**ME401U OPERATION RESEARCH**

**Teaching Scheme: 03L+01T, Credit: 04**

**Evaluation Scheme: 30MSE + 10 ISA + 60 ESE Total Marks: 100**

**Duration of ESE: 03Hrs**

**Course Description:**

This course introduces under graduate students to imparting knowledge of various decision making techniques.

**Course Objectives:**

On successful completion of this course student shall be able to:

1. provide about Operational research and its model.

2. develop knowledge about Linear programming.

3. develop knowledge about transportation, assignment and Sequencing model.

**Course Outcome:**

On successful completion of this course student shall be able to:

1. develop knowledge of operational research and its model.

2. illustrate the need to optimally utilize the resources in various types of industries.

3. apply and analyze mathematical optimization to various applications.

4. demonstrate cost effective strategies in various applications in industry

**Relevance of COs /POs and strength of co-relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **3** |  |  |  |  |  |  | **1** |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  | **1** | **2** |  |  |  |  |  |  |  |  |  | **2** | **-** | **-** |
| **CO 3** |  |  |  |  | **3** |  |  |  |  |  |  |  | **-** | **-** | **1** |
| **CO 4** |  | **2** |  |  |  | **3** |  |  | **2** |  |  |  | **-** | **-** | **-** |

1. Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Contents**

**Introductions to Operation Research**

Scope, applications of operations research, phases and models of operations research, advantages and limitations of operations research and applications of operations research.

**Linear Programming-**

Formulation of LPP, graphical method of solution, simplex method, artificial variable technique- Big M method, two phase method, duality in LPP, sensitivity analysis.

**Transportation Model**

Mathematical formulation of TP, methods to obtain initial basic feasible solution, TP without degeneracy and with degeneracy.

**Assignment Model and Game Theory**

Introduction, mathematical models of assignment problem, solution method of assignment problem, hungarian method, maximization case, unbalanced restrictions on assignment, travelling salesman, and problem, introduction to theory of games ,two person zero sum game, pure strategies, maximin, minimax principles, game with saddle point, mixed strategy games, the principles of dominance ,games without saddle point, algebraic method, arithmetic method, sub game method, graphical method.

**Replacement and Queuing Theory**

Replacement and maintenance method- introduction, types of failure- gradual failure ,sudden failure replacement of items whose efficiency deteriorates with time, replacement of items that completely fail, individual replacement policy, group replacement policy, staffing problem ,failure trees, introduction to queuing theory, elements of queuing theory, characteristic of waiting lines, service discipline, service mechanism, terminology and notations for queuing system.

**Inventory control**

Inventory control: need and types of inventory, inventory associated costs, Economic Order Quantity (EOQ), classical EOQ model with uniform demand rate and infinite replenishment, EOQ model with multiple price breaks.

**Text Book**

* 1. Optimization Concepts and Applications in engineering, Belegundu, 2nd edition, Cambridge Uni.Press, India, 2018**.**
  2. Operations Research, Hillier F.S., and Lieberman G.J., 8th Edition, Mc. Tata

McGraw Hill, India,2010.

* 1. Engineering optimization Methods and Appliations, Ravindran, 2nd edition, Wiley, India,2011.
  2. Operations Research Principles and Practice, Ravindran, Phillips and Solberg, 2nd Edition,Mc. WSE Willey, 2014.
  3. Operations Research - An introduction, Hamdy A Taha, 3rd edition, Pearson Education, 2009.

**Reference Books**

1. Quantities Techniques, L.C. Jhamb , Vol I and II, Everest Publication.

2. Operation Research, S.D. Sharma, Khanna Publication.

3. Operation Research, Problem and Solution, J. K. Sharma, Macmillan

4. Quantitative Techniques in Management, N. D. Vohra, TATA McGraw Hill.

5. Operation Research Principles and Practice, Ravindran, Wiley India Pvt. Ltd. New Delhi.

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| **ME402UA REFRIGERATION AND AIR CONDITIONING**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30 MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  This course introduces undergraduate students to refrigeration and air conditioning. The background required includes a sound knowledge of mathematics (Calculus), engineering thermodynamics, applied thermodynamics and fluid mechanics of second year level. The course aims at imparting knowledge of refrigeration processes and air conditioning system |
| **Desirable awareness:**  Fundamental knowledge of physics and engineering thermodynamics |
| **Course Objectives:**  The Student should able to:   1. learning the fundamental principles and different methods of refrigeration and air   conditioning.   1. study of various refrigeration cycles and systems for evaluating their performance . 2. present the properties, applications and environmental issues of different refrigerants. 3. operate and analyze the refrigeration and air conditioning systems. |
| **Course Outcomes:**  On successful completion of this course student shall be able to:   1. understand the fundamental methods of refrigeration and air conditioning. 2. analyze various refrigeration and air conditioning system. 3. evaluate impact of refrigerants and refrigeration and air conditioning system environmental issues. 4. apply the basic knowledge for designing the different refrigeration and air conditioning system |

**Relevance of COs /POs and strength of co-relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **3** |  |  |  |  |  |  | **1** |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  | **1** | **2** |  |  |  |  |  |  |  |  |  | **2** | **-** | **-** |
| **CO 3** |  |  |  |  | **3** |  |  |  |  |  |  |  | **-** | **-** | **1** |
| **CO 4** |  | **2** |  |  |  | **3** |  |  | **2** |  |  |  | **-** | **-** | **-** |

1. Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content:**

**Fundamentals and Applications of Refrigeration and Air Conditioning** Fundamentals reverse carnot cycle, block diagram of refrigerator & heat pump (numerical), modified reverse carnot cycle (Bell Coleman cycle) applications domestic refrigerator, domestic air conditioners, automotive air conditioners, evaporative coolers, water coolers, commercial refrigeration- dairy, cold storage, ice plant, commercial air conditioning multiplex, hospitals,introduction to cryogenics.

**Refrigerants and Vapour Compression Cycle**

Refrigerants classification of refrigerants, desirable properties of refrigerants, environmental issues, ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, zeotropes and azeotropes, refrigerant: recovery reclaims, recycle and recharge, vapour compression cycle working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC, actual VCC, methods of improving COP using flash chamber, sub-cooling, liquid vapour heat exchanger, comparison of VCC with Reverse Carnot cycle

**Vapour Absorption Refrigeration System**

Refrigeration systems vapour compression systems Single stage, two stage and cascade VCC systems using single and multi-evaporators vapour absorption systems, introduction, working, desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VAS, comparison between VCC and VAC,

**Air Conditioning System**

Introduction to air conditioning, psychometric, psychometric properties and terms, psychometric relations, Psychometric processes and its representation on psychometric chart, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. (Numerical Treatment).working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning. components of refrigeration and air conditioning systems working of reciprocating, working of air cooled, water cooled and evaporative condensers, working of DX, flooded, forced feed evaporators, Expansion devices, cooling load calculations.

**Air Distribution Systems** Air handling unit, classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design) fan coil unit, types of fans used in air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke).

**Text Books:**

1. Refrigeration and Air Conditioning, Arora C. P., 4th edition,Tata McGraw-Hill,2003
2. Refrigeration and Air Conditioning, Manohar Prasad,5th edition, Willey Eastern Ltd,

1983

1. Refrigeration & Air Conditioning, Arora and Domkundwar,latest edition, Dhanpatrai & Company, New Delhi,2008
2. Refrigeration and Air conditioning, Khurmi R.S. and Gupta J.K, 2nd edition, Eurasia

Publishing House Pvt. Ltd, New Delhi,2012

5.Refrigeration and Air conditioning, Ballaney P.L.,Latest edition, Khanna Publishers,

New Delhi,1992

**Reference books:**

1. Principles of refrigeration, Dossat Ray J, limited edition, S.I. version, Willey Eastern

Ltd, 2000

1. Refrigeration and Air conditioning, Stockers W.F and Jones J.W., 3rd edition,

McGraw Hill International editions 1982.

1. Thermal Environmental Engineering, Threlkeld J.L, 2nd edition, Prentice Hall Inc.,

New Delhi,2000.

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| **ME406UA REFRIGERATION AND AIR CONDITIONING LAB**  **Teaching Scheme : 02P Credit: 01**  **Evaluation Scheme : 25 ICA +25 ESE Total Marks: 50** |

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**Course Outcomes:**

Learner will be able to

* 1. demonstrate fundamental principles of refrigeration and air conditioning.
  2. identify and locate various important components of the refrigeration and air conditioning system.
  3. represent various refrigeration and air conditioning processes using psychometric chart.
  4. operate and maintain refrigeration system.
  5. operate and maintain air conditioning system

**Relevance of COs /POs and strength of co-relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **3** |  |  |  |  | **2** |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  | **1** |  |  |  | **2** |  |  |  |  |  |  | **2** | **-** | **-** |
| **CO 3** | **2** |  |  |  | **1** |  |  | **1** |  |  |  |  | **-** | **-** | **1** |
| **CO 4** |  | **2** |  |  |  | **3** |  |  | **2** |  |  |  | **-** | **-** | **-** |
| **CO 5** | **2** |  |  | **1** |  |  |  | **2** |  |  |  |  |  |  |  |

1. Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content:**

**Internal continuous assessment performance shall be based on ME402UA and consist of following assignments and projects**

The term work shall consist of minimum **eight experiments** out of the following:

1. Test on Domestic Refrigerator for evaluation of EER
2. Test on vapour compression test rig
3. Test on air conditioning test rig
4. Test on ice plant test rig
5. Visit to Vapour absorption refrigeration plant
6. Estimation of cooling load of simple air conditioning system (case study)
7. Case study on cold storage
8. Visit to any air conditioning plant
9. Thermal analysis of refrigeration cycle using suitable software
10. Installation and servicing of split air conditioner

**Guidelines for ICA:** Internal continuous assessment should support for regular performance of practical and its regular assessment with proper understanding principle of practical completed.

**Guidelines for ESE:** Oral will be based on content of syllabus and practical.

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| **ME402UB ADVANCE MACHINE DESIGN**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30 MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  This course introduces undergraduate students to different parts of machines, failure criteria and conventional design procedures. |
| **Desirable awareness:**  A sound knowledge of Mathematics, Engineering Mechanics, SOM, TOM and Machine Drawing are require. |
| **Course Objectives:**  On completion of this course student should be able to:   1. understand procedure of machine design and develop an ability to apply it for simple   component design.   1. understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure. 2. consider cost, reliability and durability factors 3. make design sound and safe and maintenance free or easy to maintenance. |
| **Course Outcomes:**  On completion of this course student should be able to:   1. analyze the stresses and strains induced in a machine element. 2. design and plan the product development 3. understand and identify the threats in upcoming conventional and computerized design flaws through customers. 4. design a machine component using theories of failure. |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  |  | **3** |  | **1** |  |  |  |  | **1** | **1** |  |
| **CO 2** |  | **2** |  |  | **1** |  | **3** |  |  |  |  |  |  |  |  |
| **CO 3** |  | **1** |  | **1** |  |  |  | **2** |  |  |  |  |  |  |  |
| **CO 4** | **3** |  |  | **2** |  | **1** |  |  | **1** |  |  |  |  |  |  |

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| **Course Content:** |
| **Need Identification and problem definition, product specification, concept generation**  Design based on - fatigue, fracture, creep criteria, safe life v/s fails safe design and selection, evaluation, creativity methods, concept testing,dynamic design of mechanical equipments: modelling of machine tools, aircraft and automobiles etc. for determining dynamic characteristics and extraction of modal parameters for dynamic design.  **Design for manufacture, assembly, maintenance, casting, forging,**  Design for manufacturing including assembly aspects & other aspects, reliability based design of mechanical components. |
| **Design for Reliability, strength based reliability, parallel and series systems, robust design**  Recent developments in pressure vessel design, testing of pressure vessels as per standards. Computer aided design of pressure vessels |
| **Industrial design**  Design for emotion and experience, introduction to retrofit and eco-design, human behavior in design rotating disc and rotating cylinder:- disc with uniform thickness – disc for uniform strength – stresses in rotating cylinders with and without internal pressure, thermal stress, creep and stress rupture; dynamic and fatigue behaviour. |
| **Bearing Design**  Friction theories, wear & types of wear, lubrication, different modes of lubrication -hydrodynamic, hydrostatic & Elasto-Hydrodynamic, porous bearings, determination of static load capacity of bearing (Stribek’s equation), bearing design & testing,lubrication problems at certain extreme environmental conditions pressure, temperature & vacuum |
| **Material and Component Advance Design &Identifying**  Recent trends in materials handling equipment design, basic principles of design, main girder design, structure analysis , loading patterns, service factors & environmental conditions, testing as per BIS, etc.  **Advances in Gear Design**, gear materials, corrective gear design, gear rating calculation as per BIS, etc Quality Function Deployment – Concurrent engineering. |

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| **Text Books:**   1. Machine Design – An Integrated Approach, Robert L Norton, 10th edition PearsonEducation,2014. 2. Mechanical System Design by Farazdak Haidery, 3rd edition, nirali publication , pune, India, 2009. 3. Material handling equipment by P.Rudenko, 4th edition, MIR Publication, 2015. 4. Handbook of Gear design by G.M. Maitra, vol. –I & II. |
| **Reference books:**   1. Engineering Design by George E. Dieter, McGraw Hill. 2. Mechanical analysis & design by Burr and Cheatham. 3. Engineering Design by George E. Dieter, McGraw Hill. 4. Simulation, modeling and analysis”, Averill M. Law and W. David Kelton “ McGraw Hill Book Company, 1991. 5. Engineering Design–A Systematic Approach – Pahl, G.and W. Beitz, Springer, 2nd Ed., 1996. 6. Product Design and development Karl T. Ulrich, Steven Eppinger. |

**ME406UB ADVANCE MACHINE DESIGN LAB**

**Teaching Scheme:** 02 P, **Total:** 02 **Credit:** 01

**Evaluation Scheme:** 25 ICA + 25 ESE **Total Marks:** 50

**Internal continuous assessment shall consist of Minimum six and three case studies of any product design experiments shall be performed to cover entire curriculum of course ME402UB.**

**List of Assignments:**

1. Assignment on Development processes and organizations, Product Planning

2. Assignment on Need Identification and problem definition, product specification,

concept generation and selection, evaluation, creativity methods, Concept testing

3. Assignment on Design for manufacture, assembly, maintenance, casting, forging,

4. Assignment on Design for Reliability, strength based reliability, parallel and series

systems, robust design,.

5. Assignment on Industrial design: Design for Emotion and experience, Introduction to retrofit and eco design, human behaviour in design

6. Assignment on Rapid Prototyping.

**List of case study:**

1**.** Two case study report shall prepare on product design and its development of any

Components and bunched along with journal of ICA

2. One case study of product development from designing shall be on forged or casted

Parts.

**Guidelines for ICA:**

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S 10).

**Guidelines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

**ME402UC TRIBOLOGY**

**Teaching Scheme:** 03L **Credit:**03

**Evaluation Scheme:** 30MSE + 10 ISA +60ESE **Total Marks:**100

**Duration of ESE:** 3 hours

# Course Description:

The course aim of imparting the knowledge of Tribology. The background required includes knowledge of mathematics, chemistry, engineering materials, and fluid mechanics. The objective of the course is to understand the tribological concept, bearing design and its application, lubrication practices, friction and wear.

# Desirable awareness/skills:

Fundamental Knowledge of Physics, Chemistry, Engineering Math, Fluid Mechanics, Machine Design and Engineering materials.

# Course Objective:

The students should able to

1. know about properties of lubricants, modes of lubrication, additivesetc.
2. select suitable/proper grade lubricant for specificapplication.
3. apply the basic theories of friction, wear and lubrications about frictional behaviour commonly encountered slidingsurfaces.
4. apply and analyze the knowledge of hydrodynamic and hydrostatic bearing.
5. impart Knowledge about gas lubrication.

# Course Outcomes:

On completion of this course student should be able to:

1. understand about the basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of frictionsurfaces.
2. apply of the friction/lubrication mechanisms and know how to apply them to the practical engineeringproblem.
3. design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals and brakingsystems.

# RELEVANCE OF COS / POS AND STRENGTH OF CO RELATION:

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** | **2** |  |  | **3** | **2** |  | **2** |  |  |  |  | **1** |  |  |
| **CO 2** |  |  |  | **3** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO 3** | **2** |  | **2** |  |  |  |  |  |  |  |  |  |  |  |  |
| **CO 4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **1** |
| **CO 5** | **2** |  |  |  | **3** |  |  | **2** |  | **1** |  |  |  |  |  |

1. Weakly correlated 2–Moderately correlated 3–Stronglycorrelated

# Course Content:

**Introduction to Tribology**, tribology in design, tribology in industry, lubricants properties-physical and chemical, Types of additives, extreme pressure lubricants, lubrication-introduction, basic modes of lubrication, tribology of sliding contact bearings and rolling contact bearings.

**Wear, Friction and Lubrication**

Wear- mechanism of wear, types of wear, measurement of wear (wear testing and wear debris analysis). Theory of wear, factor affecting on wear rate, wear prevention. friction: sources of friction, Influence of roughness of friction, coefficient of friction, friction of metals, kinds and measurements of frictions, static and kinematics coefficient of friction, friction control. lubrication: types of lubricants, lubricant coating, lubrication mechanism, squeeze film, hydrodynamic, elasto-hydrodynamic lubrication

**Hydrodynamic Bearings:**

Mechanism of pressure development in oil film in hydrodynamic lubrication, solution of generalized Reynold’s equation, Infinitely long journal bearing, infinitely short journal bearing, thrust bearing, Sommerfield number, Raimondi and Boyd method, temperature rise, parameters of bearing design-Length to diameter ratio, unit bearing pressure, optimal radial clearance and minimum oil film thickness, applications of hydrodynamic bearing.

**Hydrostatic Bearings:**

Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses (numerical treatment). hydrostatic squeeze film: introduction, circular and rectangular plates approaching a plane, applications of hydrostatic bearing.

**Gas Lubrication**:

Introduction, Reynolds equation for gas lubrication, self-acting gas bearing, merits and demerits of gas lubrication, applications, lubrication in metal working: rolling, forging, drawing and extrusion bearing materials and bearing constructions. oil seals and shields, gaskets.

# Text Book

* 1. A Text Book of “Tribology” by Hg Phakatkar, Rr Ghorpade, 2nd revised edition, Nirali Prakashan, Pune, Aug2011.
  2. A Text Book of “Tribology” by R.B.Patil, 1st edition, Tech-Max Publications, Pune, Aug2009
  3. A Text Book of “Introduction to Tribology” by Bharat Bhushan, 2nd Edition, John Wiley and Sons Publication, NY,2013.
  4. A Text book of “Design of Machine Elements by V.B.Bhandari, 4th edition, Tata-McGraw Hill Publication Co. Ltd., Aug2016

# Reference Books

1. Theory and Practice of Lubrication for Engineers, by Fuller D. D., Vol.1, Issue 4, by John Wiley and Sons Publication.1984.
2. The Tribology Hand Book, Neale M. J, Second Edition, Butterworth-Heinemann,1996.
3. Handbook of Tribology Bharat Bhushan. First Edition, Krieger Publishing Company,2000.
4. Principles of Tribology, Halling J, McMillan Press Ltd.2004

**ME406UC TRIBOLOGY LAB**

**Teaching Scheme: 0**2P **Credit:**01

**Evaluation Scheme:** 25ICA+25ESE **Total Marks:**50

# Course Description:

The course aim of imparting the knowledge of Tribology. Main focus of the course is to understand the tribological concept by hands-on experiment, bearing design and its application, lubrication practices, friction and wear.

# Course Objective:

The students should able to

1. know about properties of lubricants, modes of lubrication, additivesetc.
2. select suitable/proper grade lubricant for specificapplication.
3. apply the basic theories of friction, wear and lubrications about frictional behaviour commonly encountered slidingsurfaces.
4. apply and analyze the knowledge of hydrodynamic and hydrostatic bearing.
5. impart Knowledge about gas lubrication.

# Course Outcomes:

On completion of this course student should be able to:

1. study of journal bearing appaeatus, thrust bearing.
2. apply of the friction/lubrication mechanisms and know how to apply them to the practical engineeringproblem through brake line test rig
3. calculate wear ratio and wear measurement through pin on disc test rig.

# RELEVANCE OF COS / POS AND STRENGTH OF CO RELATION:

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
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| **CO1** | **1** |  |  |  | **1** | **2** |  | **1** |  |  |  |  | **1** |  |  |
| **CO 2** |  |  |  | **1** |  |  |  |  |  |  |  |  | **2** |  |  |
| **CO 3** | **2** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

1-Weakly correlated 2–Moderately correlated 3–Stronglycorrelated

# Content

# Minimum five experiments and three assignments shall be performed to cover entire curriculum of course ME402UC.

1. Study/Demonstration on Journal Bearingapparatus.
2. Study/Demonstration on tilting pad thrust bearingapparatus.
3. Study/Demonstration on Brake line friction testrig.
4. Measurement of wear and coefficient of friction using Pin on Disk.
5. Friction in JournalBearing.
6. Simulation and Modelling of Tribo Pairs

**Note:** 03 assignments include in the course based on curriculum of this course.

# Guidelines for ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S10)

# Guidelines for ESE:

Oral will be based on content of syllabus and practical.

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| **ME402UD Advanced Manufacturing Technology**  **Teaching Scheme : 03 Hrs/week**  **Evaluation Scheme : 30MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description**:  Students will have a broad and fundamental understanding of Advanced Manufacturing Techniques. Topics range from an Advanced casting, Advanced micro machining, Laser beam machining, powder metallurgy and Advanced measuring techniques like CMM etc. Students will learn Advanced manufacturing technique knowledge and tools used in it, and career options available within this field. |
| **Desirable awareness:**  Manufacturing Processes, Machine Tools |
| **Course Objectives:**  After completing the course, students will be able to:   1. acquire knowledge of various advanced casting processes, casting simulation and analysis. 2. understand various micro-machining methods and device. 3. understand the measurement system for micro-machining and understand it’s inspection methods. 4. understand different aspects of powder metallurgy and surface coating. 5. understand high velocity forming of metals |
| **Course Outcomes:**  After completing the course, students will be able to:   1. understand and posses the knowledge of different advanced manufacturing technique. 2. identify different micro-machining processes and devices used for AMT. 3. evaluate different aspects of micro-machining. 4. understand about powder metallurgy and surface coating. 5. identify rapid prototyping and types of generative manufacturing processes |

**Relevance of POs and Strength of Correlation:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  |  |  | **3** |  |  |  |  | **1** |  |  |  | **1** |  | **3** |
| **CO 2** | **1** |  |  |  |  |  |  |  |  |  |  |  |  | **2** |  |
| **CO 3** |  |  |  |  | **3** |  |  |  |  |  |  |  |  |  |  |
| **CO 4** |  | **2** |  |  |  |  | **3** |  |  | **1** |  |  |  |  |  |
| **CO 5** |  |  | **2** |  |  |  |  | **3** |  |  |  |  |  |  |  |

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| **Course Content:** |
| **Advances in Casting Process**:  Sheet moulding, casting, V-process, flask less moulding, evaporative casting, plaster mould casting, design for plaster mould casting quality accuracy, uniformity and other considerations in casting and moulding. Recent developments in pattern and casting designing, Use of CAD/CAM in foundries, Casting simulation and analysis. |
| **Fabrication of Micro Devices:** Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology |
| **Powder Metallurgy and Surface Coating**:  Powder Metallurgy: process, different methods of producing powders, different techniques to form the shape viz. pressing, extruding, sintering, and hot pressing. advantages, disadvantages, of powder metallurgy.  Surface Coating: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding. |
| **High Speed Forming of Metals:-**  Effects of high speeds on the stress strain relationship steel, aluminium, Copper. Comparison of conventional and high velocity forming methods, deformation velocity, material behaviour, strain distribution. Sheet metal forming: explosive forming, elecrto hydraulic and electromagnetic forming process, properties of explosively formed parts, etc |
| **Processing of Composites**  Composite Layers, Manufacturing of Particulate and fibre reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites. |

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| **Text Books**   * 1. Modern Manufacturing process engineering, Benjamin W. Niebel, Allen B Draper,   Richard A. Wysk, 2nd edition, McGraw Hill, New delhi,2001.   * 1. Non Traditional Manufacturing Processes, Garry F. Benedict- Marcel Dekker,   by CRC Press New York.2014.   * 1. Production Technology, HMT,Hand Book”,TMH.   2. Metal Casting, Hayane and Rosanthal, Indian edition, McGraw Hill, New delhi,2001.   3. Non traditional manufacturing process, Derban Michigan,5th edition, E.J. Weller Society of Manufacturing Engineers, 2012.   **Reference Books**   1. B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman “Manufacturing process”,   By John Wiley & Sons, Eighth edition.   1. ASM “Metals Hand Book”, ASM Publications. 2. P.K. Mishra “Non conventional machining process” by, Narosa Publication. 3. M P Groover and Zimmer “Manufacturing processes”- PHI Pvt. Ltd. Publications 4. ASTME, High velocity forming of metals, PHI, 1968. |

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| **ME406UD Advanced Manufacturing Technology Lab**  **Teaching Scheme : 02Pr Credit: 01**  **Evaluation Scheme : 25 ICA + 25 ESE Total Marks: 50** |

# Minimum five experiments and three assignments shall be performed to cover entire curriculum of course ME402UD.

**List of experiments:**

1. Study of various advanced casting processes, casting simulation and analysis.
2. Study of various micro-machining methods and devices.
3. Study the measurement system for micro-machining and understand it’s inspection methods.
4. Study different aspects of powder metallurgy and surface coating.
5. Study, manipulate and control machining parameters for various manufacturing

processes used in industry.

1. Study hardness measurement of mild steel specimen, applying various heat treatment processes.
2. Study rapid prototyping and generative manufacturing processes.
3. Study of geometry of robot manipulator, actuators and grippers.
4. Programming on CNC Turning.
5. Programming on CNC Milling Machine.

**Guide lines for ICA:** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S10).

**Guide Lines for ESE:** The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student. It shall be evaluated by two examiners out of which one examiner shall be out of institute.

**ME403UA INDUSTRIAL ROBOTICS**

**Teaching Scheme:** 03L**, Credit:** 03

**Evaluation Scheme: 30MSE** + 10 ISA + 60 ESE  **Total Marks:** 100

**Duration of ESE:** 03Hrs

**Course Description**

This course is aimed to provide exposure on the Robot anatomy, sensors, kinematics, End Effectors, Sensors and Vision Systems, applications and problems associated with their design.

**Course Objectives:**

On the successful completion of this course; student shall be able to:

1. provide about robot drives and control system.

2. develop knowledge about end effectors and sensors.

3. develop knowledge about robot vision system and robot programming.

**Course Outcome:**

On the successful completion of this course; student shall be able to

1. have knowledge of Robotics, automation, robotics motion, sensors and control, robotic programming and roles of robots in industry
2. understand the working methodology of robotics and automation, motion and control, machine vision and programming, application of robots in industry.
3. apply localization and mapping aspects of mobile robotics.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  |  |  | **3** |  |  |  |  | **1** |  |  |  | **1** |  | **3** |
| **CO 2** | **1** |  |  |  |  |  |  |  |  |  |  |  |  | **2** |  |
| **CO 3** |  |  |  |  | **3** |  |  |  |  |  |  |  |  |  |  |
| **CO 4** |  | **2** |  |  |  |  | **3** |  |  | **1** |  |  |  |  |  |
| **CO 5** |  |  | **2** |  |  |  |  | **3** |  |  |  |  |  |  |  |

**Course contents:**

**Basic Concept in Robotics**

Historical perspective of robot, classification of robot, automation and robotics, robot anatomy, basic structure of robotics, resolution, accuracy and repeatability, classification and structure of robotics system, point to point and continuous path system, control loop of robotic application Current and future.

**Robot Motion Analysis**:

Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller.

**Robot End Effectors:**

Types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems. Sensors in Robotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics.

**Coordinate Transformation:**

Direct kinematic problem in robotics, geometry based direct kinematic analysis coordinate & vector transformation using matrices, the orientation matrix & translator vector, homogeneous transformation matrices, three dimensional homogeneous transformations.

**Autonomous mobile robots**

Introduction, locomotion - key issues for locomotion, legged mobile robots, leg configurations & stability , examples of legged robot locomotion , wheeled mobile robots, wheeled locomotion-the design space, wheeled locomotion: case studies.

**Robot Programming** : Using Sensors and Actuators with ROS, SCORBOT structure, joint movements, work envelop, motors, encoders, microswitch, transmission, gripper, SCORBOT programming, IS-14533 : 2005 Manipulating industrial robots - Performance criteria related test methods, Mobile Robot Programming, Industrial Robot Programming, Python programming.

**Text Books:**

* 1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, Industrial Robotics: Technology, Programming and Applications, 2 nd Edition, Tata McGraw Hill, 2012.
  2. Roland Siegwart, Illah R. Nourbakhsh, an d Davide Scaramuzza, “Introduction to Autonomous Mobile Robots, 2 nd Edition, PHI, 2011

**References:**

1. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.

2. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

3. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.

4. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition, 2010.

**ME403UB Materials Management and Cost Estimation**

# Teaching Scheme: 03L Credit:03

**Evaluation Scheme:** 30MESE+10ISA+60ESE **Total marks:**100

**Duration of ESE:** 03 Hrs.

**Course Description:**

This course introduces undergraduate students to different modes of planning the material sources, schedule of flow of material, management and governance of all material stocking.

**Desirable awareness/skills:**

A sound knowledge of Industrial engineering, operations techniques, production planning & control techniques, work study and time study techniques are basic prerequisite

**Course Objectives**

Students should be able to:

* 1. understand the stocking of material
  2. know plan the production, and control
  3. development techniques for vendor developments
  4. know the procurement procedure for materials, documentation,

**Course Outcomes:**

On completion of this course student should be able to:

1. identify source of materials, and costing
2. schedule & plan materials flow,
3. technically sorting material status in various stages under production for inventory control.
4. apply various techniques to boost up capability of vendor, and able to use various techniques of developments.

**Relevance of COs /POs and strength of co-relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **CO1** |  | 1 |  | 2 |  |  |  |  | 1 |  |  |  | 1 |  | 3 |
| **CO2** | 2 |  |  |  |  | 1 |  |  |  |  |  |  |  | 2 |  |
| **CO3** |  |  | 3 |  | 1 |  |  |  |  |  |  |  |  |  |  |
| **CO4** |  | 3 |  |  |  |  | 2 |  |  | 1 |  |  |  |  |  |

1. Weakly correlated 2 – Moderately correlated3 – Strongly correlated

**Course Contents**

**Introduction:** Materials management – An overview– scope objective, importance integrated approach to materials management, materials planning introduction – factors affecting material planning – techniques of material planning – MRP. Vendor Management –Vendor selection, vendor auditing, vendor development and its importance, techniques of development, vendor suppliers prerequisites.

**Purchase Management**:

Purchasing, Procedure & Pricing Issues , Enquiry letter, Quotations ,Comparative statement ,Purchase orders, Tendering – Scrutiny of indents, preparation of tender documents, Evaluation of tenders and Award of orders .Application of Computers in Purchasing, E-procurement guidelines. Stores Management :Stores function, Types of stores, stores identification system, Receipts, Inspection , Storage procedure, Safety and Security aspects, Issue system, Disposal of unserviceable scrap including survey off and disposal activity, stock verification and store accounting, store records, legal aspects of store keeping.

**Inventory Control Management**:

Inventories – Definition-Classification of Inventories- Need for inventories – Merits & Demerits of Inventories, Inventory control techniques and principles - classification, codification, standardization – ABC analysis –VED, GOLF, FSN – HML, Economic order quantity concept – Derivation of EOQ formula, modified EOQ.

**Introduction to Cost Estimation**:

Importance of costing and estimation –methods of costing elements of cost estimation – Types of estimates – Estimating procedure Estimation labour cost, material cost allocation of overhead charges Calculation of depreciation cost.

**Production Cost Estimation and Machining Time Calculation** :

Estimation of Different Types of Jobs Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop, Estimation of Machining Time Importance of Machine Time Calculation of Machining Time for Different Lathe Operations, Drilling and Boring Machining Time Calculation for Milling, Shaping and Planning Machining Time Calculation for Grinding

**Text Book:-**

1. Materials and logistics Management, Prof. Shailesh Kasande,3rd edition, Nirali publication, pune, 2015
2. Materials and logistics Management, Dr. L. C. Jhamb, 2nd edition, everest publishing house,new delhi,2015.

**Reference book:-**

* 1. Purchasing and Materials Management – Datta A. k , 5th edition PHI Publishing House,2005, India
  2. An integrated approach to Materials Management – Gopalkrishnan & Sundersan PHI Publication 2002.
  3. Principles and practice of Management Prasad, L.M. 5th edition Sultan Chand & Sons, 2006.
  4. Supply chain Management: Strategy, Planning and Operations Chopra, S., and Meindl, P. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
  5. Designing & Managing the Supply Chain: Concepts, Strategies & Case studies Simchi -Levi, D.,Kaminsky, P., and Simchi-Levi, E.,. Second Edition, Tata McGraw-Hill Edition, 2003.

**ME403UC Production Planning and Control**

**Teaching Scheme:** 03L**, Credit**: 03

**Evaluation Scheme**: 30MSE 10 ISA + 60 ESE **Total Marks**: 100

**Duration of ESE:** 3 hours

**Course Description:**

The course aim of imparting the knowledge of two strategies that works cohesively throughout the manufacturing process. Production planning involves what to produce, when to produce it, how much to produce, and more. Production control uses different control techniques to reach optimum performance from the production system to achieve throughput targets.

**Desirable awareness/skills:**

Fundamental Knowledge of scheduling, dispatch, inspection, quality management, inventory management, supply management and equipment management.

**Course Objective:**

On completion of this course student should be able to:

1. understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
2. know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
3. understand the PPC function in both manufacturing and service organizations.
4. examine several classic Operations Management planning topics including production planning and inventory control.

**Course Outcomes:**

On completion of this course student should be able to:

1. summarize various aggregate production planning techniques.
2. solve routing and scheduling problems
3. recognize the objectives, functions, applications of PPC
4. explain different Inventory control techniques.

**Relevance of COs / POs And Strength Of CO- Relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **1** |  | **2** |  | **3** |  |  | **1** |  |  |  | **1** |  | **3** |
| **CO 2** | **2** |  |  |  | **1** |  |  | **3** |  |  |  |  |  | **2** |  |
| **CO 3** |  |  | **2** |  | **1** |  |  |  |  |  |  |  |  |  |  |
| **CO 4** |  | **3** |  |  |  |  | **1** |  |  | **1** |  |  |  |  |  |

1.Weakly correlated 2–Moderately correlated 3–Strongly correlated

**Course Content:**

**Introduction**:

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect -Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

**Work Study**:

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards

**Product Planning and Process Planning:**

Product planning-Extending the original product information-Value analysis -Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

**Production Scheduling:**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

**Recent Trends In PPC**:

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system – Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis – Recorder procedure –Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**Text Book**

1. Operations management-Design, Planning and Control for manufacturing and services, James. B. Dilworth , Mcgraw Hill International edition 1992.
2. Industrial Engineering and Production Management, Martand Telsang, First edition, S. Chand and Company, 2000.

**Reference Books**

1. Theory and Problems in Production & Operations Management, Chary. S.N., Tata McGraw Hill, 1995.
2. Production Planning Control and Industrial Management”, Jain. K.C. & Aggarwal. L.N., Khanna Publishers, 1990.
3. Production and Operations management, Kanishka Bedi, 2nd Edition, Oxford university press, 2007.
4. Operations Management, Norman Gaither, G. Frazier, 9th Edition, Thomson learning IE, 2007.

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| **ME403UD Product Design and Development**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30 MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  Introduction to the engineering design and structured design methods. Topics include: mechanical design process; design specifications, concept generation and selection; detailed design, design simulation, design for manufacturing and assembly, design for product safety; principles of life-cycle engineering. |
| **Desirable awareness:**  Product development and design processes and methods, including product specifications, concept development, engineering drawings, design for prototyping, and manufacturing. |
| **Course Objectives:**  After completion of the course, the student will be able to:  1. understand basic concepts of product design, product features and its architecture.  2. understand basic knowledge in the common features a product has and how to incorporate them suitably in product. |
| **Course Outcomes:**  After completion of the course, the student will be able to:   1. describe an engineering design and development process 2. create 3D solid models of mechanical components using CAD software 3. demonstrate individual skill using selected manufacturing techniques 4. employ engineering, scientific, and mathematical principles to execute a design from concept to finished product |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  |  | **1** |  | **3** |  |  |  |  | **1** | **1** |  |
| **CO 2** |  | **3** |  | **1** |  |  | **2** |  |  | **3** |  |  |  |  |  |
| **CO 3** |  |  |  |  |  |  |  |  |  |  |  | **3** |  |  |  |
| **CO 4** |  | **2** |  | **1** |  | **3** |  |  |  |  |  |  |  |  |  |

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| **Course Content:** |
| **Design Fundamentals:**  The importance of engineering design, types of design, the design process, relevance of product lifecycle issues in design, designing to codes and standards- societal considerations in engineering design, generic product development process, various phases of product development-planning for products, establishing markets, market segments- relevance of market research |
| **Customer oriented design & Societal Considerations:**  Identification of customer needs, customer requirements, Quality Function Deployment Product Design Specifications, Human Factors in Design, Ergonomics and Aesthetics. Societal consideration, Contracts, Product liability, Protecting intellectual property, Legal and ethical domains, Codes of ethics, Ethical conflicts, Environment responsible design-future trends in interaction of engineering with society |
| **Material selection processing and Design:**  Material Selection Process, Economics – Cost Vs Performance, Weighted property Index, Value Analysis, Role of Processing in Design, Classification of Manufacturing Process, Design for Manufacture, Design for Assembly, Designing for castings, Forging, Metal Forming, Machining and Welding, Residual Stresses, Fatigue, Fracture and Failure. |
| **Design Methods:**  Creativity and problem solving, creative thinking methods, generating design concepts, systematic methods for designing, functional decomposition, physical decomposition, functional representation, morphological methods-TRIZ- axiomatic design. Decision making theory, utility theory, decision trees, concept evaluation methods. |
| **Industrial Design concepts:**  Human factors design, user friendly design, design for serviceability, design for environment, prototyping and testing, cost evaluation, categories of cost, overhead costs, activity based costing, methods of developing cost estimates, manufacturing cost, value analysis in costing. |

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| **Text Books:**  1. Product Design, Kevin Otto and Kristin wood,2nd edition, Pearson Education Inc.  2. Product design and development, K.T. Ulrich and S.D. Eppinger, Tata McGraw  Hill,2015  3. Product Development, Chitale & Gupta, 4th edition,Tata McGraw Hill,2016  4. The Mechanical Process Design, David Ullman, McGrawhill Inc, 2008  5. Engineering Design Process,Yousef Haik andT M MShahin, 3rd edition, Cengage Learning,2012 |
| **Reference books:**  1. Product design & process Engineering by Niebel & deeper, McGraw hill  2. Value Management by Heller, Addison Wasley  3. Value Engineering A how to Manual S.S.Iyer, New age International Publishers  4. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill  5. New Product Development Timjones. Butterworth Heinmann, Oxford.  6. Value Engineering A how to Manual S. S. Iyer, New age International Publishers  7. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill  8. Assembly automation and product design – by Geoffrey Boothroyd, CRC Taylor &Francis |

**ME404UX INRODUCTION TO ROBOTICS**

**Teaching Scheme:** 03L**, Credit:** 03

**Evaluation Scheme: 30MSE** + 10 ISA + 60 ESE **Total Marks:** 100

**Duration of ESE:** 03Hrs

**Course Description**

This course is aimed to provide exposure on the Robot anatomy, sensors, kinematics, End Effectors, Sensors and Vision Systems, applications and problems associated with their design.

**Course Objectives:**

On the successful completion of this course; student shall be able to:

1. provide about robot drives and control system.

2. develop knowledge about end effectors and sensors.

3. develop knowledge about robot vision system and robot programming.

**Course Outcome:**

On the successful completion of this course; student shall be able to

1.understand fundamental knowledge about the robot

2.know about robot motion analysis

3.describe drives and control system used in robots

4.understand end effectors, sensors and vision system

5.learn about robot programming methods and languages

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **3** |  | **2** |  |  | **1** |  |  |  |  | **1** | **1** |  |  |
| **CO 2** | **1** |  | **2** |  | **2** |  |  |  |  |  |  |  |  | **2** |  |
| **CO 3** |  |  |  |  |  | **1** |  | **1** |  |  | **1** |  |  |  |  |
| **CO 4** |  | **3** |  | **1** |  |  |  |  |  |  |  |  | **1** |  |  |
| **CO 5** | **2** |  |  |  |  |  |  |  | **1** |  |  |  |  |  |  |

1. Weakly correlated 2–Moderately correlated 3–Stronglycorrelated

**Course contents:**

**Basic Concept in Robotics**

Historical perspective of robot, classification of robot, automation and robotics, robot anatomy, basic structure of robotics, resolution, accuracy and repeatability, classification and structure of robotics system, point to point and continuous path system, control loop of robotic application Current and future.

**Drives and Control System**

Hydraulic, DC servomotors, basic control system, concept and models, control system analysis. Robot activation and feedback component, positional and velocity sensors. Actuators, power transmission system, Application of robot in manufacturing.

**End Effectors and Sensors in Robotics**

End Effectors Types of end effectors, mechanical grippers, vacuum, magnetic, adhesive grippers, tools as end effectors, Gripper selection and Introduction to Sensors: Need of sensors in a robotic system, selection of sensors, photo sensors, limit switches. Range sensors, proximity sensors, touch / sensors.

**Robot Vision System**

Concept of low level and high-level vision in a robotic system. Lagrange’s Analysis of Manipulator and Components, functions of vision system, industrial application of vision controlled robotic system, advantage and application of machine vision.

**Robot Programming**

Methods of robot programming, lead through programming methods, a robot program as a path in space. Motion interpolation WAIT, SIGNAL, AND DELAY commands. ROBOT LANGUAGES: The textural robot languages, generation of robot programming languages, robot language structure, constant and variables. Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI, introduction to Python.

**Text Books**

1. Robotic Engineering An Integrated Approach, Richard D. Klafter, Thomas A.

Chmielewski andMichael Negin, Prentice Hall India, 2002.

1. Industrial Robotics,M. P. Groover, McGraw Hill Publication Co. Ltd.
2. Introduction to Robotics Mechanics and Control, John J. Craig, Pearson Education

Inc.,

**Reference Books**

1. Industrial Robotics - Technology, Programming and Applications, M. P. Groover.
2. Introduction to Robotics: Analysis System and Application, Niku, Pearson

Education.

**ME404UY OPERATION RESEARCH and PROJECT MANAGEMENT**

**Teaching Scheme:** 03L, **Credit:** 03

**Evaluation Scheme:** 30MSE + 10 ISA + 60 ESE **Total Marks**: 100

**Duration of ESE:** 03Hrs

**Course Description:**

This course introduces under graduate students to imparting knowledge of various decision making techniques.

**Course Objectives:**

The Student should able to:

1. provide about Operational research and its model.

2. develop knowledge about Linear programming.

3. develop knowledge about transportation, assignment and Sequencing model.

**Course Outcome:**

On successful completion of this course student shall be able to:

1. develop knowledge of Operational research and its model

2. illustrate the need to optimally utilize the resources in various types of industries

3. understand the theory and concepts of project planning and associated cost-benefit

analysis.

4. identify and proactively manage project pitfalls

5. learn the art of planning and structuring a project

**Relevance of COs /POs and strength of co-relation:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **3** |  |  | **2** |  |  |  | **1** |  |  | **1** | **1** |  |  |
| **CO 2** | **2** |  |  | **1** |  |  |  |  |  | **1** |  |  |  | **2** |  |
| **CO 3** |  | **2** |  |  |  | **3** |  | **2** |  |  |  |  |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |
| **CO 5** | **2** |  |  |  |  |  |  | **1** | **1** |  |  |  |  |  |  |

1. Weakly correlated 2–Moderately correlated 3–Stronglycorrelated

**Course Contents**

**Introductions to Operation Research**

Scope, applications of operations research, phases and models of operations research, advantages and limitations of operations research and applications of operations research.

**Linear Programming-**

Formulation of LPP, graphical method of solution, simplex method, artificial variable technique- Big M method, two phase method, duality in LPP, sensitivity analysis.

**Transportation, assignment and sequencing model Transportation Problem (TP)**: Mathematical formulation of TP, methods to obtain initial basic feasible solution, TP without degeneracy and with degeneracy Assignment Problem (AP): Mathematical formulation of AP, variations of AP, travelling salesman problem Sequencing Problem: Assumptions in sequencing, processing of n jobs on two machines, processing of n jobs on three machines and processing of n jobs on m machines

**Replacement and Queuing Theory**

Replacement and maintenance method- Introduction, types of failure- gradual failure ,sudden failure Replacement of items whose efficiency deteriorates with time, Replacement of items that completely fail, individual replacement policy, Group replacement policy, staffing problem ,failure trees. Introduction to queuing theory, elements of queuing theory, characteristic of waiting lines, Service Discipline, Service Mechanism, Terminology and Notations for queuing System.

**Project Management Foundations**

Definition of project management, project manager and project, Project types, project phases and knowledge areas.

**Planning Projects**

Project estimating and scheduling techniques. PERT, CPM, GANTT chart, Introduction to any one project scheduling software (Bitrix24, Freedcamp, Orangescru, etc).

**Planning Projects and Termination**

Risk planning methods; Cost planning, Communication plan and Final project plan. Monitoring and Information Systems, Project control, Progress and performance measurement and evaluation, Project termination.

Project finance ,sources of finance,

**Text Book**

1. Optimization Concepts and Applications in engineering, Belegundu, Cambridge

Uni. Press, India

1. Operations Research, Hillier F.S., and Lieberman G.J., 8th Edition, Mc. Tata

McGraw Hill,India.

1. Engineering optimization Methods and Appliations, Ravindran, 2nd edition, Wiley, India
2. Project management: the managerial process Larson, C. F., & Gray, E. W.,5th

edition, McGraw-Hill Education,2013

1. Project management: a managerial approach Meredith, J. R., & Mantel Jr, S. J., 8th

edition New Jersey: John Wiley & Sons, Inc.2011.

**Reference Books**

1. Quantities Techniques, L.C. Jhamb , Vol I and II, Everest Publication

2. Operation Research, S.D. Sharma, Khanna Publication.

3. Operation Research, Problem and Solution, J. K. Sharma, Macmillan

4. Quantitative Techniques in Management, N. D. Vohra, TATA McGraw Hill.

5. Ravindran, A. R. (2016). Operations research and management science

handbook. New York: CRC Press.

**ME405U CAD/CAM**

**Teaching Scheme:** 03L**,**  **Credit :** 03

**Evaluation Scheme: 3**0 MSE+10 ISA+ 60ESE **Total marks:** 100

**Duration of ESE:** 03 Hrs.

**Course Description:**

The course presents the elements of solid modelling, creation of parts of increasing complexity and the assembly of parts to form a final design, along with mechanism simulation. The operation and programming of CNC machines is covered.

**Desirable awareness/skills:**

Fundamental knowledge of Computers, Engg. Graphics, Graphical entities, Computer Networking, Manufacturing Processes, Industrial Engg.

**Course Objective:**

Students should be able to:

1. use of Computers in Design and Manufacturing
2. interface of Computer Software and Hardware
3. automation of Manufacturing System
4. applications of Robotic systems in manufacturing

**Course Outcomes:**

On completion of this course student should be able to:

1. demonstrate fundamental knowledge of CAD/CAM.
2. solve numerical on transformation and modelling of curves.
3. understand the tool path for parts.
4. apply CNC program for manufacturing .
5. know the terminology of various prototyping techniques.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **3** |  |  | **2** |  |  |  | **1** |  |  | **1** | **1** |  |  |
| **CO 2** | **2** |  |  | **1** |  |  |  |  |  | **1** |  |  |  | **2** |  |
| **CO 3** |  | **2** |  |  |  | **3** |  | **2** |  |  |  |  |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |
| **CO 5** | **2** |  |  |  |  |  |  | **1** | **1** |  |  |  |  |  |  |

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content**

**Introduction to CAD/CAM and Networking**

Definition of CAD/CAM, Product Life Cycle & CAD/CAM, Selection of a CAD system, Desirable relationship of CAD/CAM database, Benefits & Application of CAD.Hardware in CAD, The Design Work Station, The graphics terminal, Operator input/output devices.Computer communication, Principle of networking, Classification of network, Transmission media & interface, LAN system.

**Computer Aided Graphics**

Introduction, Graphic Primitives, Point plotting, drawing of lines, Coordinate system used in graphic element, Transformation in graphics, Homogeneous transformation, Concatenate coordinate transformation, Translation, Rotation, Scaling, Mirror, Reflection

**Computer Aided Modelling & Automation**

Requirement of Geometric Modelling, Geometric Model, Geometric Model Construction Method: Wire Frame Modelling, Surface Modelling, Solid Modelling, Representation of Curve & Surfaces, Design of curve shape, Cubic Spline, Bezier curve, B-spline curve.

AUTOMATION- Concept of Automation, Types of Automation, Advantages & limitations of Automation, Levels of Automation, Advanced Automation Function.

**Computer Aided Manufacturing**

Continuous control system, discrete control system, Computer process control, Forms of CPC, Computer process Monitoring, Direct Digital Control, Manual Part Programming using G and M codes

**Introduction to FMS, GT.**

FMS – Introduction, Components of FMS, Types of FMS, Application & Benefits, Planning & implementation issue, Typical FMS layout.

GT – Part families, Part classification & coding, optic coding system, Multiclass coding system, Application of GT.

**Rapid Prototyping and Manufacturing**

Introduction to Rapid Prototyping, rapid tooling and rapid manufacturing, Process of rapid prototyping, Different techniques of Rapid prototyping and their applications.

**Text Book**

1. CAD/CAM– Theory and Practice, Ibrahim Zeid and R. Sivasubramanian, 4th edition, Tata McGraw Hill Publishing Co., 2009.
2. Mastering CAD/CAM, Ibraim Zeid, latest edition,Tata McGraw Hill Publishing Co., 2000.
3. Introduction to CAD/CAM”, Tata McGraw Hill Publishing Co., 2012

**References Books**

1. Yoram Koren – “Robotics”, McGraw Hill Publishing Co., 2007

2. Ibraim Zeid, “Mastering CAD/CAM” – Tata McGraw Hill Publishing Co. 2000.

3. Groover M. P., “Automation, production systems and computer integrated

manufacturing”, Prentice Hall of India

4. Yoram Koren - Robotics McGraw Hill Publishing Co.

5. James G. Keramas, Robot Technology Fundamentals, Delmar Publishers.

**ME407U CAD/CAM LAB**

**Teaching Scheme:** 02P, **Credit:** 01

**Evaluation Scheme:** 25 ICA+25 ESE **Total Marks: 5**0

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**Course Objective**:

This course will enable the student To gain knowledge about the basic fundamental of CAD and CAM

#### **Course Outcome:**

1. Draw 3D and Assembly drawing using CAD software.
2. explain the concepts and underlying theory of modeling and the usage of models in different engineering applications.
3. Create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications.

#### **Relevance of COs / POs And Strength Of CO- Relation:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **1** |  |  | **2** |  |  |  |  |  |  | **1** | **1** |  |  |
| **CO 2** | **3** |  |  |  |  |  |  |  |  | **1** |  |  |  | **2** |  |
| **CO 3** |  |  |  |  |  | **1** |  | **2** |  |  |  |  |  |  |  |

1. 1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content:**

**Internal continuous assessment performance shall be based on ME405U & consist of following Assignments and Project**

A. Introduction to Modelling (Using any CAD software).

1. 2D drawing of any three machine components (such as cotter joint, knuckle joint, sleeve joint etc.)
2. 3D modelling using 3D features (Modelling of above mentioned 2D drawing)
3. Assembling and drafting (Above assembly) with proper mating conditions and interference checking.
4. Surface Modelling (Any 2 of the above components).

B. Three assignments based on above syllabus.

**Guidelines for ICA:**

Internal continuous assessment should support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal and sheet) based on performed practicals. The performance shall be assessed experiment wise using internal continuous assessment format.

**Guidelines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student.

**ME408U PROJECT PHASE – I**

**Teaching Scheme:** 02P, **Credit:** 02

**Evaluation Scheme:** 50ICA+50 ESE **Total Marks:** 100

**Course Description:**

The Project Phase – I is one of the most important single piece of work in the degree programme. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organise a large project over a long period. The mini-project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

**Desirable awareness/skills:**

Knowledge of concepts, principles and techniques studied in all earlier courses.

**Course objectives:**

On successful completion of this course students shall

1. develop ability to synthesize knowledge and skills previously gained and to put some of them into practice.
2. make students capable to select from different methodologies, methods and forms of analysis studied to produce a suitable system or sub-system.
3. inculcate ability to present the findings of their technical solution in a written report.
4. plan and organise a large project over a long period.

**Course outcome:**

On successful completion of this course students shall able to

1. apply the knowledge and skills previously gained into the practice.
2. understand appropriate decision w.r.t various parameters related to production of a system or sub-system.
3. demonstrate the leadership quality along with ability to work in a group.
4. prove the ability to present the findings in a written report or oral presentation.

**Relevance of COs /POs and strength of co-relation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **3** |  |  | **2** |  |  |  | **1** |  |  | **1** | **1** |  |  |
| **CO 2** | **2** |  |  | **1** |  |  |  |  |  | **1** |  |  |  | **2** |  |
| **CO 3** |  | **2** |  |  |  | **3** |  | **2** |  |  |  |  |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |

1. Weakly correlated 2–Moderately correlated 3–Stronglycorrelated

**Expectations from Work**

* The project is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I in odd semester and Phase – II in even semester.
* The project work shall be carried out in the group of 2 – 4 students and shall be carried out inhouse i.e. in the department’s laboratories and centers OR in the industry/organization allotted through department’s T & P/project coordinator.
* The project outline (a brief or condensed information giving a general view) on the selected topic should be submitted to the Program Head for approval within two weeks from the commencement of academic year.
* The topic and guide shall be approved in the departmental meeting and informed to student within one week after the submission of outline to enable students to start the topic based work..
* Salient observations on the results you have obtained such as the relationships between different variables and parameters, unusual trends, interpretations of the observed trends, comparison between theory and experiment, comparison withprevious literature, limitations, justification of prior assumptions made, and inconsistencies.
* Summary of salient observations and trends, how the study filled some gaps in the literature, scope and desirability of further work on the problem, applications, potential areas.
* After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define project objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals. In case of Industry sponsored project, (co-guide) the relevant application notes, white papers, product catalogues should be referred and reported.
* Each group is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation of the project and phase wise work distribution, and submit the proposal to guide within a month from the date of commencement of classes.
* Around 30–40 % work of the total quantum (i.e. literature survey, system schematic and its design and/or flowchart along with some software development etc.) Should be completed by the end of 7thsemester.

**Guide lines for ICA:**

Internal continuous assessment should support for regular performance and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record (log book) submitted by student (log book) based on performance. The performance shall be assessed presentation or demonstration wise using internal continuous assessment format.

Format for Log Book

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sr. No . | Date Time; numbers and Roll of present candidates | Work done (discussion with guide) during the session | Guide’s Remark Dated | sign of Guide |
|  |  |  |  |  |

**Guide Lines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of Project, to judge the skills acquired by student.

ME409U INDUSTRIAL LECTURES

**Teaching Scheme**:01L

**Total Marks**: 50 ICA **Credits**: 01

**Course Description**

It reflects on the importance of acquaintanceships and the interchange of needed information between practicing engineers in industry and students in educational institutions. There is a criticism, especially from practicing engineers, that existing engineering education is too theoretical and numerical with less orientation toward practical aspects. This course is designed to overcome this criticism. This course is intended to generate such interaction directly, through expert lectures by outstanding practicing engineers. This course will prove helpful to denote and understand the relations among the employers, employees, and other organisations.

**Desirable awareness/skills**

Listening, understanding and analysing ability along with the knowledge of concepts, principles and techniques studied earlier.

**Course objectives**

The objectives of offering this course are to:

1. make students familiar with industrial environment i.e. to provide appropriate

exposure to world of work.

1. know and understand the industrial experience, attitudes, needs, and viewpoints of industrial expert to students.
2. denote and understand the role of various parties’ viz., employers, employees,

and state in maintaining industrial relations.

1. improve industry institute interaction.

**Course outcome**

On successful completion of this course students shall be able to

1. demonstrate the ability to face industrial environment/ world of work.

2. fulfil expectations of industry wrt expertise, attitude and viewpoint.

3. demonstrate the good inter personnel relations.

4. work in industrial environment either as employee or self-employed (entrepreneur) with comfort.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **2** |  |  | **1** |  | **2** |  | **1** |  |  |  | **1** |  | **1** |
| **CO 2** | **3** |  |  | **1** |  | **2** |  |  |  | **1** |  |  |  |  |  |
| **CO 3** |  |  |  |  |  | **1** |  | **2** |  |  |  | **1** |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content**

1. There is a need to create avenues for a close academia and industry interaction through all the phases of technology development, starting from conceptualization down to commercialization.
2. List of renowned persons from industry shall be prepared by the committee appointed by Head of the department. After approval from the Principal, Minimum **Four** Industrial lectures shall be arranged, which shall be delivered by theexperts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors /R&D Labs covering the various aspects.
3. TopicsofIndustrialLecturesshallbeTechnicalinnatureandshouldnotbethespecificcontentsfrom the curriculum.
4. Students shall submit the report based on minimum **Four** lectures giving summary of the lecture delivered.
5. The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in bullet point form.

**Guidelines for ICA:**

Assessment of the Industrial Lecture for award of ICA mark shall be done jointly by departmental committee as per attendance in industrial lecture report submitted by student and student and overall performance in semester as per the guidelines given in Table-D

TableD:-

Expert lecture on topic:-

Name of Expert and designation: -

Class:- Semester: - A-Year: -

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sr.No. | Name of Students | Attendance(**05** Marks Per Lecture | Depth of Understanding(**05** Marks Per Lecture) | ReportWriting  and Presentation | Total |
|  |  | 15 | 15 | 20 | **50** |
| 1) |  |  |  |  |  |
| 2) |  |  |  |  |  |

**ME410U PROFESSIONAL INTERNSHIP**

**Teaching Scheme:**

**Total Marks:** 50 ICA **Credits:** 02

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**Course Description:**

This course gives opportunity to students to explore the knowledge of industry organization, new trends in manufacturing, maintenance and safety and also gives actual work experience with exposure to industrial environment or boosts entrepreneurial aspirations or analytical skills to solve real life problem as per student interest.

**Course objectives:**

The objective of course are as follows

1. introduce the basic industries and the process/product development cycle.
2. be familiar with the industrial environment and work culture
3. learn the importance of entrepreneurial skills.
4. emphasizes intuitive understanding and practical implementations of the theoretical concepts

**Desirable awareness/skills:**

Listening, understanding and analyzing ability along with the knowledge of concepts, principles and techniques studied earlier

**Course Content-cum-instructions**:

This course shall be completed preferably during the summer vacation after sixth semester but in exceptional cases can be completed from during the winter vacation after fourth semester or during the weekends of seventh semester. Under any circumstances; this course shall be completed before the commencement of eighth semester.

Industrial visit for minimum four industries local or outstation shall be carried out by each student. Department shall arrange the industrial visits during the summer/winter vacations after sixth/seventh semester or in exceptional cases weekends during the seventh semester. Industries shall be related to solar energy/ Core mechanical based / computer hardware-software/ manufacturing/ automobile automation/ bio-tech-agriculture sector/power station, any other relevant industry approved by course coordinator.

For this course, the instructions andr guidelines of AICTE shall be followed. The guidelines, instructions and various format Can be obtained using following link:

<https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf>

In addition to above

Industrial Training:

Individual or group of students shall undergo industrial training in any industry of own interest and convenience related to any interdisciplinary topic/field/ nature for minimum one week fulltime or two weeks part time so that total training period should be more than 40 hours

**Course Deliverable**

Every student shall submit the appropriate (visit/training/attendance/visit for special study) certificate along with a report in the format provided by department/course coordinator duly signed by course coordinator and HoD. Evaluation system It includes Internal Continuous Assessment (ICA) and Guidelines for ICA are given bellow.

**Internal Continuous Assessment (ICA)**

The ICA shall be evaluated by course coordinator appointed by the HoD. Course coordinator shall judge the student on the basis of presentation, deliverables of the course described earlier. The guidelines and format prescribed by AICTE may be used for ICA

<https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf>

**ME451U. PROJECT AND FINANCIAL MANAGEMENT**

|  |  |
| --- | --- |
| **Teaching Scheme:** 03L**, Total:** 03 | **Credit:** 03 |
| **Evaluation Scheme:** 30 MSE + 10 ISA + 60 ESE | **Total Marks:** 100 |
| **Duration of ESE:** 03Hrs |  |

**Course Description:**

This course introduces undergraduate students to imparting knowledge of project & business management. The background required a sound knowledge of network technique, organization structure, Financial and material management.

##### **Course Objectives**

Student should be able to

* 1. provide about project and its management.
  2. develop knowledge about organization and impart knowledge about functioning of management.
  3. develop knowledge about financial management techniques.

##### **Course Outcome**

On completion of this course student should be able to:

1. develop knowledge of project management and statistical tools used in its.
2. helped to understand the various functions of management along with its types.
3. develop knowledge about Capital cost and cost control.

**Relevance of COs /POs and strength of co-relation:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  |  | **3** |  |  |  |  |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  | **1** |  |  |  |  |  |  |  |  |  |  | **2** | **-** | **-** |
| **CO 3** |  |  |  |  | **3** |  |  |  |  |  |  |  | **-** | **-** | **1** |

1. Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Contents**

**Project Management**

Introduction to project management, concept of project management, managerial function at different organizational levels, types of projects, project identification, scheduling, monitoring, control, basic tool and techniques for projects scheduling bar chart, project life cycle curves, line balancing, problems on line balancing.

**Project statistic technique**

Introduction of network technique, fundamental concept and network models, construction of network diagrams, application of network analysis, definition of PERT and CPM, comparison between CPM and PERT, critical path method with problem, programme evaluation and review techniques with problem, time cost problem (crash) with PERT.

**Business management**

Introduction to management, concept of management, the function of management, importance of management Forms of business organization, concept of ownership organization, types of ownership, individual ownership, partnership organization, joint stock companies, types of stock companies, co- operative organizations, various types of co-operative societies, public sector organization, state ownership, public cooperation, choice of form of organisation, comparative evaluation of different forms of business ownership.

**Financial Management**

Introduction, definition of financial management, functions of financial management, sources of funds, capital, classification of capital, working capital, need for working capital, assessment of working capital, factors affecting working capital, sources of finance (shares, debentures, loans from banks, trade credit public deposits financial institutions). cost and cost control: elements of cost, direct cost, indirect cost, variable and fixed cost, cost control technique, marginal costing, break even analysis.

**Material and Purchase Management**

Scope of material management, function of material management, objectives of scientific purchasing, functions of purchase department, , 5R’s of buying, methods of buying, source selection (vendor),vendor rating, just in time purchasing. Inventory management, objective of inventory management, types of inventory, selective inventory technique (ABC,VED), inventory model (Economic lot size with fixed price, EOQ with quantity discount).

**Text Books**

* 1. Production(Operation)Management, L. C. Jhamb , Everest publishing house
  2. Theory And Problems in Production and Operations Management, Chary, 2nd Reprint, Tata McGraw Hill Publishing Co. New Delhi., 1996.
  3. Production & Operations Management, Nair, N.G., Tata McGraw Hill Publishing Co. New Delhi, 1997.

**References Books**

* 1. Fundamentals of Financial Management, Chadra Presanna, Tata McGraw Hill New Delhi,1994.
  2. Marketing Management, Kolter Philip, Prentice-hall of India,1988.
  3. Fundamental of Financial Management, Vyuptakesh Sharan.,Pearson Education
  4. Industrial engineering and production management, Martand telsang,1st Edition reprint 2013- S.chand & company ltd. New Delhi, 2013
  5. Financial Management, M.K.Khan & P.K.Jain, Tata McGraw Hill Publishing Co. New Delhi.
  6. Business Management, J.P.Bose, S.Talukdar, New Central Agencies (P) Ltd.

**ME452U INDUSTRIAL ENGINEERING AND MANAGEMENT**

**Teaching Scheme:** 03 L, **Credits:** 03

**Evaluation Scheme:**30MSE+10 ISA+ 60ESE **Total Marks:** 100

**Duration of ESE:** 03 hrs.

**Course Description:**

The course is intended to build up necessary background for understanding the Industrial knowledge, understand the applications of knowledge and correlation of various departments, acquire managerial skills of handling Industrial Environment and develop awareness about Industrial Engineering and Management.

**Desirable awareness/skills:**

Fundamental knowledge and Interaction related to Industry.

**Course Objectives:**

The Student should able to:

1) study the basics and details of production, planning and control

2) understand the use of work study, method study and time study analysis related to

production

3) enable students to do the material and purchase management and inventory control

4) study about the plant location and lay outs

5) enable to use the Demand forecasting and Production information system

**Course Outcomes:**

On the successful completion of this course; student shall be able to:

1) understand an introductory course in production.

2) apply the basic concept of the decision-making process as it relates to the major

areas of production.

3) understand operations economies (how to employ labour materials, machines, and capital) in a balance to match the changing relative values of the basic components.

4) execute knowledge in an industry for production planning and scheduling, as well as for its realization by production management.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO 1** | **1** | **3** |  | **1** |  | **1** |  |  |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  | **2** |  |  |  |  |  |  |  |  |  |  | **-** | **-** | **-** |
| **CO 3** |  |  |  |  | **2** |  |  |  |  |  |  |  | **-** | **-** | **1** |
| **CO 4** | **1** |  |  |  |  | **1** |  |  | **1** |  |  |  | **-** | **-** | **-** |

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content**

**Introduction:**

Definition, Objectives, Functions, technique of industrial engineering, Productivity, Productivity measures and measurement models, introduction to production planning and Control (PPC), various functions of PPC, Routing, Scheduling, Dispatching, Follow up and Progress report.

**Plant Layout and Product Design:**

Introduction, factors governing selection of a plant layout , Criteria of location decisions, Site selection, State Regulations of Location, Backward Areas and Industrial Policy, Government Policies for Decentralisation, Industrial Estates, Comparison of Locations, Sub-Urban Area, Economic Survey of Site Selection, Objectives of a Good Plant Layout, Importance of Plant Layout, Situations in which Layout Problem may arise, Factors Influencing Plant Layout, Principles of Plant Layout, Techniques used in Plant Layout, Steps in Planning and Layout for a New Enterprise, Different types of plant layout, Symptoms of Bad Layout, Work Station Design, Storage Space Requirements, New product development, Product life cycle, Product design process , Standardization.

**Method Study & Time Study:**

**Method Study:** Introduction, objectives, Method study procedure, Steps of method study, Recording techniques, SIMO chart, Multiple activity charts, Principles of motion economy, Two handed person chart, Work sampling, Predetermined Motion Time system, Objectives and Uses of P.M.T.S., P.M.T.S. Technique/Development of a P.M.T. System, Selection of a Particular P.M.T. System, Advantages, Limitations and Uses of P.M.T.S., Work Factor System, \Method Time Measurement.

**Time Study:** Introduction, Objectives of Work Measurement, Techniques of Work Measurement, Objectives, and procedure of time study, Performance rating and allowances, Predetermined motion time analysis, Method time measurement, Use of time study in wage incentives, Simple numerical problems on industrial applications.

**Value Engineering:**

Introduction, Concept of Value Analysis, Definition of Value Analysis, Aims/Objectives of Value Analysis , Difference between Value Analysis and Value Engineering, When to Apply Value Analysis, Unnecessary Costs, Tests for Value Analysis, Advantages of Value Analysis, Applications, Different steps in value analysis, Function analysis systems techniques, Principles of value analysis.

**Ergonomics and Modern Trends in Industrial Engineering:**

Concepts of Ergonomics, Objectives of Ergonomics, Historical Background, Related Sciences of Ergonomics, Man- machine system-Interfaces, Important aspects of Man-Machine system, Design of control, Environmental factors, Anthropometry, Principles in the application of Anthropometry data, Development of Anthropometry considerations in Design steps by steps, Body measurements, Posture, Movement and Workplace Design, Manual materials handling, Ergonomics and Safety, Introduction to MRP, Objectives of MRP, Benefits of MRP, Introduction to Supply chain management, Supply chain Strategy, Framework.

**Text Books :**

* 1. Introduction to Work Study, Jorge V.3rd Revised Edition, International Labour Office (ILO), Geneva, 2000.
  2. Elements of Production Planning & Control, Samuel Eilon, 3rd Edition, Universal

Book Corporation, Mumbai, 2003.

* 1. Production and Operations Management, Chary S N , 3rd Edition, : Tata McGraw

Hill Pub. New Delhi, 2004.

**Reference Books:**

1. Industrial Engineering and Management, O. P. Khanna: 3rd edition2002, : Dhanpat Rai &Sons, New Delhi.
2. Motion and Time Study, Burnes R M, 7th Edition, John Wiley & Sons, New York, 1980.
3. Human Factors in Engineering & Design Mark S Sanders, Mccormick,7 th edition 1993,McGraw Hill Company, New York, 2002.
4. Production Systems, Planning Analysis and Control, Riggs J L, 3rd Edition, John Wiley & Sons, New Delhi, 2005.
5. Work Study and Ergonomics, Jhamb L. C. , 4th Edition,: Himalaya Pub. House, Mumbai, 2003.

**ME453UA Design of Heat Exchanger**

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| **Teaching Scheme:** 03L+1T**, Total:** 04 | **Credit:** 04 |
| **Evaluation Scheme:** 30 MSE + 10 ISA + 60 ESE | **Total Marks:** 100 |
| **Duration of ESE:**03Hrs |  |

##### **Course Description:-**

##### The course aims at imparting knowledge of Heat exchanger developments. Desirable awareness/skills: Fundamental knowledge of Heat Transfer.

##### **Course Objectives:-**

##### The students are expected to understand the subject of Heat Transfer and its technological developments in detail with capability to solve Industrial Problems. This will also create the base and interest among the students to carry out the Future Research.

##### **Course Outcome:-**

After successful competition of this course students will be able to:

1. demonstrate a basic understanding of several types of heat exchangers that will include shell-and-tube, double pipe, plate-and-frame, finned tube, and plate-fin heat exchangers, Heat pipes.
2. design and analyses of shell-and-tube double pipe, compact, plate heat exchangers.
3. demonstrate the performance degradation of heat exchangers subject to fouling.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  | **3** |  |  | **1** |  |  |  |  | **1** | **-** | **-** |
| **CO 2** |  |  | **2** |  |  |  |  |  |  |  |  |  | **-** | **-** | **-** |
| **CO 3** | **1** |  |  |  | **3** |  |  |  |  |  |  |  | **-** | **-** | **1** |

1. Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

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| **Course Content:** |
| **Introduction**  Types of heat exchangers, Parallel flow, counter flow and cross flow; single pass and multipass; once through steam generators shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA) |
| **Process Design Of Heat Exchangers**  Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers,TEMA code, J-factors, conventional design methods, Bell-Delaware method, fouling factors, fouling resistance, cleanliness factor, techniques to control fouling, pressure drop calculations. |
| **Stress Analysis**  Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration. Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet joint design, buckling of tubes. |
| **Compact and Plate Heat Exchanger**  Types-  Merits  and  Demerits-  Design  of  compact  heat  exchangers,  plate  heat  exchangers, performance influencing parameters, limitations. |
| **Condensers and Cooling Towers**  **A)Shell and tube condenser**, plate condenser, air cooled condenser, direct contact condenser, condenser for refrigeration and air-conditioning, thermal design of shell and tube condenser, Design of surface and evaporative condensers – cooling tower – performance characteristics.Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers  **B)Heat Transfer Enhancement and Performance Evaluation**  Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis. |

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| **Text Books:**  1. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Ltd, New Delhi.2012  2. Engineering Heat and Mass Transfer, M. M. Rathore 2nd Edition, Laxmi .  Publications, New Delhi,2008  3.Heat and Mass Transfer, R.K.Rajput, Revised edition 2012, S.Chand & Company  Ltd, New Delhi.2016 |
| **Reference books:**  1.RobertW.  Serth,  "Process  heat  transfer  principles  and  applications",  Academic  press, Elesevier, 2007.  2.Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005  3.John E.  Hesselgreaves,  "Compact  heat  exchangers:  selection,  design,  and  operation",Elsevier science Ltd, 2001.  4.Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000.  5.Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct- sizing, step-wise rating, and transients", John Wiley & Sons, 1999. |

**ME455UA Design of Heat Exchanger Lab**

**Teaching Scheme:** 02P, **Credit:** 01

**Evaluation Scheme:** 25 ICA+25 ESE **Total Marks: 5**0

**Internal continuous assessment performance shall be based on ME453U.A. and consist of following 3 Assignments on syllabus and 5 following Projects**

List of Experiments:

1. Design of heat exchange equipment by using LMTD method.

2. Design of heat exchange equipment by using effectiveness– NTU method.

3. Measure the effectiveness of shell and tube heat exchanger.

4. Design and analysis of Parallel flow and Counter flow heat exchanger.

5. Design and analysis of Shell and tube type heat exchanger.

6. Design and analysis of Plate type heat exchanger.

**Guidelines for ICA:**

Internal continuous assessment should support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal and sheet) based on performed practicals. The performance shall be assessed experiment wise using internal continuous assessment format.

**Guidelines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student.

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| **ME453UB FINITE ELEMENT Method** | |
| **Teaching Scheme:** 03L+01T  **Evaluation Scheme:** 30MSE + 10 ISA + 60 ESE  **Duration of ESE:** 03 hours | **Credit:** 04  **Total Marks:** 100 |

**Course Description:**

Course introduces undergraduate students to Finite Element Analysis and Simulation Technique. The course aims at imparting knowledge of Finite Element Analysis and Simulation Technique.

**Desirable awareness/skills:**

Fundamental knowledge of Mathematics, Mechanics of Material and Machine Drawing.

**Course Objective:**

The students should able to

1 introduce the concepts of Mathematical Modelling of Engineering Problems.

2. study the applicability of FEM to a range of Engineering Problems.

3. acquaint with applications of numerical techniques for solving problems.

**Course Outcomes:**

On completion of this course; student shall be able to:

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| 1. | apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. |
| 2. | formulate and solve problems in one dimensional structures including trusses, beams and frames. |
| 3. | formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. |
| 4. | implement and solve the finite element formulations using MATLAB. |

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **2** |  |  | **1** |  | **2** |  | **1** |  |  |  | **1** |  | **1** |
| **CO 2** | **3** |  |  | **1** |  | **2** |  |  |  | **1** |  |  |  |  |  |
| **CO 3** |  |  |  |  |  | **1** |  | **2** |  |  |  | **1** |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Contents**

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| **Introduction to FEA** |
| Introductory Concepts: Introduction to FEM , Discretization going from part to whole approach, Physical problem, mathematical models and finite element solution, FEA as an integral part of CAD. FEM Software’s - Pre-processing, processing and post processing. Advantages and disadvantages of FEM. |
| **One-Dimensional Analysis** |
| Discretization. Derivation of Shape functions, interpolation function, Stiffness matrices, global stiffness matrix, application of boundary, and force vectors.  Assembly of Matrices - solution of problems in one dimensional structural analysis, Stepped and Taper Bars, Torsion of circular shaft, thin wall tubes steady state heat conduction& convection, laminar pipe flow.FEM direct approach elements stiffness, potential energy approach, treatment of boundary conditions, temperature effects. Analysis of Plane Trusses, Analysis of Beams. |
| **Two-Dimensional Analysis** |
| Introduction. Finite element analysis for two dimensional problems. Natural coordinates and coordinates transformations, Derivation of shape functions for triangular element. Application of heat transfer, analysis of structural vibration. Finite element formation of beams. |
| **Two Dimensional Vector analysis** |
| Equations of elasticity – Plane stress, plane strain problems. Automatic mesh generation and imposition, Eigen value problems. Jacobian matrix, stress analysis of CST element. Applications to free vibration problems of rod and beam. Lumped and consistent mass matrices. |
| **Simulation Theory and Application** |
| Simulation: Introduction, definition, steps used in simulation, advantage and limitations, techniques of simulation. System models and studies: - concepts of a system, system environment, stochastic activities, continuous and discrete systems, system modelling, types of models, principles used in modelling, types of system studies, comparison of simulation and analytical methods, analogue computers and methods, hybrid computer |

**Text Book**

1. Textbook of Finite Element Analysis, Seshu P, Eastern Economy Edition, PHI, 2012
2. Finite Element Method in Engineering”, Reddy, J. N., 3rd edition, Tata McGraw Hill 2007.

**Reference Books**

1. Finite Element Method in Engineering, Reddy, J.N, 3rd edition, Tata McGraw Hill, 2007.
2. Finite element Method in Engineering, Singiresu S. Rao, 5th edition, Butterworth-Heinemann, 2012
3. The Finite Element Method for Solid and Structural Mechanics, Zeincowicz, 4th Edition, 2007.
4. Finite element analysis, C. S. Krishnamoorthy., 2nd edition, TMH, 2007.

**ME455UB FINITE ELEMENT METHOD LAB**

**Teaching Scheme:** 02P, **Credit:** 01

**Evaluation Scheme:** 25 ICA+25 ESE **Total Marks: 5**0

**Course Objectives:**

Learner will be able to…

1. familiarise FEA concept for practical implementation

2. acquaint with FEA application software

**Course Outcomes:**

Learner will be able to…

1. select appropriate element for given problem

2. understand how select suitable meshing and perform convergence test

3. select appropriate solver for given problem

4. apply and Interpret the result

5. validate FEA solution

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  | **2** |  |  | **1** |  | **2** |  | **3** |  |  |  | **1** |  | **1** |
| **CO 2** | **1** |  |  | **1** |  |  |  |  |  | **1** |  |  |  |  |  |
| **CO 3** |  |  |  |  |  | **1** |  |  |  |  |  | **1** |  |  |  |
| **CO 4** |  | **3** |  |  | **2** |  |  |  |  |  |  |  | **1** |  |  |
| **CO 5** | **1** |  | **2** |  | **1** |  |  |  |  | **2** |  |  |  |  |  |

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Internal continuous assessment performance shall be based on ME453U and consist of following Assignments and Projects**

**PART A.**

1. Analysis of I-cantilever beam.

2. Analysing Flow in a System of Pipes.

3. Analysis of Trusses.

4. Modal Analysis of Spring-Mass System.

5. Modal Analysis of continuous System.

6. Thermal analysis of any component.

7. Stress strain analysis of any component.

8. Kinematic Analysis and simulation of slider crank Mechanism.

**PART B.** Three assignments on syllabus

Note: Lab file should contain any five experiments by using any analysis software.

**Guidelines for ICA:**

Internal continuous assessment should support for regular performance of practical and its regular assessment with proper understanding principle of practicals completed.

**Guidelines for ESE:**

Oral will be based on content of syllabus and practical.

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| **ME453UC Advanced Mechanism**  **Teaching Scheme : 03L+1T**  **Evaluation Scheme: 30 MSE +10 ISA +60 ESE Credit: 4**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  The overall objective of this course is to understand kinematics synthesis of mechanism, to learn how to synthesis a given mechanism, when input and output is given with different methods and optimal synthesis of mechanism. |
| **Desirable awareness:**  Fundamental knowledge of theory of machines and mechanism. |
| **Course Objectives:**  On the successful completion of this course, student will be able to   1. provide theoretical background for basic and advanced kinematics and synthesis of   mechanisms to achieve desired motion.  2. introduce basic and advanced computer-based tools for synthesis of mechanisms. |
| **Course Outcomes:**  On the successful completion of this course, student will be able to  1. understand theoretical background in synthesis of mechanisms.  2. become familiar with basic and advanced computer-based engineering tools for the  design of linkages.  3. apply theory and the use of practical engineering tools in a substantial mechanism  design project.  4. understand the concept of optimal synthesis of mechanism for N-accuracy points |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **3** | **2** | **1** | **1** | - | **1** | - | - | - | - | - | - | **1** | **-** | **-** |
| **CO 2** | **3** | **2** | **1** | **1** | **2** | **1** | - | - | - | - | - | - | **-** | **-** | **-** |
| **CO 3** | **3** | **2** | **1** | **1** | **2** | **1** | - | - | - | - | - | - | **-** | **-** | **-** |
| **CO 4** | **3** | **2** | **1** | **1** | **2** | **1** | - | - | - | - | - | - | **1** | **-** | **1** |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

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| **Course Content:** |
| **Introduction to kinematic synthesis**:  Type, number and dimension synthesis. Tasks of kinematic synthesis with practical applications, Degree of freedom, class-I, class-II chain, Grashof criterion, Grubler's criterion, concept of transmission angle. |
| **Three position synthesis** for function, path and rigid body guidance problem. Four position synthesis-Point position reduction, Precision position, Structural Error, Chebychev Spacing. Coupler- curve synthesis, Cognate linkages, Robert-Chebychev Theorem. |
| **Freudenstein’s Equation,** Analytical Synthesis using complex algebra, Synthesis of Dwell mechanism, computer approach for the above problem |
| **Optimal synthesis** of planar mechanisms, Powells search methods, least square method penalty function computer approach. |
| **Spatial Mechanism**: Introduction, Exception in the mobility of mechanism, Position-Analysis problem, Velocity and acceleration Analysis, Eulerian angles and Denavit-Hartenberg parameters. |

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| **Text Books:**   1. Sandor G.N., Erdman, A. G, “Advanced mechanism design”, Prentice Hall Inc, 1984 2. Theory of machines and mechanism, Joseph Shigley,Si edition, Oxford University Press, 2014 |
| **Reference books**:  1. Kinematics and mechanisms design, Suh C.H., Radcliff C.W John Wiley &Sons., 1978 |

**ME455UC Advanced Mechanism Lab**

**Teaching Scheme: 02P Credit: 1**

**Evaluation Scheme: 25ICA+25ESE Total Marks: 50**

Minimum Eight experiments shall be performed to cover entire curriculum of course ME453U.C.

**List of Practical:**

1. Synthesis of a planar mechanism for function generation. Problem (Analytical Approach)

2. Synthesis of a planar mechanism for path generation. Problem. (Analytical Approach)

3. Synthesis of a planar mechanism for Motion generation. Problem. (Analytical Approach)

4. Kinematic analysis of spatial mechanisms.

5. Synthesis of a planar mechanism for function generation. Problem (Graphical Approach)

6. Synthesis of a planar mechanism for path generation. Problem. (Graphical Approach)

7. Synthesis of a planar mechanism for Motion generation. Problem. (Graphical Approach)

8. Study of Powell’s search methods for optimal synthesis of a planar mechanism

9. Study of least square method for optimal synthesis of a planar mechanism

10 Optimal synthesis of a planar mechanism for any one task of kinematic synthesis

**Guidelines for ICA**:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S 10).

**Guidelines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

**ME453UD STEAM TECHNOLOGY**

**Teaching Scheme : L03+1T Credit: 04**

**Evaluation Scheme: 30MSE+10ISA+60ESE Total Marks: 100**

**Duration of ESE : 03 Hrs**

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| **Course Description:**  This course introduces undergraduate students to steam generating devices and its technology. The background required includes a sound knowledge of Various Boilers efficiency and loss reduction techniques, Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics of second year Level. The course aims at imparting knowledge of steam generating system, transport pipes insulation importance |
| **Desirable awareness:**  The student should have fundamental knowledge of Thermodynamics, Heat Transfer,  Fluid Dynamics, Metallurgy and Fuels and Combustion |
| **Course Objectives:**  Students will be able to   1. know the steam generating devices, its construction andworking principals. 2. understand the energy efficiency of steam generating devices. 3. understand losses in steam generating and transport system |
| **Course Outcomes:**  Students will be able to   1. explain working of different boilers and significance of mountings and   accessories.   1. use techniques, skills, and modern engineering tools necessary for boiler   performance assessment.   1. Students will have a theoretical and practical orientation in thermal systems, 2. Students will be able draw a steam piping system for a process with various   components and also design economical and effective insulation.   1. Students will be able to analyze a thermal system to determine sources of   waste heat and design waste heat recovery systems.  **Relevance of POs and Strength of Correlation:**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CO** | **PO** | | | | | | | | | | | | **PSO** | | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | | **CO1** | **1** |  |  |  | 2 | **3** |  | 1 |  |  |  |  | **1** | **-** | **-** | | **CO 2** |  | **3** | **2** |  |  |  |  |  |  |  |  |  | **-** | **-** | **-** | | **CO 3** | **1** |  |  |  |  | 3 |  |  |  |  | 1 |  | **-** | **-** | **-** | | **CO 4** |  | **1** |  |  | **2** |  | 3 |  |  |  |  |  | **1** | **-** | **1** | | **CO 5** | **1** |  |  | **3** |  |  |  |  | 1 |  |  |  |  |  |  |   1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated |
| **Course Content:** |
| **Boilers**  Types, Mountings and Accessories, Combustion in boilers, Feed Water and its quality, Blow down; IBR, Boiler standards, overview of properties of steam. |
| **Piping & Insulation**  Water Line, Steam line design, IS Pipe color codes; insulation, Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss. |
| **Steam Systems**  Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipment’s / Systems; Identifying opportunities for energy savings. |
| **Boiler Performance Assessment**  Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance. |
| **Energy Conservation and Waste Minimization.**  Energy conservation options in Boiler; waste minimization, methodology; economic  viability of waste minimization Instrumentation & Control Process instrumentation; control and monitoring |

**Textbooks:**

* 1. Applied Thermodynamics, T.D.Estop, A. McConkey, Parson Publication,5th

Edition, 2009.

* 1. A Course in Thermal Engineering, Domkundwar, 6th edition Dhanapat Rai and Sons, 2010.
  2. R.K. Rajput, Applied Thermodynamics, S. Chand & Company Limited, 8th Edition,2011.

**Reference books:**

1. Energy Efficiency in Thermal Utilities; Bureau of Energy Efficiency

2. Energy Performance Assessment for Equipment & Utility Systems; Bureau of

Energy Efficiency, Edited by J. B. Kitto & S C Stultz; Steam: Its Generation and

Use; The Babcock and Wilcox Company, 42nd Edition, 2015

3. Boiler Operation Engineering: Questions and Answers;P. Chatopadhyay; Tata

McGraw Hill Education Pvt Ltd, N Delhi, 3rd Edition 2013.

**ME455UD STEAM TECHNOLOGY LAB**

**Teaching Scheme:** 02P, **Credit:** 01

**Evaluation Scheme:** 25ICA + 25 ESE **Total Marks:** 50

**Minimum Eight experiments shall be performed to cover entire curriculum of course ME453UD.**

List of Experiments:

* 1. To study low pressure boilers and their accessories and mountings.
  2. To study high pressure boilers and their accessories and mountings.
  3. To study the working of impulse and reaction steam turbines.
  4. To prepare heat balance sheet for given boiler.
  5. To find power output & efficiency of a steam turbine.
  6. To find the condenser efficiencies.
  7. To study cooling tower and find its efficiency.
  8. To find calorific value of a sample of fuel using Bomb calorimeter.
  9. Calibration of Thermometers and pressure gauges.
  10. To study and find volumetric efficiency of a reciprocating air compressor.
  11. To find dryness fraction of steam by separating and throttling calorimeter

**Guidelines for ICA**: Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S 10).

**Guidelines for ESE:**

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student. It shall be evaluated by two examiners out of which one examiner shall be out of institute

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| **ME454UA AUTOMOBILE ENGINEERING**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description**:  After completing this course, students will have a broad and fundamental understanding of Automobile Engineering. Topics range from a classification of automobile to details sub systems of vehicle such as engine, clutch, gear box, transmission line , differential gear box, types of axles ,steering system, breaking system and electrical system overdrive suspension system etc. and career options available within this field |
| **Desirable awareness:**  Fundamental knowledge of Engineering Graphics, Machine Drawing, Mathematics, Physics, Metallurgy, Strength of materials, Theory of Machines, Electrical and Electronics and I.C. Engines |
| **Course Objectives:**  The students should able to   1. described basics of principles of actual automobile systems. 2. know importance and features of different systems like axle, differential, brakes, Steering, suspension, and balancing etc 3. understand working of various Automobile Systems. 4. remember some modern trends in Automotive Vehicles. |
| **Course Outcomes:**  The students should able to   1. understand the Construction, working and other details about Internal   Combustion Engines used in automobiles.   1. identify Construction, working, preventive maintenance, trouble shooting and   diagnosis of various Automobile Systems.   1. understand importance and features of different systems like axle, differential,   brakes, steering, suspension, and balancing etc.   1. identify Modern technology and safety measures used in Automotive Vehicles |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** | **2** |  |  | **2** |  | **3** |  |  | **1** |  |  | **1** | **1** |  |
| **CO 2** |  |  | **1** |  |  | **3** |  | **1** |  | **1** |  |  |  |  |  |
| **CO 3** | **2** |  |  |  | **3** |  |  |  |  |  |  |  |  |  |  |
| **CO 4** |  |  | **3** |  |  |  | **1** |  |  |  |  |  |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

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| **Course Content:** |
| **Classification of automobiles** :  Chassis, layout types, Sub-systems of automobile Power Unit:-Functions and locations power for propulsion, Engine parts-types, construction and functions, multiple cylinder engines. General considerations of engine balance vibration, firing order road performance curves, introduction to electrical vehicles. |
| **Fuel feed systems:-**  fuel feed systems for petrol engines. Fuel pumps, Basic principles of Multipoint Fuel Injection Systems (MPFI), B.S.-VI, Multi-Jet, VVT, DCI, Cooling system: purpose, types of cooling system, troubles and remedies of cooling system, lubrication: - Types of lubricants, multi-viscosity oils, chassis lubrication. Engine lubrication:- types of lubricating systems, crankcase ventilation, Engine lubrication troubles and remedies. |
| **Starter motor drive:**  Bendix drive, over running clutch drive, Solenoid switch; solenoids switch. Ignition system:- Battery coil and magneto ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system. |
| **Transmission system:-**  Construction, transmission, requirements of single plate friction clutch and multiplate clutch, clutch adjustments, clutch troubles and remedies.  Gear Boxes:- Sliding mesh, constant mesh and synchromesh gear box, function of over drives, trouble shooting and remedies. Propeller shaft, hotchkiss drive torque tube drive, differential ,Final drive, Types of rear axles. Introduction to AMT, CVT, DSG, DCT. |
| **Braking system:-**  Mechanical, hydraulic brakes, power brakes, air brakes and vacuum brakes Fault finding and maintenance of brakes, Steering system:- Function, types of linkages, steering gears, steering gear ratio. Wheel alignment, steering geometry, & their effects, Introduction of power steering. Suspensions: - Types of Rigid, axle and independent suspension system, shock absorbers. |

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| **Text Books:**  1. Automobile Engineering”-Vol.I vol II, Singh K. 9th Ed; Standard pub &  Distributors,2011  2. Automobile Engineering, Ramalingum K.K.,Scitech publications”, Chennai,2011  3. Automotive Engines, Srinivasan S,1st edition, Tata Mc Graw Hill,1989  4.Automotive Mechanics, Crouse W.H ,10th edition,Tata Mc Graw Hill  5.Automotive Mechanics, Joseph Heitner ,East-West press pvt .Ltd |
| **Reference books:**  1. Motor Vehicle, K. Newton and W. Seeds, T.K. Garrett, 13th Edition, 2001  onwards, Elsevier publications  2. Handbook of Automotive Engineering, Hans Hermann Braess, Ulrich Seiffen, 1 st  Edition, 2005 onwards, SAE Publications  3. Automotive Mechanics, William H. Crouse, 10 th Edition, 2006 onwards Tata  McGraw Hill Publishing House. |

**ME454UB COMPUTATIONAL FLUID DYNAMICS**

**Teaching Scheme:** 03 L, **Credits:** 03

**Evaluation Scheme:** 30MSE + 10 ISA + 60 ESE **Total Marks:** 100

**Duration of ESE:** 03 Hrs

**Course Description:**

Computational fluid dynamics (CFD) has become an essential tool in analysis and design of thermal and fluid flow systems in wide range of industries. Few prominent areas of applications of CFD include meteorology, transport systems (aerospace, automobile, highspeed trains), energy systems, environment, electronics, bio-medical (design of lifesupport and drug delivery systems), etc.

The correct use of CFD as a design analysis or diagnostic tool requires a thorough understanding of underlying physics, mathematical modeling and numerical techniques. The user must be fully aware of the properties and limitations of the numerical techniques incorporated in CFD software. This course aims to provide precisely these insights of CFD.

**Desirable awareness/skills:**

Knowledge of Higher Engineering Mathematics, heat transfer and Fluid Mechanics

**Course Objective:**

The students should able to

1. To provide the students with sufficient background to understand the mathematical representation of the governing equations of fluid flow and heat transfer.
2. To solve one and two-dimensional ordinary and partial differential equations using traditional CFD tools.
3. To express derivatives and differential equations through discretization techniques.
4. To understand the general transformation equations for grid generation.
5. To apply explicit, implicit and semi-implicit methods of finite differencing and solve fluid flow field using some popular CFD techniques.

**Course Outcomes:**

On completion of this course student should be able to:

1. Derive the basic governing equations applied for fluid flow problems.
2. Possess the knowledge of CFD techniques, basic aspects of discretization and grid generation.
3. Solve fluid flow fields using CFD methods.
4. Model fluid flow problems and heat transfer.

**RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** |  |  | **2** |  |  | **3** |  |  | **1** |  |  |  | **1** | **1** |  |
| **CO 2** | **1** |  |  | **3** |  |  | **2** |  |  |  |  | **1** |  |  |  |
| **CO 3** |  | **3** |  |  | **1** |  |  |  |  | **1** |  |  |  |  |  |
| **CO 4** | **1** |  | **3** |  |  | **2** |  | **1** |  |  |  | **1** |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course content**

**Introduction and Governing Equations**

Introduction to Computational Fluid Dynamics, CFD Applications, Governing equations of  
fluid dynamics – Continuity, Momentum and energy, Generic integral form for governing  
equations - Initial and Boundary conditions, Governing equations for boundary layers,  
Classification of partial differential equations – Hyperbolic, Parabolic, Elliptic and  
Mixed types - Applications and relevance.

**Discretization**

Basic aspects of discretization, Discretization techniques, Finite difference, Finite volume and Finite Element Method, Comparison of discretization by the three methods, Introduction to Finite differences, Transient one-dimensional and two-dimensional conduction, Explicit, Implicit, Crank-Nicolson, ADI scheme, Stability criterion, Difference equations - Numerical errors - Grid independence test - Optimum step size.

**Grid Generation**

Grid generation, General transformation of the equations, Form of the governing  
equations suitable for CFD, Algebraic and Elliptic Methods, Adaptive grids, Unstructured grid generation, Modern developments in grid generation.

**Finite Volume Method**

Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretized equations using TDMA. Finite volume methods for unsteady problems – explicit schemes, implicit schemes. Finite Element Method: Introduction. Weighted residual and variational formulations. Interpolation in one-dimensional and two-dimensional cases.

**Viscous Incompressible Flow**

Introduction, Governing equations, Incompressible flow computation, Stream function vorticity approach, MAC Method, solution scheme, Determination of pressure for viscous flow, Two dimensional incompressible viscous flow, estimate on of discretization error, applications to curvilinear geometries, derivation of surface pressure & drag.

**Text Books:**

1. Computational Fluid Flow and Heat Transfer, Muralidhar. K, and Sundararajan.T, Second Edition, 2008, Narosa Publishing House, New Delhi.
2. Computational Fluid dynamics, Anderson J.D, 2010, McGraw Hill International, New York.
3. Numerical Heat Transfer and Fluid Flow, Suhas.V. Patankar, 2009, Hemisphere  
   Publishing Corporation.

**References Books:**

1. An Introduction to computational fluid dynamics: The finite volume method, Versteeg H.K., and Malalasekera W, 2007, Longman Scientific & Technical.
2. Computational Fluid Dynamics: The Basics with Applications, John David Anderson, First edition, 1995, McGraw Hill Education, New York.
3. Computer simulation of fluid flow and heat transfer, Ghoshdasdidar P. S, 1998, Tata  
    McGraw Hill Publishing Company Ltd.

4) Introduction to Computational Fluid Dynamics, Date A. W, First edition, 2005,

Cambridge University Press.

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| **ME454UC MACHINE TOOL DESIGN**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30 MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  This course introduces undergraduate students to different parts of machines, failure criteria and conventional design procedures. |
| **Desirable awareness:**  A sound knowledge of Mathematics, Engineering Mechanics, SOM, TOM and Machine Drawing are requiring. basic knowledge of workshop practice, manufacturing process, gear design are requisite . |
| **Course Objectives**:  On completion of this course student should be able to:   1. understand procedure of machine design and develop an ability to apply it for simple component design such as headstock driven system. 2. understand the different theories of failure and develop an ability to apply its knowledge for design of mechanical component and determine the resisting areas against failure 3. determine forces on transmission shaft and design of transmission shaft and speed reduction via gear trains and engagement system 4. determine the endurance strength and design of components subjected to fluctuating loads of machine tools components |
| **Course Outcomes**:  On completion of this course student should be able to:  1. analyze the stresses and strains induced in a machine element. Design different  components as column, guide ways, slide ways and gear box etc miscellaneous  components .  2. design spindle speed stages along with gear teeth and other parameter  and design with drawing gear box |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **2** |  |  | **1** |  | **3** |  | **1** |  |  |  |  | **1** | **1** |  |
| **CO 2** |  | **1** |  |  | **3** |  |  |  |  | **1** |  |  |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

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| **Course Content:** |
| **Introduction & Drives: Recent Trends in designing machine tools:**  Classification of various machine tools General purpose, Special purpose, NC-CNC on the basis of kinematics. Considerations in designing drives, based on continuous on intermittent requirement of power. Type and selection of motor for the drive, regulation and range of speed based on preferred number series/ Geometric progression. Design of headstock gear box for spindle drive using ray diagram, structure diagram, nodal optimization while designing compact gearbox. |
| **Stepless Regulation & Elements of Machine Tools:**  Electromechanical regulation of speeds, Friction, pressure and ball variators, P.I.V. drive (Kopp. Variator) Epicyclic drive etc. Design of beds, slideways, carriage, tables of lathes, milling machines based on force, frictional behavior and different types of lubrication system, used. Design of Power Screws – sliding as well as rolling friction, spindle units, and bearing, Preloaded supports. |
| **Static & Dynamic Rigidity of Machine tools**:-  Sources of Vibration, Chatter, Stability, Dynamics of Cutting Process Vis-a-Vis machine tool, Stick-slip phenomenon and methods of combating.  **Control System:**  Electrical Control: Push button control, directional control relays, thermal relays, electrical brakes, Control for reversing traverse and automation in feed mechanism, selective/pre-selective control, and adaptive control.  Hydraulic Control of shaper, miller and other machine. Power pack for lubrication system in hydrostatic drive. |
| **NC - CNC Machine:**  Introduction, Construction, Operation, Transducers of various type, CPU block diagram, CAD-CAM Systems interfacing, APT programming, Retrofitting & Design considerations for conversion. Open or closed loop for NC\CNC machine using stepper motor or DC motor, protective and safety devices. Flexible manufacturing System: Definition, Types, classification, equipment application – Auto Tool Changer – types, functional details, Modular Concept of Design. |
| **Acceptance tests for machine tools:**  Schlesinger‟s tests and Tobias‟s Stability Envelopes, Performance criteria of Machine Tools, Static & Dynamic tests, foundation of Machine tools etc. |

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| **Text Books:**   * + - 1. Machine Tool Design G. R. 3rd edition Nagpal Khanna publication, New Delhi.       2. Design of Machine Tool’’,D. K Pal, S. K. Basu, 4th Edition. Oxford IBH 2005, 204-0968.       3. Machine Tool Design G. R. 3rd edition Nagpal Khanna publication, New Delhi, 1999.       4. Machine Tool Design, N. K. Mehta, Tata McGraw Hill, ISBN 0-07-451775-9. |
| **Reference books:**   1. Design Principles of Metal Cutting Machine Tools, F. Koenigsberger, The Macmillan Company New York 1964. 2. Principles of Machine Tool, Bhattacharya and S. G. Sen., New central book agency Calcutta, ISBN 81-7381-1555. 3. Machine Tool, N. S. Acherkan, Vol. I, II, III and IV, MIR publications. 4. Machine Tool Design, N. K. Mehta, Tata McGraw Hill, ISBN 0-07-451775-9. |

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| **ME454UD Advanced Production Processes**  **Teaching Scheme : 03L**  **Evaluation Scheme : 30 MSE +10 ISA +60 ESE Credit: 03**  **Duration of ESE : 03 Hrs Total Marks: 100** |

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| **Course Description:**  After completing this course, students will have a broad and fundamental understanding of Advanced Manufacturing Techniques. Topics range from an Advanced casting, Advanced micro machining, Laser beam machining, powder metallurgy and Advanced measuring techniques like CMM etc. Students will learn Advanced manufacturing technique knowledge and tools used in it, and career options available within this field. |
| **Desirable awareness:**  Study the associated aspects in Advanced Production Processes. |
| **Course Objectives:**  On completion of this course student should be able to:   1. acquire knowledge of various advanced casting processes, casting simulation and analysis. 2. understand various micro-machining methods and devices. 3. understand the measurement system for micro-machining and understand it’s inspection methods. 4. understand different aspects of powder metallurgy and surface coating 5. understand rapid prototyping and generative manufacturing processes. |
| **Course Outcomes:**  understand and posses the knowledge of different advanced manufacturing  technique.  identify different micro-machining processes and devices used for AMT.   * + - 1. evaluate different aspects of micro-machining.       2. understand about powder metallurgy and surface coating.       3. identify rapid prototyping and types of generative manufacturing processes. |

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  | **3** |  | **1** |  |  | **1** |  |  | **1** | **1** |  |
| **CO 2** |  | **2** |  | **2** |  |  | **3** |  | **1** |  |  |  |  |  |  |
| **CO 3** | **3** |  | **1** |  |  | **1** |  |  |  | **1** |  |  |  |  |  |
| **CO 4** |  | **2** |  | **3** |  |  | **1** |  | **2** |  |  |  |  |  |  |
| **CO 5** | **2** |  |  |  | **3** |  |  | **1** |  |  |  | **1** |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

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| **Course Content:** |
| **Advances in Casting Process**  Sheet molding, casting, V-process, flask less molding, evaporative casting, plaster mould casting, design for plaster mould casting quality accuracy, uniformity and other considerations in casting and molding. Recent developments in pattern and cast. |
| **Micro Machining**  Machining for Micro devices, Various methods of micromachining like Micro EDM, Micro ECM, Ultrasonic, Lithography, Beam machining processes: LBM, IBM, EBM. Micro Electro Manufacturing System (MEMS). |
| **Measurement systems for Micromachining**  Uncertainty of measurement, calibration; Sensors; Non-contact inspection methods: ultrasonic, computer vision, laser-based, interferometers; Tactile inspection: Coordinate Measuring Machines (CMM), mechanical arms; Intelligent systems, components, benefits and applications. Devices, instruments used for micro machined components. |
| **Powder metallurgy and surface coating**  Powder Metallurgy: process, different methods of producing powders, different techniques to form the shape viz. pressing, extruding, sintering, and hot pressing, advantages, disadvantages, Surface Coating: principles, elements, process, advantages and surface preparation, physical vapour deposition, chemical vapour deposition, electrolysis coating. |
| **Rapid Prototyping**  Product development cycle and importance of prototyping, types prototypes, principles and advantages, different types of generative manufacturing process, viz. streolithography, FDM, and SLS. |

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| **Text Books:**   1. Amitabh Ghosh, “Genetic Manufacturing”, Prentice Hall Industrial Robotics,M. P. Groover, McGraw Hill Publication Co. Ltd. 2. P.K. Mishra “Non-conventional machining process” by, Narosa Publication. H.M.T , “Production Technology Hand Book”, TMH 3. B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman “Manufacturing process”, By John Wiley & Sons, Eighth edition |
| **Reference** books:   1. Benjamin W. Niebel, Allen B Draper, Richard A. Wysk, “Modern Manufacturing process engineering” by McGraw Hill International Editions. Garry F. Benedict- Marcel Dekker Inc “Non Traditional Manufacturing Processes” by CRC Press New York. 2. B.H. Amsteal, Philip F. Ostwald & Myron L. Begeman “Manufacturing process”, By John Wiley & Sons, Eighth edition |

**ME458U PROJECT**

**Teaching Scheme:** 04P **Credit:** 06

**Evaluation Scheme:** 100 ICA+100 ESE **Total Marks: 2**00

**Course Description:**

The Project is one of the most important single piece of work in the degree programme. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organise a large project over a long period. The mini-project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

**Desirable awareness/skills:**

Knowledge of concepts, principles and techniques studied in all earlier courses.

**Course objectives:**

The students should able to

develop ability to synthesize knowledge and skills previously gained and to put

some of them into practice.

2. make students capable to select from different methodologies, methods and forms

of analysis studied to produce a suitable system or sub-system.

3. inculcate ability to present the findings of their technical solution in a written

report.

4. plan and organise a large project over a long period.

**Course outcome:**

On successful completion of this course students shall

1. apply the knowledge and skills previously gained into practice.
2. take appropriate decision w.r.t. various parameters related to production of a

system or sub-system.

1. demonstrate the leadership quality along with ability to work in a group.
2. prove the ability to present the findings in a written report or oral presentation.

**Relevance of POs and Strength of Correlation:**

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| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  | **3** |  | **1** |  |  | **1** |  |  | **1** | **1** |  |
| **CO 2** |  | **2** |  | **2** |  |  | **3** |  | **1** |  |  |  |  |  |  |
| **CO 3** | **3** |  | **1** |  |  | **1** |  |  |  | **1** |  |  |  |  |  |
| **CO 4** |  | **2** |  | **3** |  |  | **1** |  | **2** |  |  |  |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content**

It actually combination og Project Phase-I and II

The remaining work of Project Phase – I shall be undertaken and completed by the same group of students in this course as the project is a yearlong activity.

Project Phase - II deliverables: A project report as per the specified format (available on the institute website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of continuous progress (Log Book) duly signed by guide and present as Project Phase - II deliverable along with report.

**Internal Continuous Assessment (ICA)**

* The ICA shall be evaluated by departmental committee consisting of two - three faculty members of the department (one of which shall be guide) appointed by the HoD following the principle of continuous evaluation i.e. project reviews as per academic calendar.
* Examiners shall judge the student on the basis of presentation, deliverables of Project Phase – II described earlier. In case of unsatisfactory performance, committee may recommend repeating the Project Phase – II work and such group shall reregister for this course in next semester.

**End Semester Examination (ESE)**

* The End Semester Exam for this course shall be based on presentation and demonstration of Project Phase – II deliverables followed by oral examination. It shall be evaluated by two examiners out of which one examiner shall be out of institute and other shall be guide. (If guide is absent at the time of examination, the other examiner shall be the committee member of ICA evaluation)

**ME457U SEMINAR**

**Teaching Scheme:** 02 P **Credit:** 02

**Evaluation Scheme:** 50 ICA **Total:** 50

**Course Description:**

The course explores the knowledge of presentation and effective communication. The course develops ability to work on multidisciplinary teams, Identify, formulate, and solve engineering problems in view of economic, environmental and societal context.

**Prerequisite Course(s):**

Knowledge of science, mathematics, computer programming and core subject of engineering

**Course Objectives:**

The objectives of Seminar are to develop ability express our view, presentation and effective communication. The scope of seminar-II is study various national and international journal for design, experiments conduct, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability.

**Content :-**

1. Each Student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.

2. Topic of Seminar shall be registered within a three weeks from commencement of VII Semester and shall be approved by the committee.

3. The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar. Seminar shall be related state of the art topic of his choice approved by the committee.

4. Each student should deliver a seminar in scheduled period (Specified in time table or time framed by department) and submit the seminar report (paper bound copy/Thermal bound)in following format: a. Title b. Abstract c. Introduction d. Literature survey e. Concept f. Functional and Technical Details g. Applications h. Comparison with similar topics / methods i. Future scope j. References ASSESSMENT OF SEMINAR

5. Follow all project guidelines of report writing for seminar report writing.

**Guide lines for ICA:**

ICA shall be based on topic selection, presentation and Seminar report submitted by the student in the form of thermal bound. Assessment of the Seminar-II for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the guidelines given in **Table- B**

Presentation seminar topic shall be performed by the each student at the end of tem by at least 03 (guide may be default member ) committee member of department assigned by HoD.

Summative Assessment of each student at the time of seminar presentation shall be assessing by referencing following format,

**Assessment of seminar**

Name of Guide: - Name of two internal evaluator: - 1. 2.

Class: - Semester:- A- Year:-

Table-B

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **PRN No.** | **Name of Student** | **Seminar Topic** | **Topic Selection**  **(05)** | **Literature survey**  **(05)** | **Report writing**  **(05)** | **Depth of understanding (05)** | **Presentation**  **(05)** | **Total**  **(25)** |
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**Remark, if any, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(Evaluated by three committee member of dept. and dully signed on such format)

**ME456U Project Phase- II**

**Teaching Scheme:** 04P **Credit:** 04

**Evaluation Scheme:** 100 ICA+100 ESE **Total Marks: 2**00

**Course Description:**

The Project is one of the most important single piece of work in the degree programme. It is introduced in curriculum to put into practice some of the techniques that have been taught to students in earlier years. It also provides the opportunity to students to demonstrate independence and originality, to plan and organise a large project over a long period. The mini-project topic should be selected to ensure the satisfaction of the need to establish a direct link between the techniques they learnt and productivity. Thus it should reduce the gap between the world of work and the world of study.

**Desirable awareness/skills:**

Knowledge of concepts, principles and techniques studied in all earlier courses.

**Course objectives:**

The students should able to

develop ability to synthesize knowledge and skills previously gained and to put

some of them into practice.

2. make students capable to select from different methodologies, methods and forms

of analysis studied to produce a suitable system or sub-system.

3. inculcate ability to present the findings of their technical solution in a written

report.

4. plan and organise a large project over a long period.

**Course outcome:**

On successful completion of this course students shall

1. apply the knowledge and skills previously gained into practice.
2. take appropriate decision w.r.t. various parameters related to production of a

system or sub-system.

1. demonstrate the leadership quality along with ability to work in a group.
2. prove the ability to present the findings in a written report or oral presentation.

**Relevance of POs and Strength of Correlation:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CO** | **PO** | | | | | | | | | | | | **PSO** | | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** |
| **CO1** | **1** |  | **2** |  | **3** |  | **1** |  |  | **1** |  |  | **1** | **1** |  |
| **CO 2** |  | **2** |  | **2** |  |  | **3** |  | **1** |  |  |  |  |  |  |
| **CO 3** | **3** |  | **1** |  |  | **1** |  |  |  | **1** |  |  |  |  |  |
| **CO 4** |  | **2** |  | **3** |  |  | **1** |  | **2** |  |  |  |  |  |  |

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

**Course Content**

The remaining work of Project Phase – I shall be undertaken and completed by the same group of students in this course as the project is a yearlong activity.

**Project Phase - II deliverables**: A project report as per the specified format (available on the institute website), developed system in the form of hardware and/or software. In addition, student shall maintain a record of continuous progress (Log Book) duly signed by guide and present as Project Phase - II deliverable along with report.

**Internal Continuous Assessment (ICA)**

* The ICA shall be evaluated by departmental committee consisting of two - three faculty members of the department (one of which shall be guide) appointed by the HoD following the principle of continuous evaluation i.e. project reviews as per academic calendar.
* Examiners shall judge the student on the basis of presentation, deliverables of Project Phase – II described earlier. In case of unsatisfactory performance, committee may recommend repeating the Project Phase – II work and such group shall reregister for this course in next semester.

**End Semester Examination (ESE)**

* The End Semester Exam for this course shall be based on presentation and demonstration of Project Phase – II deliverables followed by oral examination. It shall be evaluated by two examiners out of which one examiner shall be out of institute and other shall be guide. (If guide is absent at the time of examination, the other examiner shall be the committee member of ICA evaluation)