307 | Advances in Welding and Casting Technology | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

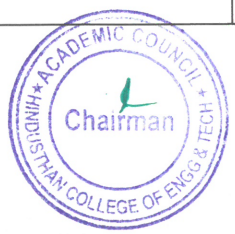
**For the students admitted during the academic year 2017-2018 and onwards**

### SEMESTER III

| S. No | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | | |
| 1 | 16CC33XX | Professional Elective IV | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | 16CC33XX | Professional Elective V | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | 16CC33XX | Professional Elective VI (OR) | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | 16XX34XX | Open Elective | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **PRACTICAL** | | | | | | | | | |
| 5 | 16CC3901 | Project Work (Phase I) | 0 | 0 | 12 | 6 | 50 | 50 | 100 |
| **Total** | | | **9** | **0** | **12** | **15** | **170** | **230** | **400** |

### SEMESTER IV

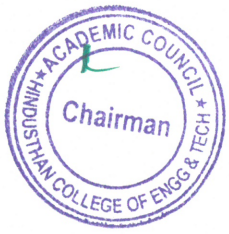
| S. No | Course Code | Course Title | L | T | P | C | CIA | ESE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 16CC4902 | Project work (Phase II) | 0 | 0 | 24 | 12 | 100 | 100 | 200 |
| **Total** | | | **0** | **0** | **24** | **12** | **100** | **100** | **200** |



## LIST OF PROFESSIONAL ELECTIVES

## SEMESTER III

| S. No | Course Code | Course Title | L | T | P | C | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 16CC3301 | Enterprise Resource Planning | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | 16CC3302 | Industrial Safety Management | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 3 | 16CC3303 | Reliability in Engineering Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 4 | 16CC3304 | Nano Technology | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 5 | 16CC3305 | Vibration Analysis and Control | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 6 | 16CC3306 | Supply Chain Management | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 7 | 16CC3307 | Design and Analysis of Experiments | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 8 | 16CC3308 | Optimization Techniques in Design | 3 | 0 | 0 | 3 | 40 | 60 | 100 |



## LIST OF OPEN ELECTIVES

| S. No | Course Code | Course Title | L | T | P | C | CIA | ESE | No. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 16CCX401 | Micro Electro Mechanical Systems | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2 | 16CCX402 | Quality Management Techniques | 3 | 0 | 0 | 3 | 40 | 60 | 100 |

**CREDIT DISTRIBUTION**

| Semester | I | II | III | IV | TOTAL |
|---|---|---|---|---|---|
| Credits | 25 | 25 | 15 | 12 | 77 |

**Chairman, Board of Studies** **Dean – Academics** **Principal**

Chairman - BoS
MECH - HiCET

Dean (Academics)
HiCET

PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

HINDUSTHAN COLLEGE OF ENGG & TECH * ACADEMIC COUNCIL * Chairman

# SYLLABUS

| Programme | Course code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/ CAM | 16MA1123 | ADVANCED MATHEMATICS FOR MECHANICAL ENGINEERS | 3 | 1 | 0 | 4 |

**Course Objectives**

1. To provide information about Estimation theory, Correlation, Regression and Testing of hypothesis.
2. To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology.
3. To formulate and construct a mathematical model for a linear programming problem in real life situation.
4. To Understand network modeling for planning and scheduling the project activities.
5. To impart knowledge on numerical methods that will come in handy to solve numerically the problems

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **ESTIMATION THEORY** Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines. | 9+3 |
| II | **TESTING OF HYPOTHESES** Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit. | 9+3 |
| III | **LINEAR PROGRAMMING** Formulation – Graphical solution – Simplex method –Artificial variable Techniques - Transportation and Assignment Models. | 9+3 |
| IV | **SCHEDULING BY PERT AND CPM** Network Construction – Critical Path Method – Project Evaluation and Review Technique – Resource Analysis in Network Scheduling. | 9+3 |
| V | **FINITE ELEMENT METHOD** Partial differential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method. | 9+3 |
| | **Total Instructional Hours** | 45+15 |

**Course Outcomes**

CO1: Students will able to acquire the basic concepts of Probability and Statistical techniques for solving mathematical problems which will be useful in solving Engineering problems.
CO2: Able to use optimization concepts in real time problems.
CO3: To prepare project scheduling using PERT and CPM.
CO4: It helps the students to get familiarized with the numerical methods which are necessary to solve numerically the problems that arise in engineering.
Co5: Able to solve differential equations in finite element problems.

**TEXT BOOKS:**

T1- Jay L. Devore, "Probability and Statistics For Engineering and the Sciences", Thomson and Duxbury, 2002.
T2- Richard Johnson. "Miller & Freund's Probability and Statistics for Engineer", Prentice – Hall, Seventh Edition, 2007
T3- Taha H.A., "Operations Research: An Introduction "8th Edition, Pearson Education, 2008.

**REFERENCE BOOKS:**

R1- Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).
R2- Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", Pearson Education, Asia, Fifth Edition, 2002.
R3- Gupta S.C. and Kapoor V.K."Fundamentals of Mathematical Statistics", Sultan an Sons, 2001.
R4- Morton K.W. and Mayers D.F., "Numerical solution of partial differential equations", Cambridge University press, Cambridge, 2002.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1201 | COMPUTER AIDED DESIGN | 3 | 0 | 2 | 4 |

**Course Objectives**

1. To acquire the knowledge on CAD/CAM software.
2. To familiarize about wireframe, surface and solid modeling techniques.
3. To enable the students to use the concepts of assembly and animation techniques.
4. To learn the techniques for Design applications.
5. To understand the principles of parametric, associative and feature based modeling concepts.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION TO CAD/CAM**<br>Introduction, Product life cycle, CAD/CAM – Systems, applications, CAD – Methodology, uses, benefits, applications, 3D Modeling – Geometric models, coordinate systems. Sketching, parameters, dimensions, basic and datum features, geometric constraints, modeling operations. | 9 |
| II | **GEOMETRIC MODELING**<br>Wireframe models - entities, Surface models - entities, representation, analytic surfaces, plane surface, ruled surface, surface of revolution, tabulated cylinder, synthetic surfaces, hermite bicubic surface, Bezier surface, B-spline surface, coons surface, blending surface, offset surface, triangular patches, surface manipulations, product data exchange. | 9 |
| III | **SOLID MODELLING**<br>Solid models - entities, representation, Fundamentals of solid modeling, Basic elements and Building operations on boundary representation, constructive solid geometry and sweep representation, solid modeling based applications. | 9 |
| IV | **ASSEMBLY AND ANIMATION**<br>Assembly modeling – Modeling, tree, planning, mating conditions, Bottom-Up assembly, Top-Down assembly, load options, managing and working, inference and orientation, analysis.<br>Conventional and computer animation – Engineering animation, animation systems, animation types – frame buffer, real time playback and real time animation, key frame technique in animation, simulation technique. | 9 |
| V | **DESIGN APPLICATIONS**<br>Limits and fits, Geometric tolerancing - datum's, types of geometric tolerances, drafting practices in dimensioning and tolerancing, design and engineering applications, finite element modeling. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to
CO1: Understand the concepts of wireframe, surface and solid modeling.
CO2: Assemble and create the mechanisms of components.
CO3: Familiarize in the concepts of geometric Dimensioning and Tolerance.
CO4: Execute the techniques of assemblage and animation.
CO5: Implement the concepts in applications of Design.

**TEXT BOOKS:**

T1- Ibrahim Zeid, "Mastering CAD/CAM" – McGraw Hill, International Edition, 2007.
T2- Dr.Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers – Fifth Edition.

**REFERENCE BOOKS:**

R1- William M Neumann and Robert F.Sproul "Principles of Computer Graphics", Mc Graw Hill Book Co. Singapore, 1989.
R2- Ibrahim Zeid, CAD/CAM Theory and Practice, Tata McGraw-Hill, 1998.
R3- Donald Hearn and M. Pauline Baker "Computer Graphics", Prentice Hall, Inc., 1992.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1202 | INTEGRATED MECHANICAL DESIGN (Use of Approved Data Book Is Permitted) | 3 | 1 | 0 | 4 |

**Course Objectives**

1. To familiarize the various steps involved in the Design Process and to use standard practices and standard data.
2. To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
3. To learn the usage of catalogues and standard machine components.
4. To acquire the knowledge of factor of safety and design procedures.
5. To enable the students to work in design calculations.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **FUNDAMENTALS AND DESIGN OF SHAFTS**<br>Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration –BIS, ISO, DIN, BS, ASTM Standards.<br>Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress – Theories of Failure – Ductile vs. brittle component design -Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity. | 12 |
| II | **BRAKES**<br>Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments. | 12 |
| III | **DESIGN OF GEARS**<br>Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads– Component design of spur, helical, bevel and worm gears. | 12 |
| IV | **DESIGN OF GEAR BOX**<br>Design for sub assembly –Integrated design of speed reducers and multi-speed gear boxes – application of software packages. | 12 |
| V | **INTEGRATED DESIGN**<br>Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators and Escalators. | 12 |
| | **Total Instructional Hour** | 60 |

**Course Outcomes**

Student shall be able to

CO1: Understand the concepts of shaft and brake.

CO2: Design gear and gearbox components.

CO3: Understand the Integrated Design of Mechanical systems and Machines.

CO4: Execute the principles in real time problems.

CO5: Implement the concepts in automobile and automation components.

**TEXT BOOKS:**

T1- Norton L. Robert., "Machine Design – An Integrated Approach" Pearson Education, 2005.

T2- Newcomb T.P. and Spur R.T., "Automobile Brakes and Braking Systems", Chapman & Hall, 2nd Edition.

**REFERENCE BOOKS:**

R1- Shigley, J.E., "Mechanical Engineering Design", McGraw Hill, 1986.

R2- Prasad. L. V., "Machine Design", Tata McGraw Hill, New Delhi, 1992.

R3- Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.

**APPROVED DATA BOOKS**

1. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & 2, Suma Publishers, 1983.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1203 | COMPETITIVE MANUFACTURING SYSTEMS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the principles of manufacturing and flexible manufacturing systems.
2. To educate the students on Lean Green manufacturing systems.
3. To familiarize the concept of Just in time for manufacturing the products.
4. To understand the concepts of green manufacturing systems.
5. To impart the knowledge of Automation and production system techniques.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **AUTOMATION AND PRODUCTION SYSTEMS**<br>Production system facilities, support systems, automation and manual labor in production systems, automation principles and strategies, manufacturing industries, products and operations, Components and classifications of manufacturing systems. | 9 |
| II | **GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS**<br>Part families, classification and coding, production flow analysis, group technology applications and cellular manufacturing, Flexible manufacturing systems- components, applications, benefits, planning and implementation. | 9 |
| III | **LEAN MANUFACTURING**<br>Origin of lean production system, customer focus, muda (waste),Standards – 5S system, Total productive maintenance, standardized work, man power reduction, overall efficiency, kaizen , common layouts, Jidoka concept, Poka-Yoke (mistake proofing),Worker Involvement, quality circle activity, kaizen training, suggestion programmes, oshin planning system (systematic planning methodology), lean culture. | 9 |
| IV | **JUST IN TIME**<br>JIT – Definitions, approach, elements, effects, pull and push systems, KANBAN, MRP II, quality management system, plant layout, product design, purchasing, implementation, automation and benefits. | 9 |
| V | **GREEN MANUFACTURING**<br>Impact of manufacturing in environment, role of manufacturing sector in national growth, technological change and evolving risk, Principles of green manufacturing , green manufacturing efficiency and its sustainability , green manufacturing strategies, motivation, barriers, advantages and limitations, Standards for green manufacturing. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Students can understand the concept of various Production and flexible manufacturing systems.
CO2: Enhance the ability of students to create GT code for a given product and differentiate the different types of products.
CO3: Create capability to manufacture different products with minimum defects using lean principles.
CO4: Student can understand the concepts of Just in time and Green Manufacturing approach.
CO5: Able to prepare a well-planned schedule for production in industries.

**TEXT BOOKS:**

T1- Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Third Edition, Prentice-Hall, 2007.
T2- Dr.Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers – Fifth Edition.

**REFERENCE BOOKS:**

R1- Pascal Dennis, "Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System", (Second edition), Productivity Press, New York, 2007.
R2- Jha.N.K. "Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1204 | DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the principles of design such that the manufacturing of product is possible.
2. To educate students on various design aspects to be considered for manufacturing products using different processes.
3. To know the computer application in design for manufacturing and assembly.
4. To acquire the knowledge about global issues.
5. To provide information about economical design and recyclability.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION** General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits -Datum features - Tolerance stacks. | 5 |
| II | **FACTORS INFLUENCING FORM DESIGN** Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings. | 13 |
| III | **COMPONENT DESIGN - MACHINING CONSIDERATION** 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 machine ability - Design for economy - Design for clamp ability – Design for accessibility - Design for assembly. | 8 |
| IV | **COMPONENT DESIGN - CASTING CONSIDERATION** Redesign of castings based on parting line considerations - Minimizing core requirements, Machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA. | 10 |
| V | **DESIGN FOR THE ENVIRONMENT** Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T's environmentally responsible product assessment - Weighted sum assessment method – Lifecycle 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 – Design to regulations and standards. | 9 |
| | **Total Instructional Hours** | 45 |

**Course Outcomes**

The students develop ability as indicated below:
CO1: Material selection based on Design, manufacturing process and assembly.
CO2: Application of DFMA tools for minimizing cost in manufacturing and efforts.
CO3: Designing of components based on environmental Factors.
CO4: Considerations in machining and casting to facilitate easy manufacturing.
CO5: Execute the principles in real time problems.

**TEXT BOOKS:**

T1- Boothroyd, G, 1980 Design for Assembly Automation and Product Design. New York, MarcelDekker.
T2- Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.

**REFERENCE BOOKS:**

R1- Bralla, Design for Manufacture handbook, McGraw hill, 1999.
R2- Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
R3- Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | COURSE CODE | NAME OF THE COURSE | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1001 | COMPUTER AIDED DESIGN LAB | 0 | 0 | 4 | 2 |

**COURSE OBJECTIVE**

1. To provide hands on training to create surface, two- and three-dimensional modeling of machine components using modeling software.
2. To educate training to simulate various simple mechanisms.
3. To understand the design concepts of all components.
4. To familiarize information about bill of materials, limits, and tolerances.
5. To gain knowledge in assembling top down and bottom-up approach.

| Unit | Description | Instructional Hours |
|---|---|---|
| 1 | Assembly modeling of the center lathe. | |
| 2 | Assembly modeling of fixture parts. | |
| 3 | Assembly modeling of IC engine components. | |
| 4 | Surface modeling of a vehicle parts. | |
| 5 | Sheet metal modeling of a container. | |
| 6 | Detailing of center lathe with bill of materials, limits and tolerances. | |
| 7 | Mechanism of IC engine components. | |
| | **Total Instructional Hours** | **30** |

**Course Outcomes**

Students shall be able to
CO1: Design the given machine components.
CO2: Assemble the machine components.
CO3: Detailing the given machine components.
CO4: Simulate the machine components.
CO5: know the concepts of modeling techniques.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL COLLEGE OF ENGG & TECH Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1002 | COMPUTER AIDED ENGINEERING LAB | 0 | 0 | 4 | 2 |

**Course Objectives**

1. To provide hands on training on Finite Element Analysis software package for steady state and transient case for machine components.
2. To provide hands on training to simulate ANSYS APDL platform.
3. To acquire knowledge in ANSYS workbench platform.
4. To understand the concepts of computational fluid dynamics.
5. To enable the students to work with simulation techniques.

| Unit | Description | Instructional Hours |
|---|---|---|
| 1 | Analysis of a structural truss with a point and UDL load using ANSYS classic platform. | |
| 2 | Analysis of a thermal plate with a mixed boundary (conduction / convection) using ANSYS classic platform. | |
| 3 | Modal analysis of a wind mill blade using ANSYS workbench platform. | |
| 4 | Transient analysis of a machine element under dynamic loads using ANSYS workbench platform. | |
| 5 | Analysis of a piston using ANSYS workbench platform. | |
| 6 | Analysis of a connecting rod ANSYS workbench platform. | |
| 7 | Analysis of a water flow in a pipeline using ANSYS Fluent. | |
| | **Total Instructional Hours** | **30** |

**Course Outcomes**

Students shall be able to
CO1: Select the method, meshing, analysis and optimize the given problem for structural, heat transfer and couple field applications.
CO2: Familiarize the concepts of simulation techniques.
CO3: Implement the techniques in real-time problems.
CO4: Prepare the report of finite element results.
CO5: Expose with various simulation software's.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2201 | FINITE ELEMENT ANALYSIS IN MANUFACTURING ENGINEERING | 3 | 1 | 0 | 4 |

**Course Objectives**

1. To equip students with fundamentals of finite element principles so as to enable them to understand the behavior of various finite elements.
2. To select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.
3. To provide the students with knowledge of the finite element method that will be of use in different manufacturing areas and to provide a foundation for further study.
4. To Develop code for one dimensional analysis and validation.
5. To learn higher order formulations for complex problems.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Basics of FEM – Initial value and boundary value problems – weighted residual Galerkin and Raleigh Ritz methods – review of Variational calculus – Integration by parts – Basics of variational formulation. | 12 |
| II | **ONE DIMENSIONAL ANALYSIS**<br>Steps in FEA – Discretisation, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in solid mechanics and heat transfer. | 12 |
| III | **SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS**<br>Global and Natural Co-ordinates – Shape functions for one and two dimensional elements – Three noded triangular and four noded quadrilateral element – Non linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional axi symmetric analysis. | 12 |
| IV | **ANALYSIS OF PRODUCTION PROCESSES**<br>FE Analysis of metal casting – Special considerations, latent heat incorporation, gap element – time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity – Solid and flow formulation – small incremental deformation formulation – FE Analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency. | 12 |
| V | **COMPUTER IMPLEMENTATION**<br>Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages such as ANSYS and DEFORM – Development of code for one dimensional analysis and validation. | 12 |
| | **Total Instructional Hours** | **60** |

**Course Outcomes**

Student shall able to
CO1: Develop Skills to select and use finite elements for different field problems like complex structure, heat transfer, vibration and fluid flow applications.
CO2: Acquire knowledge in one and two dimensional solutions.
CO3: Implement the FEM techniques in application packages such as ANSYS and DEFORM.
CO4: Create code for one dimensional analysis.
CO5: Execute the principles in real time problems.

**TEXT BOOKS:**

T1- Reddy, J.N, "An Introduction to the Finite element Method", McGraw – Hill, 1985.
T2- S.S.Rao, "The Finite Element Method in Engineering", Elsevier, Fifth Edition, 2011.

**REFERENCE BOOKS:**

R1- Bathe, K.J., "Finite Element Procedures in Engineering Analysis, 1990.
R2- Kobayashi, S, Soo-IK-Oh and Altan, T, "Metal forming and the Finite element Methods", oxford University Press, 1989.
R3- Lewis, R.W., Morgan, K, Thomas, H.R., and Seetharaman, K.N., "The Finite Element Method in Heat Transfer Analysis", John Wiley, 1994.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2202 | INTEGRATED PRODUCT AND PROCESSES DEVELOPMENT | 3 | 1 | 0 | 4 |

**Course Objectives**

1. To impart knowledge on product planning and product specifications, concept of selection and the product architecture.
2. To create expertise in the development of product and process.
3. To understand the product architecture and its implications.
4. To know the concepts of industrial and robust design.
5. To learn the techniques of product development.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Need for IPPD-Strategic importance of Planning and Product development – Generic development process, concept development, product development of process flow and organization, Customer needs. | 12 |
| II | **CONCEPT GENERATION, SELECTION AND TESTING**<br>Plan and establish product specifications. Task - Structured approaches - clarification – search externally and internally-Explore systematically - reflect on the solutions and processes – concept selection - methodology - benefits. Implications - Product change - variety – component standardization - product performance - manufacturability – Concept Testing Methodologies. | 12 |
| III | **PRODUCT ARCHITECTURE**<br>Implications of Architecture, establishing the architecture, Delayed differentiation, Platform planning- related system level design issues. | 12 |
| IV | **INDUSTRIAL AND ROBUST DESIGN**<br>Need for industrial design, impact – design process, management of the industrial design process - assessing the quality of industrial design - Robust design. | 12 |
| V | **DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**<br>Definition - Estimation of Manufacturing cost-reducing the component costs, assembly costs and production costs- Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-baseline project planning - accelerating the project-project execution. | 12 |
| | **Total Instructional Hours** | **60** |

**Course Outcomes**

Student shall be able to

CO1: Define Integrated Product Teams, states their purpose, and describes how they are used to implement the concept of Integrated Product and Process Development.

CO2: Define Integrated Product and Process Development and describes the successful use of Integrated Product Teams by government Program Managers.

CO3: Acquire knowledge about product architecture.

CO4: know the industrial design and robust design techniques.

CO5: Execute the needs of the customer in global market.

**TEXT BOOKS:**

T1- Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999.

T2- Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book

**REFERENCE BOOKS:**

R1- Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4

R2- Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing, Newyork, 1991, ISBN 0-202-41639-5

Chairman - BoS
MECH - HiCET

HINDUSTHAN COLLEGE OF ENGG & TECH ACADEMIC COUNCIL Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2203 | COMPUTER AIDED MANUFACTURING | 3 | 0 | 2 | 4 |

**Course Objectives**

1. To understand the principles of manufacturing and Numerical control Techniques.
2. To educate the students on CNC machine construction and its programming.
3. To familiarize the concept of advanced manufacturing techniques.
4. To know the principles of PDM and PLM concepts.
5. To enable the students to know the performance of CNC machines.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Objectives of a manufacturing system-identifying business opportunities and problems classification production systems-linking manufacturing strategy and systems analysis of manufacturing operations. Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Strategies, PDM & PLM. | 9 |
| II | **FUNDAMENTALS OF NUMERICAL CONTROL**<br>Automation –Definition, Elements of CAM system, Product Development, Principles of Numerical control, Coordinate system for NC machine, Advantages and Limitations of NC ,CNC Technology, Types, Interpolation, Machine control unit, CNC Performance, Benefits, safety and Maintenance, DNC, Functions and Advantages. | 9 |
| III | **CONSTRUCTIONAL FEATURES OF CNC MACHINES**<br>Design considerations of CNC machines for improving machining accuracy-Structural members-Slide ways-Sides linear bearings-Ball screws-Spindle drives and feed drives-work holding devices and tool holding devices-Automatic Tool changers. Feedback devices- Principles of Operation-Turning and Machining Centre's-Tooling for CNC machines. | 9 |
| IV | **PART PROGRAMMING FOR CNC MACHINES**<br>Numerical control codes – Standards - Manual Programming - Canned cycles and subroutines-Computer Assisted Programming, CAD/CAM approach to NC part programming-APT language, machining from 3D models. | 9 |
| V | **ADVANCED CNC MACHINES AND MANUFACTURING**<br>CNC grinders, CNC gear cutting machines, CNC wire cut EDM, CNC-CMM, CNC Molding Machines, Automated Welding, features of CAM packages, Tool path simulation, generation of NC code, Optimization of tool path using CAM software. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to
CO1: Select the appropriate code for performing particular task in a CNC machine.
CO2: Acquire the knowledge about constructional features of CNC machines.
CO3: Prepare the program for Turning and Milling operations.
CO4: Implement the Numerical control techniques in CNC machines.
CO5: Develop skills in tool path simulation, generation of NC code and tool path optimization.

**TEXT BOOKS:**

T1- Radhakrishnan.P, "Computer Numerical Control CNC machines" New central book agency, 2003.
T2- Mikell P.Groover, "Automation production systems and computer – integrated manufacturing", Prentice Hall of India. Ltd.,2008

**REFERENCE BOOKS:**

R1- Rao P.N., N.K. Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill, 2001.
R2- Kant Vajpayee.S, "Principles of CIM", Prentice Hall of India, 1995.
R3- Dr.Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers – Fifth Edition.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL ★ HINDUSTHAN COLLEGE OF ENGG & TECH ★ Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2204 | COMPUTER AIDED INSPECTION AND NON DESTRUCTIVE TESTING | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To provide knowledge on various metrological equipments to measure the components dimension.
2. To learn the correct procedure to be adopted to measure the dimension of the components.
3. To familiarize the concepts of liquid penetrant inspection and shearography.
4. To understand the principles of Radiography Inspection.
5. To impart knowledge in ultrasonic inspection.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **COMPUTER AIDED METROLOGY AND MEASURING MACHINES** Metrological concepts – Abbes principle – need for high precision measurements –problems associated with high precision measurements - Computer aided metrology and inspection – principles and interfacing, software metrology, laser metrology, application of lasers in precision measurements – laser interferometer, laser scanners, contact and non-contact type optical and non-optical inspection methods, In process inspection. Use of microprocessors and computers in metrology and inspection, Coordinate Measuring Machine (CMM), Tool Makers Microscope, ImageShearing Microscope, Universal Measuring Machine, etc., | 10 |
| II | **LIQUID PENETRANT INSPECTION AND SHEAROGRAPHY** Introduction – Principles of penetrant inspection - Characteristics of Liquid penetrants, - Water-washable System – Post-emulsification system – Solvent removable system– Surface preparation and cleaning – Penetrant application – Development Developers – Advantages and limitations - Applications. Shearography-principles- constructions-applications. | 8 |
| III | **MAGNETIC PARTICLE INSPECTION AND ACOUSTIC EMISSION** Introduction – Magnetisation – Magnetisation methods – Continuous and residual methods – Sensitivities – Demagnetisation – Magnetic particles - Applications, Advantages and Limitations Principles of acoustic emission techniques, instrumentation, applications, advantages and limitations. | 9 |
| IV | **RADIOGRAPHY INSPECTION** Introduction – Uses of radiography – Limitations of radiography – Principles of radiography – Radiation sources – X-Ray production, X-ray Spectra, Properties of X-rays and γRays – Attenuation of radiation – Radiographic equivalence – Shadow formation, enlargement and distortion – Radiographic film and paper – Exposure curves and charts, Contrasts – Radiographic screens – Viewing and interpretation of radiographs – Operational characteristics of X-ray, Equipment, Applications, Advantages, limitations etc. | 9 |
| V | **ULTRASONIC INSPECTION** Introduction – Nature of Sound - Production of Ultrasonic waves, Different types of waves, General characteristics of wave s, Pulse echo method, Sound attenuation –Display systems – Probe types and construction – Type of Display – Inspection techniques - Identification of defects – Sensitivity and Calibration - Applications, Advantages and limitations. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Acquire the knowledge on the representatives of modern testing methods.
CO2: Creatively participate in designing a system for optical measuring and non-destructive testing.
CO3: Measure and test the specimen appropriately.
CO4: Implement the various inspection techniques to find the defects.
CO5: work in various measuring Machines.

**TEXT BOOKS:**

T1-Baldev Raj, Jayakumar .T and Thavasimuthu M., 'Practical Nondestructive Testing', Narosa Publishing House, 2002.
T2- Jain R.K., "Engineering Metrology", Khanna Publishers, 1997.

**REFERENCE BOOKS:**

R1- "American Society of Metals", Metals Hand book, Vol. 11, 10th edition, 1998.
R2-"Progress in Acoustic Emission", Proceedings of 10thInternational Acoustic Emission symposium, Japanese society for NDT, 1990.
R3- Barry Hull and Vernon John, "Non Destructive Testing", Macmillan, 1988.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * Chairman * HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2001 | COMPUTER AIDED MANUFACTURING LAB | 0 | 0 | 4 | 2 |

**Course Objectives**

1. To impart hands on training on CNC Machine tools, CMM and RPT.
2. To acquire practical knowledge through intensive practice on CNC Machines & related software.
3. To develop part programs for various components.
4. To create product using Rapid prototyping machine.
5. To know about the NC code generation.

| Unit | Description | Instructional Hours |
|---|---|---|
| 1 | Manual part programming on CNC Lathe by using FANUC software. | |
| 2 | Manual part programming on CNC Milling and Drilling by using FANUC software. | |
| 3 | NC code generation for Lathe using CAM software. | |
| 4 | NC code generation for milling using CAM software. | |
| 5 | NC code generation for a component using CMM software. | |
| 6 | NC code generation in an Image Processing method for a component using CMM software. | |
| 7 | Prototype creation of a product using Rapid prototyping machine. | |
| | **Total Instructional Hours** | **30** |

**Course Outcomes**

Students develop ability in the following
CO1: Tool and machine setting.
CO2: CNC programming and tool path simulation.
CO3: Maintenance of CNC lathe and milling machine.
CO4: Hands on experience in CMM and RPT.
CO5: NC code generation.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2002 | DESIGN PROJECT | 0 | 0 | 4 | 2 |

**Course Objectives**

1. The main objective is to give an opportunity for the student to achieve integrated mechanical design ofa product through parts design and assembly preparation of manufacturing drawings.
2. To learn the practical knowledge and skills in the field of Mechanical Engineering.
3. To get an experience and confidence level in a particular domain.
4. To train the students in preparing a project report to face the reviews and viva examinations.
5. To identify a problem in the field of Mechanical Engineering and provide solutions, which are technically, economically, and environmentally feasible.

| Unit | Description | Instructional Hours |
|---|---|---|
| | **GUIDELINE FOR REVIEW AND EVALUATION**<br><br>Each student's works under a project supervisor. The product system /component(s) to be designed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the student which will be reviewed and evaluated for internal assessment by a committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners. | |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Identify the real world power system problems.
CO2: Analyze, design and implement solution methodologies.
CO3: Apply modern engineering tools for solution.
CO4: Write technical reports following professional ethics.
CO5: Able to analyze the current scenario in industries.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * Chairman * HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

## LIST OF ELECTIVES

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1301 | COMPUTER CONTROL IN PROCESS PLANNING | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the principles of process planning for manufacturing the product.
2. To educate the students on various design aspects and process engineering.
3. To familiarize the students in computerized process planning and its integration.
4. To acquire knowledge in Geometric tolerance.
5. To learn the sequential and concurrent engineering concepts.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION** The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning, sequential and Concurrent Engineering, CAPP. | 9 |
| II | **PART DESIGN REPRESENTATION** Design Drafting - Dimensioning - Conventional tolerance - Geometric tolerance - CAD - input / output devices - topology - Geometric transformation - Perspective transformation - Data structure- Geometric modeling for process planning. | 9 |
| III | **PROCESS ENGINEERING AND PROCESS PLANNING** Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning. | 9 |
| IV | **COMPUTER AIDED PROCESS PLANNING SYSTEMS** Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP. | 9 |
| V | **AN INTERGRADED PROCESS PLANNING SYSTEMS** Totally integrated process planning systems - An Overview - Modulus structure - Data Structure, operation - Report Generation, Expert process planning. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Identify the process capabilities, such as process parameters, process boundaries, process performance and process cost in the areas of machining, mechanical and electronic assembly and circuit boards manufacturing.

CO2: Learn manual and computer aided process planning systems based on process planning criteria and implementation of economic considerations.

CO3: Prepare the Generative and Variant process planning approach.

CO4: Develop skills in preparing Decision table and decision trees.

CO5: Implement planning techniques with the help of MIPLAN, AUTOPLAN and PRO.

**TEXT BOOKS:**

T1- Gideon Halevi and Roland D. Weill, " Principles of Process Planning ", A logical approach, Chapman & Hall, 1995.

T2- Tien-Chien Chang, Richard A.Wysk, "An Introduction to automated process planning systems ", Prentice Hall, 1985.

**REFERENCE BOOKS:**

R1- Chang, T.C., "An Expert Process Planning System ", Prentice Hall, 1985.

R2- Nanua Singh, "Systems Approach to Computer Integrated Design and Manufacturing ", John Wiley & Sons, 1996.

R3- Rao, "Computer Aided Manufacturing ", Tata McGraw Hill Publishing Co., 2000.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL ★ Chairman ★ HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1302 | TRIBOLOGY IN DESIGN | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To impart knowledge in friction, wear and lubrication aspects of machine components.
2. To understand the material properties this influences the tribological characteristics of surfaces.
3. To understand the analytical behavior and design of bearings based on analytical /theoretical approach.
4. To learn the surface treatment methods.
5. To enable the students in learning with pressure contacts and elasto hydrodynamic lubrication.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **SURFACE INTERACTION AND FRICTION**<br>Topography of Surfaces – Surface features-Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact. | 7 |
| II | **WEAR AND SURFACE TREATMENT**<br>Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications –surface coatings methods- Surface Topography measurements –Laser methods – instrumentation – International standards in friction and wear measurements. | 8 |
| III | **LUBRICANTS AND LUBRICATION REGIMES**<br>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. | 8 |
| IV | **HYDRODYNAMIC AND HYDROSTATIC LUBRICATION**<br>Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings. | 12 |
| V | **PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION**<br>Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives. | 10 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Students shall be able to

CO1: Apply in long life product development areas.

CO2: Strengthen the skills in failure analysis and condition monitoring.

CO3: Acquire the knowledge of various lubrication techniques.

CO4: Calculate the friction, load and flow occurrence level over components.

CO5: Execute the Laser methods in the engineering field.

**TEXT BOOKS:**

T1- Rabinowicz.E, "Friction and Wear of materials", John Willey & Sons, UK, 1995

T2- Halling, J. (Editor) – "Principles of Tribology ", Macmillian – 1984.

**REFERENCE BOOKS:**

R1- Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.

R2- S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", PHI Pvt Ltd , New Delhi, 2005

R3- Stachowiak G.W. & A.W .Batchelor, Engineering Tribology, Butterworth-Heinemann, UK, 2005.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1303 | ADVANCED STRENGTH OF MATERIALS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To impart knowledge on simple stresses, strains and deformation in components due to external loads and their relations, provide knowledge in shear centre and unsymmetrical bending.
2. To impart knowledge on stresses induced in curved flexible members, stresses in flat plates and torsion of non-circular sections.
3. To understand various principles of stress-strain theory.
4. To study the stress due to rotary sections and contact Stresses.
5. To prepare shear force and bending moment diagrams.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION** Stress-strain relations and general equations of elasticity in Cartesian, polar and spherical co-ordinates equations of equilibrium - compatibility - boundary conditions - representation of 3-dimentional stress -tensor - generalized Hooke's law - St.Venant's principle - plane strain - plane stress - Airy's stress function. | 9 |
| II | **UN-SYMMETRICAL BENDING** Stress and deflections in beams subjected to unsymmetrical loading - kern of a section. | 9 |
| III | **SHEAR CENTER, CURVED FLEXURAL MEMBERS** Shear centre - Location of shear center for various sections - shear flow. Curved flexural members - circumferential and radial stresses - deflections - curved beam with restrained ends - closed ring subjected to concentrated loading and uniform load - chain links and crane hooks. | 9 |
| IV | **STRESS IN FLAT PLATES** Stresses in circular and rectangular plates due to various types of loading and end conditions - buckling of plates. | 9 |
| V | **TORSION, STRESSES DUE TO ROTATION, CONTACT STRESSES** Torsion of rectangular cross section - St. Venant's theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin-walled tubes - strees due to rotation - Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speeds. Methods of computing contact stresses - deflection of bodies in points and line contact - applications. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student can be able to

CO1: Relate the mechanical properties of materials to their structure.

CO2: Select materials for structural applications.

CO3: Solve realistic and/or fundamental problems relating to the mechanical behavior of materials for individual solutions and tests.

CO4: Work in teams for the materials selection in design.

CO5: Execute the principles in real time problems.

**TEXT BOOKS:**

T1- Seely and Smith, "Advanced mechanics of materials", John Wiley International Edn, 1952.
T2- Den Hartong, "Advanced Strength of Materials", McGraw Hill Book Co., New York 1952.

**REFERENCE BOOKS:**

R1- Rimoahwnko, "Strength of Materials", Van Nostrand., 1970.
R2- Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill., 1994.
R3- Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Macmillian Pub. Co. 1952.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC1304 | COMPOSITE MATERIALS AND MECHANISMS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the fundamentals of composite material strength and its mechanical behavior.
2. Understanding the analysis of fiber reinforced Laminate design for different structures.
3. Combinations of plies with different orientations of the fiber.
4. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
5. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **LAMINA CONSTITUTIVE RELATIONS** Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic And Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke"s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes | 12 |
| II | **FLAT PLATE LAMINATE CONSTITUTE EQUATIONS** Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates. | 10 |
| III | **LAMINA STRENGTH ANALYSIS** Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill"s Criterion for Anisotropic materials. Tsai-Hill"s Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure. | 5 |
| IV | **THERMAL ANALYSIS** Assumption of Constant C.T.E"s. Modification of Hooke"s Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E"s. C.T.E"s for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates. | 8 |
| V | **ANALYSIS OF LAMINATED FLAT PLATES** Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies. | 10 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Able to analyses the fiber reinforced Laminate for optimum design.
CO2: Apply classical laminate theory to study and analyses the residual stresses in Laminate.
CO3: To familiarize the concepts of Thermal Analysis.
CO4: To Implement various analyses in the real time problems.
CO5: To execute mechanisms of various Manufacturing Processes.

**TEXT BOOKS:**

T1- Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
T2- Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998.

**REFERENCE BOOKS:**

R1- Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007.
R2- Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2301 | ADVANCED MATERIALS SCIENCE | 3 | 0 | 0 | 3 |

**Course Objectives**

1. This course provides knowledge in the areas of Industrial metallurgy, advanced materials and selection of materials for industrial applications.
2. To acquire knowledge in fracture mechanics.
3. To understand the concepts of material selection.
4. To impart the knowledge of material processing.
5. To know about the modern materials and its treatment methods.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **ELASTIC AND PLASTIC BEHAVIOUR**<br>Mechanism of Elastic and Plastic deformation, Anelasticity and viscoelasticity- role of dislocations, yield stress, shear strength of perfect and real crystals –Strengthening mechanism, work, hardening, solid solutioning, grain boundary strengthening, Poly phase mixture, precipitation, particle fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior – Super plasticity. | 8 |
| II | **FRACTURE BEHAVIOUR**<br>Griffith's theory - stress intensity factor and fracture toughness-Toughening mechanisms – Ductile, brittle transition in steel-High temperature fracture, creep – Larson-Miller, Parameter – Deformation and fracture mechanism maps – Fatigue. Low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law – Residual Life Estimation- Effect of surface and metallurgical parameters on fatigue – fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis. | 8 |
| III | **SELECTION OF MATERIALS**<br>Motivation, 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 – Case studies in materials selection with Relevance to aero, auto, marine, machinery and nuclear applications. | 8 |
| IV | **MATERIAL PROCESSING**<br>Processing of engineering materials – Primary and Secondary processes – astability, Weldability, forgeability and malleability Criteria – Process induced defects – Monitoring and control. | 9 |
| V | **MODERN MATERIALS AND TREATMENT**<br>Dual phase steels, high strength low alloy steel, transformation included plasticity steel, marging steel, smart materials, properties and applications of engineering plastics and composites materials - advanced structural ceramics – WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN, diamond –Plasma, PVD, CVD- thick and thin film deposition – Functionally Gradient Materials , Nanomaterials. | 12 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Understand about elastic and fracture behaviour of different materials.

CO2: Select materials for different engineering applications based on various criteria.

CO3: Acquire knowledge about properties, processing and applications of advanced materials.

CO4: Implement the material processing techniques for further development.

CO5: Execute the treatment methods of various materials.

**TEXT BOOKS:**

T1- Dieter, G.E., "Mechanical Metallurgy", McGraw Hill, 1988.

T2- James, K.W., Wiley, Intersam, John, "The Hand book of Advance Materials", Wilson Publishers., 2004.

**REFERENCE BOOKS:**

R1-Charles, J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of engineering Materials", (3rd Edition, Butterworth – Heiremann, 1977.

R2-Courtney, T.H.,"Mechanical Behavior of Materials" ,(2nd edition), McGraw Hill, 2000.

R3-Flinn, R.A.and Trojan ,P.K.., "Engineering Materials and their Applications" (4th Edition), Jaico, 1999.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * Chairman * HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2302 | ADVANCED TOOL DESIGN | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the concepts of design procedures for machining.
2. To learn the concepts of cutting tools.
3. To know the information of jigs and fixtures.
4. To impart the knowledge of design of press tool dies.
5. To familiarize the concepts of tool design.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION TO TOOL DESIGN**<br>Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings –Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment. | 8 |
| II | **DESIGN OF CUTTING TOOLS**<br>Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters. | 9 |
| III | **DESIGN OF JIGS AND FIXTURES**<br>Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures –Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations. | 10 |
| IV | **DESIGN OF PRESS TOOL DIES**<br>Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout –Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting. | 10 |
| V | **TOOL DESIGN FOR CNC MACHINE TOOLS**<br>Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool petitioners – Tool presetting– General explanation of the Brown and Sharp machine. | 8 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Develop knowledge about cutting tools.
CO2: Design Jigs & fixtures.
CO3: Dies & Press tools for conventional & CNC machines.
CO4: know about the tool holding methods, Automatic tool changers and tool petitioners
CO5: Execute the principles in real time problems.

**TEXT BOOKS:**

T1- Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
T2- Hoffman E.G.," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004

**REFERENCE BOOKS:**

R1- Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000
R2- Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005
R3- Haslehurst M., "Manufacturing Technology", The ELBS, 1978

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2303 | ADDITIVE MANUFACTURING | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To educate the students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Art, Medical and industrial applications.
2. To impart knowledge in Reverse engineering concepts.
3. To learn about liquid and solid based additive manufacturing systems.
4. To understand the concepts of powder based additive manufacturing systems.
5. To know the techniques of 3D printing, SDM and BPM additive manufacturing systems.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits-Applications. | 8 |
| II | **REVERSE ENGINEERING AND CAD MODELING**<br>Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wireframe, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies. | 10 |
| III | **LIQUID AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS**<br>Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.<br>Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies. | 10 |
| IV | **POWDER BASED ADDITIVE MANUFACTURING SYSTEMS**<br>Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies. | 10 |
| V | **OTHER ADDITIVE MANUFACTURING SYSTEMS**<br>Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting. | 7 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to develop

CO1: Capability of creating two-dimensional and three-dimensional products and designs using appropriate tools, materials, methods and techniques.
CO2: Skill of applying prototype model in various disciplines.
CO3: Reverse engineering techniques.
CO4: Concepts of solid, liquid and powder based additive manufacturing systems.
CO5: Prototypes by using 3D printing, SDM and BPM additive manufacturing systems.

**TEXT BOOKS:**

T1- Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
T2- Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.

**REFERENCE BOOKS:**

R1- Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
R2- Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL ★ Chairman ★ HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2304 | INDUSTRIAL ROBOTICS AND EXPERT SYSTEMS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the applications and concept of future trends in robotics.
2. To learn robot kinematics and its anatomy.
3. To acquire the knowledge of robot drives and control.
4. To educate about robot sensors and artificial intelligence.
5. To impart knowledge of robot programming.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION AND ROBOT KINEMATICS**<br>Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects. | 10 |
| II | **ROBOT DRIVES AND CONTROL**<br>Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers. | 9 |
| III | **ROBOT SENSORS**<br>Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system. | 9 |
| IV | **ROBOT CELL DESIGN AND APPLICATION**<br>Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots. | 9 |
| V | **ROBOT PROGRAMMING AND ARTIFICIAL INTELLIGENCE**<br>Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots. | 8 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Students shall be able to

CO1: Understand about robot kinematics and dynamics.
CO2: Write basic program to control robot.
CO3: Understand about various sensors used in robotics field.
CO4: Prepare robot cell layout.
CO5: Execute the mechanism of robots.

**TEXT BOOKS:**

T1- Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey," Industrial Robotics Technology, Programming and Applications", Mc Graw-Hill, Int. 1986.
T2- Deb, S.R." Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.

**REFERENCE BOOKS:**

R1- Fu .K.S., R.C. Gonzalez and C.S.G. Lee, "Robotics Control, Sensing, Vision and Intelligence", Mc Graw Hill, 1987.
R2- Yoram Koren," Robotics for Engineers' Mc Graw-Hill, 1987.
R3- Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2305 | COMPUTATIONAL FLUID DYNAMICS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To develop finite difference and finite volume discretization forms of the CFD equations.
2. To formulate explicit & implicit algorithms for solving the Euler and Navier Stokes Eqns.
3. To understand the concepts of modes of heat transfer.
4. To impart knowledge about turbulence models.
5. To educate the compressible and incompressible flow techniques.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **GOVERNING DIFFERENTIAL EQUATION AND FDM** Classification, Initial and Boundary conditions – Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test. | 10 |
| II | **CONDUCTION HEAT TRANSFER** Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems. | 10 |
| III | **INCOMPRESSIBLE FLUID FLOW** Governing Equations, Stream Function – Verticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, finite difference approach. | 10 |
| IV | **CONVECTION HEAT TRANSFER AND FEM** Steady One-Dimensional and Two-Dimensional Convection – diffusion, unsteady one dimensional convection – diffusion, Unsteady two-dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM. | 10 |
| V | **TURBULENCE MODELS** Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes. | 5 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Students shall be able to

CO1: Understand about compressible and incompressible flow fluids.
CO2: Select the governing equations for conduction and convection fluid flow applications.
CO3: Acquire knowledge about grid generation, processing and applications of CFD.
CO4: Develop skills in finite element modeling techniques.
CO5: Execute the principles in real time thermal and fluid problems.

**TEXT BOOKS:**

T1- Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
T2- Ghoshdasdidar, P.S., "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.

**REFERENCE BOOKS:**

R1- Subas, V.Patankar "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980.
R2- Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer " Hemisphere Publishing Corporation, New York, USA,1984.
R3- Bose, T.X., "Numerical Fluid Dynamics" Narosa Publishing House, 1997.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2306 | COMPUTER INTEGRATED PRODUCTION AND INVENTORY SYSTEM | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To familiarize the student with current trends in production management activities.
2. To impress and prepare them to use modern technologies in future management systems.
3. To learn about aggregate and resource planning.
4. To impart knowledge about shop floor control.
5. To acquire computer process control and monitoring methods.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **PRODUCTION PLANNING AND CONTROL AND FORECASTING** Introduction :Production Planning and Control-Traditional Production Planning and Control – Problems with Traditional Production Planning and Control-Computer-Integrated Production Management System-Engineering and manufacturing data base –Forecasting - Qualitative methods: Delphi technique, Market research, Intrinsic methods-Time series-moving averages-exponential smoothing- Extrinsic methods-regression-forecast errors-numerical problems. | 9 |
| II | **AGGREGATE PLANNING** Planning hierarchy-Aggregate production planning (APP)-need-Alternatives for managing supply and demand-basic strategies-numerical problems-APP methods-Master Production Scheduling. | 8 |
| III | **RESOURCE PLANNING** Inventory Management - Inventory types and general control procedures-Order point systems-The inventory management module- -Material Requirements Planning- Basic MRP Concepts-capacity requirements planning-Distribution requirements planning-Independent versus dependent demand-Lumpy demand-Lead times-Common use items-Inputs to MRP-numerical problems- Manufacturing Resource planning-Enterprise planning. | 10 |
| IV | **SHOP FLOOR CONTROL** Shop Floor Control -Functions of Shop Floor Control-Priority control and assignment of shop orders- Maintain information on work-in-process-Monitor shop order status-Production output data for capacity control-The Shop Floor Control System -Order release-Order scheduling-Order progress- Operation Scheduling-An overview of the scheduling problem-Priority rules for job sequencing-The Factory Data Collection System-Job traveler-Employee time sheet-Operation tear strips-Centralized shop terminal-Individual work center terminals-Voice data input. | 9 |
| V | **COMPUTER PROCESS MONITORING AND CONTROL** Computer Process Monitoring: Data logging systems-Data acquisition systems-Multilevel scanning-Computer Control: Computer-Process Interfacing-Manufacturing Process Data-System Interpretation of Process Data-Interface Hardware Devices-Digital Input/Output Processing Interrupt system - Control programming-Computer Process Control-Structural Model of a Manufacturing Process-Process Control Strategies-Distributed Control versus Central Control- Supervisory Computer Control. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Improve knowledge in failure modes and effect analysis.
CO2: Improve knowledge in accelerated testing concept.
CO3: Increase the software skill in reliability.
CO4: Prepare resource planning activities.
CO5: Execute the process control methods in industries.

**TEXT BOOKS:**

T1- Groover, M.P. and Zimmers, JR E.R.,"CAD/CAM: Computer-Aided Design and Manufacturing", Prentice Hall 1983.
T2- Mahapatra, P.B.," Computer-Aided Production Management", Prentice-Hall of India Pvt Ltd, 2004.

**REFERENCE BOOKS:**

R1-Singh, N., "Systems Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, 1996.
R2- Mahadevan "Operations Management: Theory and practice", Pearson, 2010.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman 23

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC2307 | ADVANCES IN WELDING AND CASTING TECHNOLOGY | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To impart knowledge on advances in welding and casting technology, cast design and advanced welding and casting processes.
2. To acquire information on metallurgical process.
3. To understand the heat treatment methods.
4. To learn the foundry procedures.
5. To familiarize robot technology in welding process.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **WELDING DESIGN AND METALLURGY** Weld joint design- Heat Affected Zone (HAZ) - Weldability of steels - Cast iron - Stainless steels, aluminum, copper and titanium alloys - Hydrogen embrittlement - Pre and Post weld heat treatments - Weld defects. | 10 |
| II | **SPECIAL WELDING PROCESSES** Friction welding process - effects of speed and pressure –Types- Explosive welding –Process Parameters-Plasma arc welding - Electron beam welding - High frequency induction welding - Diffusion bonding -Types- Cold pressure welding - Ultrasonic welding - Laser beam welding. | 10 |
| III | **CASTING DESIGN AND METALLURGY** Design of gate, spruce, riser-design of patterns – design of thin and unequal sections- L,T,V,X,Y junctions-Solidification –Shrinkage – Rapid solidification processing(RSP)-Melt spinning-Roll quenching-Vibratory solidification-Splat cooling. | 8 |
| IV | **SPECIAL CASTING PROCESSES** Evaporative Pattern Casting Process and full mould process –Vaccum sealed moulding- vacuum casting-Magnetic Moulding -Squeeze Casting-types- Plaster mould casting-Ceramic mould casting-Thixoforming or semi solid forming-Single crystal growing. | 8 |
| V | **AUTOMATION OF WELDING AND FOUNDRY** Use of robots in welding- weld positioner and manipulators -weld seam tracking-arc sensing-vision system-automation of foundry-use of robots-moulding machines-Automation of sand plant, moulding and fettling sections of foundry-Dust and fume control. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Improve knowledge in weld and cast design.

CO2: Improve knowledge in foundry and metallurgy processes.

CO3: Develop skills casting design.

CO4: Execute an automation concept in existing conventional machines.

CO5: Implement the latest technologies in welding and casting in industries.

**TEXT BOOKS:**

T1- Heine .R.W, Loper,C.R. and Rosenthal,P.C., "Principles of Metal casting", Tata McGraw- Hill, 1994.
T2- Parmar .R.S "Welding Processes and Technology", Khanna Publishers, 1997.

**REFERENCE BOOKS:**

R1- Jain .P.L "Principles of Foundry Technology", Tata McGraw Hill, 2003.
R2- Timings .R " Fabrication and Welding Engineering", Elsevier Newnes,2008
R3- Weman .K "welding processes hand book", CRC press, 2003.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

# SYLLABUS

**SEMESTER – III**

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/ CAM | 16CC3901 | PROJECT PHASE - I | 0 | 0 | 12 | 6 |

**OBJECTIVES:**

The main objectives of the Project work Phase-I are:

- To identify a problem in the field of Mechanical Engineering and provide solutions, which are technically, economically and environmentally feasible.
- To train the students in preparing a project reports, presentations to face the reviews and final university viva examinations.

**Project work assignment:**

- Enable the students to form a convenient group with not more than four students.
- The project groups are assigned with a supervisor who is the faculty member of the respective department.
- In the case of industrial projects, one additional supervisor may be assigned as external supervisor.
- The students have to identify a technical problem related to the Mechanical Engineering based on the technical knowledge gained during the period of study.
- Four hours per week have been allotted in the time table.
- During project works, students can get the guidance from the supervisor(s), visiting library for literature review, conducting experiments related to the project work, computer simulation studies,field work, visiting industries (in the case of industry sponsored project works), case studies or basic research and development work assigned by the supervisor.
- The student has to make two presentations based on their project works.
- The solutions provided by the students should be technically, economically and environment friendly feasible.
- The project evaluation committee (constituted by the Head of Department) has evaluated the problem identification.
- The students has to consolidate the work as project report, which includes Introduction, Literature review, Modeling or simulation details, Experimental details, Results and discussions and Conclusions.
- The student should follow the guidelines for preparing the project work.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL OF TECH. Chairman HINDUSTHAN COLLEGE OF ENGG.

Dean (Academics)
HiCET

## SEMESTER – IV

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/ CAM | 16CC4902 | PROJECT PHASE - II | 0 | 0 | 24 | 12 |

**OBJECTIVES:**

The main objectives of the Project work are:

- To learn the practical knowledge and skills in the field of Mechanical Engineering.
- To get an experience and confidence level in a particular domain.
- To train the students in preparing a project report to face the reviews and viva examinations.

**Project work assignment:**

- Enable the students to form a convenient group of not more than four students and assigning them in a task involving theoretical and experimental studies related to Mechanical Engineering.
- The project groups are assigned with a supervisor who is the faculty member of the respectivedepartment. In the case of industrial projects, one additional supervisor may be assigned as external supervisor.
- Twelve hours per week have been allotted in the time table. The students can get the guidance from the supervisor(s), visiting library for literature review, conducting experiments related to the project work, computer simulation studies, field work, visiting industries (in the case of industry sponsored project works), case studies or basic research and development work assigned by the supervisor. Moreover, the student has to present three seminars based on the progress of their project works.
- The student has to apply his/her knowledge and skills to identify a suitable problem in the field of Mechanical Engineering and has to provide solutions, which are technically, economically and environment friendly feasible solution.
- The project evaluation committee (constituted by the Head of Department) has evaluated the project progress based on three reviews.
- The students has to consolidate the comprehensive review report, which includes Introduction (An Overview, Background and motivation, Objectives and methodology), Literature review (the studies reported during last ten years, problem identification and solution), Modeling or simulation details (equations used in the modeling, assumptions, specifications, details of the project work etc.), Experimental details (Description of experimental setup, instrumentation, experimental procedure), Results and discussions (comprehensive summary of experimental observations and discussions on improvements observed) and Conclusions (comprehensive summary of the major outcomes observed in the project work). The student should follow the guidelines for preparing the project work.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

## LIST OF ELECTIVES

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3301 | ENTERPRISE RESOURCE PLANNING | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To impart to students the basic concepts of Enterprise Resource Planning and its role in improving the business dynamics.
2. To enable the students about ERP system packages.
3. To learn the applications of ERP.
4. To acquire knowledge about Indian companies on ERP.
5. Able to focus on organizational and social issues.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **ENTERPRISE RESOURCE PLANNING** Principle – ERP framework – Business Blue Print – Business Engineering vs Business process Re-Engineering – Tools – Languages – Value chain – Supply and Demand chain – Extended supply chain management – Dynamic Models –Process Models. | 10 |
| II | **TECHNOLOGY AND ARCHITECTURE** Client/Server architecture – Technology choices – Internet direction – Evaluation framework – CRM – CRM pricing – chain safety – Evaluation framework. | 10 |
| III | **ERP SYSTEM PACKAGES** SAP, People soft, Baan and Oracle – Comparison – Integration of different ERP applications – ERP as sales force automation – Integration of ERP and Internet – ERP Implementation strategies – Organisational and social issues. | 10 |
| IV | **ERP APPLICATIONS** Overview – Architecture – AIM – applications – Oracle SCM. SAP : Overview – Architecture – applications -Before and after Y2k – critical issues – Training on various modules of IBCS ERP Package-Oracle ERP and MAXIMO, including ERP on the NET | 7 |
| V | **ERP PROCUREMENT ISSUES** Market Trends – Outsourcing ERP – Economics – Hidden Cost Issues – ROI – Analysis of cases from five Indian Companies. | 8 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Upon completion of the course, the students will be able to

CO1: Provide an integrated view of the various facets of business, including planning, manufacturing, sales, finance and marketing.

CO2: Understand the development of software to integrate business activities such as inventory management and control, order tracking, customer service, finance and human resources.

CO3: Become aware of the software applications and tools those are available to business to use to drive out costs and improve efficiency.

CO4: Execute the ERP technology and architecture in companies.

CO5: Educate about organizational and social issues.

**TEXT BOOKS:**

T1- Sadagopan.S, ERP-A Managerial Perspective, Tata Mcgraw Hill, 1999.
T2- Vinod Kumar Crag and N.K.Venkitakrishnan , Enterprise Resource Planning –Concepts and Practice, Prentice Hall of India, 1998.

**REFERENCE BOOKS:**

R1- Jose Antonio Fernandez , The SAP R/3 Handbook, Tata Mcgraw Hill, 1998.
R2- ERPWARE , ERP Implementation Framework, Garg&Venkitakrishnan, Prentice Hall, 1999.
R3- Thomas E Vollmann and BeryWhybark , Manufacturing and Control Systems, Galgothia Publications, 1998.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL * Chairman * HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3302 | INDUSTRIAL SAFETY MANAGEMENT | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To eliminate accidents causing work stoppage and production loss.
2. To reduce workman's compensation, insurance rate and all the cost of accidents.
3. To educate all members regarding the safety principles to avoid accidents in industry.
4. To achieve better morale of the industrial employees.
5. To increase production means to a higher standard of living.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **SAFETY MANAGEMENT**<br>Evaluation of modern safety concepts - Safety management functions - safety organization, safety department - safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity. | 9 |
| II | **OPERATIONAL SAFETY**<br>Hot metal Operation - Boiler, pressure vessels - heat treatment shop - gas furnace operation - electroplating- hot bending pipes - Safety in welding and cutting. Cold-metal Operation - Safety in Machine shop - Cold bending and chamfering of pipes - metal cutting - shot blasting, grinding, painting - power press and other machines. | 9 |
| III | **SAFETY MEASURES**<br>Layout design and material handling - Use of electricity - Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries - planning, security and risk assessments, on- site and off site. Control of major industrial hazards. | 9 |
| IV | **ACCIDENT PREVENTION**<br>Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid- Fire fighting devices - Accident reporting, investigation. | 9 |
| V | **SAFETY, HEALTH, WELFARE & LAWS**<br>Safety and health standards - Industrial hygiene - occupational diseases prevention - Welfare facilities - History of legislations related to Safety-pressure vessel act-Indian boiler act - The environmental protection act - Electricity act - Explosive act. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

At the end of this course, the students will have knowledge about:

CO1: Process safety management (PSM).
CO2: Maintenance principles and procedures.
CO3: Inspection engineering principles, procedures and instruments.
CO4: Safety in laboratories.
CO5: Hazards due to noise principles, measurement, safe limits and protective.

**TEXT BOOKS:**

T1-John V. Grimaldi and Rollin H.Simonds, "Safety Management", All India Travellers bookseller, Delhi-1989.
T2-Krishnan N.V., "Safety in Industry", Jaico Publisher House, 1996.

**REFERENCE BOOKS:**

R1- Managing emergencies in industries, Loss Prevention of India Ltd., Proceedings, 1999.
R2- Safety security and risk management by U.K. Singh & J.M. Dewan, A.P.H. Publishing Company, New Delhi, 1996.
R3-Occupational Safety Manual BHEL.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL ★ Chairman ★ HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3303 | RELIABILITY IN ENGINEERING SYSTEMS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To explain how system reliability can be measured and how reliability growth models can be used for reliability prediction.
2. To describe safety arguments and how these are used.
3. To discuss the problems of safety assurance.
4. To introduce safety cases and how these are used in safety validation.
5. To apply methods for estimating the likely reliability of new designs, and for analyzing reliability data.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **RELIABILITY CONCEPT**<br>Reliability definition – Quality and Reliability– Reliability mathematics – Reliability functions – Hazard rate – Measures of Reliability – Design life –A priori and posteriori probabilities – Mortality of a component –Bath tub curve – Useful life. | 9 |
| II | **FAILURE DATA ANALYSIS**<br>Data collection –Empirical methods: Ungrouped/Grouped, Complete/Censored data – Time to failure distributions: Exponential, Weibull – Hazard plotting – Goodness of fit tests. | 11 |
| III | **RELIABILITY ASSESSMENT**<br>Different configurations – Redundancy – m/n system – Complex systems: RBD – Baye's method – Cut and tie sets – Fault Tree Analysis – Standby system. | 10 |
| IV | **RELIABILITY MONITORING**<br>Life testing methods: Failure terminated – Time terminated – Sequential Testing –Reliability growth monitoring – Reliability allocation – Software reliability. | 8 |
| V | **RELIABILITY IMPROVEMENT**<br>Analysis of downtime – Repair time distribution – System MTTR – Maintainability prediction – Measures of maintainability – System Availability – Replacement theory. | 7 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Understand the concept of probability theory, distribution, network modelling and reliability analysis.
CO2: Describe the reliability functions with their relationships and Markov modeling.
CO3: Evaluate reliability models using frequency and duration techniques and generate various reliability models.
CO4: Explicate the reliability of composite systems and distribution systems.
CO5: Develop skills on Reliability assessment, monitoring and analysis.

**TEXT BOOKS:**

T1-An Introduction to Reliability and Maintainability Engineering by Charles E Ebeling , waveland press, 2009.
T2-Practical Reliability Engineering 5th Ed, by Patrick P. O'Connor , Andre Kleyner, Wiley publisher, 2012.

**REFERENCE BOOKS:**

R1- Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", TMH, 2000.
R2- Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2007.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3304 | NANO TECHNOLOGY | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To expose the students to the evolution of Nano systems, to the various fabrication techniques.
2. To impart knowledge about nano materials and various nano measurements techniques.
3. Elucidate emerging needs in nanotechnology environment, health; and safety, and incorporate them into basic education that can be immediately employed in industry.
4. Promote interdisciplinary interactions among engineering, engineering technology, science, and industrial management/technology majors.
5. Assess the effectiveness of the newly developed concepts of nano technology.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **OVER VIEW OF NANOTECHNOLOGY**<br>Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects. | 6 |
| II | **NANODEFECTS, NANO PARTILES AND NANOLAYERS**<br>Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties. | 8 |
| III | **NANOSTRUCTURING**<br>Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishing of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends | 8 |
| IV | **SCIENCE AND SYNTHESIS OF NANO MATERIALS**<br>Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes. | 12 |
| V | **CHARACTERIZATION OF NANO MATERIALS**<br>Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems. | 11 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Function effectively in a laboratory environment using complex instrumentation machinery and protocols
CO2: Independently seek out innovations in the rapidly changing field of nano-technology
CO3: Compile and analyze data and draw conclusions at the nano level.
CO4: Design, implement and document experiments.
CO5: Collaborate and communicate effectively in a high tech environment.

**TEXT BOOKS:**

T1- Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
T2- Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003

**REFERENCE BOOKS:**

R1- Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
R2- Fahrner W.R.,Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL ★ HINDUSTHAN COLLEGE OF ENGG & TECH ★ Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3305 | VIBRATION ANALYSIS AND CONTROL | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To understand the fundamentals of vibration and its practical applications.
2. To understand the working principle and operations of various vibration measuring instruments.
3. To expertise in vibration measurements and control.
4. To acquire knowledge of degrees of freedom.
5. To educate about experimental methods.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **FUNDAMENTALS OF VIBRATION**<br>Undammed Free Vibrations: Single Degrees of Freedom Systems - D Alembert's Principle, Energy method, Rayleigh method, simple applications, equivalent spring stiffness. Damped Free Vibrations: Single Degrees of Freedom System -different types of damping, Viscous damping, sub-critical, critical and over damping, logarithmic decrement, and frequency of damped oscillations. Forced Vibrations: Single Degrees of Freedom System - Solution for simple harmonic excitation, steady state vibrations, Rotating and reciprocating unbalance, base excitation, vibration isolation and transmissibility, whirling of shaft without friction. | 9 |
| II | **TWO DEGREE OF FREEDOM SYSTEM**<br>Introduction-Free vibration of undamped and damped systems - Forced vibration with Harmonic excitation System –Coordinate couplings and Principal Coordinates. | 9 |
| III | **MULTI-DEGREE OF FREEDOM SYSTEMS**<br>Lagrange's equation, Dunkerley's approximation method, Rayleigh method, matrix method, matrix iteration, orthogonality principle, modal analysis, Stodola method, Holzer method, Galerkin method, Rayleigh - Ritz method. | 9 |
| IV | **CONTINUOUS SYSTEMS AND VIBRATION CONTROL**<br>Continuous Systems -Longitudinal vibrations of bar, transverse vibration of beam, torsion of vibrations of circular shaft with various end conditions. 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 - Active Vibration Control. | 9 |
| V | **EXPERIMENTAL METHODS IN VIBRATION ANALYSIS**<br>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. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

Student shall be able to

CO1: Detect the problem of machine tool vibration.

CO2: Analyze the problem to get rid of any machine vibration trouble.

CO3: Attain the vibration control methods.

CO4: Develop skills on experimental methods.

CO5: Execute the principles in real time vibration problems.

**TEXT BOOKS:**

T1- Singh V.P, "Mechanical Vibrations", Dhanpat Rai and Company Pvt. Ltd., 3rd ed., 2006.
T2- Rao S.S , "Mechanical Vibrations", Pearson Education, 2004

**REFERENCE BOOKS:**

R1- Thomson W.T, "Theory of Vibration with Applications", Prentice Hall of India, 1997.
R2- Ashok Kumar Mallik, "Principles of Vibration Control", Affiliated East-West Press Pvt. Ltd, 1990.
R3- Lewis H Bell, "Industrial Noise Control Fundamentals and Applications", Marcel Dekkev Inc. 1982.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3306 | SUPPLY CHAIN MANAGEMENT | 3 | 0 | 0 | 3 |

**Course Objectives**

To provide the student with the knowledge of,

1. Logistics management, network design, sourcing, pricing, coordination and technology in supply chain management.
2. Customer service performance improvement.
3. Reduction of pre & post production inventory.
4. Flexible planning and control procedures.
5. Product Quantity control.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Definition of Logistics and SCM: Evaluation, Scope Importance & Decision phases – Drivers of SC performance and Obstacles. | 6 |
| II | **LOGISTICS MANAGEMENT**<br>Factors – Modes of transportation – Design options for transportation Networks - Routing and Scheduling – Inbound and outbound logistics –Reverse Logistics – 3PL – Integrated Logistics concepts- Integrated Logistics Model – Activities – Measuring logistics cost and performance – Warehouse Management – Case Analysis. | 10 |
| III | **SUPPLY CHAIN NETWORK DESIGN**<br>Distribution in supply chain – Factors in Distribution network design – design Options – Network Design in supply chain – Framework for network Decisions – Managing cycle inventory and safety. | 10 |
| IV | **SOURCING AND PRICING IN SUPPLY CHAIN**<br>Supplier Selection and contracts – design collaboration – Procurement process. Revenue management in supply chain. | 9 |
| V | **COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN**<br>Supply Chain Coordination – Bullwhip effect of lack of Coordination and obstacles – IT and SCM – supply Chain IT frame work. E Business & SCM. Metrics for SC performance – Case Analysis. | 10 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: At the end of this course the student should be able to manage logistics and supply chain of a factory or an organization.
CO2: Solving supplier's problems and beyond level.
CO3: Minimizing variance by means of activities like standardization, variety reduction, etc.
CO4: Attain Minimum total cost of operation & procurement.
CO5: Achieving maximum efficiency in using labour, capital & plant through the company.

**TEXT BOOKS:**

T1- Chopra, S. and Meindl, P., "Supply chain management, Strategy, Planning, and Operation ", PHI, Second edition, 2004.
T2- Christopher, M., "Logistics and Supply Chain Management – Strategies for Reducing Cost and Improving Service", Pearson Education Asia, Second Edition.

**REFERENCE BOOKS:**

R1- Bloomberg, D.J., Lemay, S. and Hanna, J.B.,'Logistics", PHI 2002.
R2- Shapiro, J.F. and Duxbury, T., "Modeling the supply Chain", 2002.
R3- Ayers, J.B., "Handbook of Supply Chain Management", Taylor and Francis Group, 2006.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman 33

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3307 | DESIGN AND ANALYSIS OF EXPERIMENTS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To contextualize outputs where data are drawn from diverse and evolving social, political and cultural dimensions.
2. To reflect on experience and improve your own future practice.
3. To apply the principles of lifelong learning to any new challenge.
4. To bring together and flexibly apply knowledge to characterise, analyse and solve a wide range of problems.
5. To locate and use data and information and evaluate its quality with respect to its authority and relevance.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **EXPERIMENTAL DESIGN FUNDAMENTALS** Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, and linear regression models. | 6 |
| II | **SINGLE FACTOR EXPERIMENTS** Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests. | 9 |
| III | **MULTIFACTOR EXPERIMENTS** Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F- tests. 2K factorial Experiments. | 9 |
| IV | **SPECIAL EXPERIMENTAL DESIGNS** Blocking and confounding in 2k designs. Two level Fractional factorial design, nested designs, Split plot design, Response Surface Methods. | 9 |
| V | **TAGUCHI METHODS** Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization. | 12 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

On completion of this course you should be able to:

CO1: Critically review basic concepts and models of experimental design.

CO2: Analyze the results of a designed experiment in order to conduct the appropriate statistical analysis of the data.

CO3: Interpret statistical results from an experiment and report them in non-technical language.

CO4: Prepare new solutions for existing issues.

CO5: Execute various method of solution in different areas.

**TEXT BOOKS:**

T1- Krishnaiah, K. and Shahabudeen, P. Applied Design of Experiments and Taguchi Methods, PHI learning private Ltd., 2012.

T2- Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, Eighth edition, 2012.

**REFERENCE BOOKS:**

R1- Nicolo Belavendram, Quality by Design; Taguchi techniques for industrial experimentation, Prentice Hall, 1995.

R2- Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 1996.

R3- Montgomery, D.C., Design and Analysis of Experiments, Minitab Manual, John Wiley and Sons, Seventh edition, 2010.

Chairman - BoS
MECH - HiCET

HINDUSTHAN ACADEMIC COUNCIL ★ HINDUSTHAN COLLEGE OF ENGG & TECH ★ Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CC3308 | OPTIMIZATION TECHNIQUES IN DESIGN | 3 | 0 | 0 | 3 |

**Course Objectives**

1. To impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
2. To Formulate design problems as mathematical programming problems.
3. To Understand the need and origin of the optimization methods.
4. To Get a broad picture of the various applications of optimization methods used in engineering.
5. To familiarize the concepts of static and dynamic applications.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **UNCONSTRAINED OPTIMIZATION TECHNIQUES** Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods. | 10 |
| II | **CONSTRAINED OPTIMIZATION TECHNIQUES** Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming. | 10 |
| III | **ADVANCED OPTIMIZATION TECHNIQUES** Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing techniques; Neural network & Fuzzy logic principles in optimization. | 10 |
| IV | **STATIC APPLICATIONS** 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. | 8 |
| V | **DYNAMIC APPLICATIONS** Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms. | 7 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

After completion of this course the student should be able to

CO1: Help the engineers to get familiarized with the different approaches of optimizing (maximizing or minimizing) an engineering problem or a function which is essentially required in industries.

CO2: Formulate and solve Problems which arises in companies.

CO3: Solve non linear Programming Problems.

CO4: Apply search methods to solve constrained and unconstrained optimization Problems.

CO5: Solve optimization problems using evolutionary techniques.

**TEXT BOOKS:**

T1- Rao, Singaresu, S., "Engineering Optimization – Theory & Practice", New Age International (P) Limited, New Delhi, 2000.

T2- Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.

**REFERENCE BOOKS:**

R1-Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India Pvt. 1995.

R2-Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison- Wesley, New York, 1989.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dean (Academics)
HiCET

## OPEN ELECTIVE

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CCX401 | MICRO ELECTRO MECHANICAL SYSTEMS | 3 | 0 | 0 | 3 |

**Course Objectives**

1. Understand various concepts of Micro Electro Mechanical Systems.
2. Study important methods of fabrication process and its materials.
3. Gain knowledge about the concepts of micromechanics.
4. To learn about micro system manufacturing.
5. Study the design considerations of micro system.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION**<br>Overview-Microsystems and microelectronics - Working principle of Microsystems -micro actuation techniques-micro sensors-types-micro actuators-types-micro pump-micro motors and micro valves-micro grippers-scaling laws-scaling in geometry-scaling in rigid body dynamics-scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics and scaling in heat transfer. | 9 |
| II | **MATERIALS AND FABRICATION PROCESS**<br>Substrates and wafer-single crystal silicon wafer formation-ideal substrates-mechanical properties-silicon compounds - Sio2, SiC, Si3N4 and polycrystalline silicon – Silicon piezo resistors - Gallium arsenide, Quartz-piezoelectric crystals-polymers for MEMS - conductive polymers – Photolithography - Ion implantation - Diffusion – Oxidation –CVD - Physical vapor deposition - Deposition by epitaxy - etching process. | 9 |
| III | **MICROMECHANICS**<br>Introduction-static bending of thin plates-circular plates with edge fixed - rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- micro accelerometers-design theory and damping coefficients- thermo mechanics thermal Stresses-fracture mechanics-stress intensity factors, fracture toughness and interfacial fracture mechanics. | 9 |
| IV | **MICRO SYSTEM MANUFACTURING**<br>Clean room technology-Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA Micro System packaging-materials-die level-device level-system level-packaging techniques-die preparation-surface bonding-wire bonding-sealing. | 9 |
| V | **MICRO SYSTEM DESIGN**<br>Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Understand the principles of Microsystems.
CO2: Identify the fabrication process and its materials.
CO3: Gain knowledge about structural and thermal micromechanics.
CO4: To analyze the micro system manufacturing.
CO5: Able to explain the design principles of Micro system techniques

**TEXT BOOKS:**

T1 - Mohamed Gad-el-Hak, The MEMS Hand book, CRC press 2002.
T2 - Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim,Microsensors MEMS and Smart Devices, John Wiby & sons Ltd.,2001.

**REFERENCE BOOKS:**

R1 – Fatikow .S, Rembold .U, Microsystem Technology and Microrobotics, Springer-Verlag Berlin Heidelberg, 1997.
R2 - Tai-Ran Hsu,MEMS & Microsystems Design and Manufacture,Tata McGraw-Hill,2006.
R3 – Francis E.H Tay and W.O Choong, Microfludics and BioMEMS Applications, Springer, 2002.

Chairman - BoS
MECH - HiCET

HINDUSTHAN COLLEGE OF ENGG & TECH ACADEMIC COUNCIL Chairman

Dean (Academics)
HiCET

| Programme | Course Code | Name of the Course | L | T | P | C |
|---|---|---|---|---|---|---|
| M.E. CAD/CAM | 16CCX402 | QUALITY MANAGEMENT TECHNIQUES | 3 | 0 | 0 | 3 |

**Course Objectives**

1. Learn various methods of quality functions.
2. Study important methods of planning and analysis in quality.
3. Introduce principles of quality management.
4. To learn about TQM tools and techniques.
5. Gain knowledge about systems of quality.

| Unit | Description | Instructional Hours |
|---|---|---|
| I | **INTRODUCTION** Need for TQM, evolution of quality, Definition of quality, TQM philosophy – CONTRIBUTIONS OF Deming Juran, Crosby and Ishikawa, TQM models. | 9 |
| II | **PLANNING** Vision, Mission, Quality policy and objective Planning and Organization for quality, Quality policy Deployment, Quality function deployment, introduction to BPR and analysis of Quality Costs. | 9 |
| III | **TQM PRINCIPLES** Customer focus, Leadership and Top management commitment, Employee involvement – Empowerment and Team work, Supplier Quality Management, Continuous process improvement, Training, performance Measurement and customer satisfaction. | 9 |
| IV | **TQM TOOLS AND TECHNIQUES** PDSA, The Seven Tools of Quality, New Seven management tools, Concept of six sigma, FMEA, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles. | 9 |
| V | **QUALITY SYSTEMS** Need for ISO 9000 Systems, clauses Documentation, Implementation, Introduction to ISO14000 and OSHAS18000, Implementation of TQM, Case Studies. | 9 |
| | **Total Instructional Hours** | **45** |

**Course Outcomes**

CO1: Understand the principle of Quality Management Techniques.
CO2: Identify Quality policy and planning techniques
CO3: Gain knowledge about Total Quality Management system.
CO4: To analyze TQM measurements and techniques.
CO5: Explain the principle of documentation and Implementation.

**TEXT BOOKS:**

T1 - Dale H.Besterfiled, "Total Quality Management", Pearson Education Asia, (Indian reprint 2002)
T2 - Narayana V. and Sreenivasan, N.S., "Quality Management – Concepts and Tasks", New Age International 1996.

**REFERENCE BOOKS:**

R1 - Oakland.J.S. "Total Quality Management", Butterworth–Hcinemann Ltd., Oxford, 1989. R2 - Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.
R3 - Brain Rethery, ISO 9000, Productivity and Quality Publishing Pvt.Ltd., 1993.

Chairman - BoS
MECH - HiCET

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET