

**VINOBA BHAVE UNIVERSITY HAZARIBAGH**  
**SYLLABUS FOR B-TECH 5<sup>TH</sup> SEMESTER**

**Semester - V**

**Branch: Mechanical Engineering**

S.N.	Code	Course Title	Lecture	Tutorial	Practical	Credit
1	ME501	Heat Transfer	3	1	0	4
2	ME502	Design of Machine Elements	3	0	0	3
3	PEC-I		3	0	0	3
4	PEC-II		3	0	0	3
5	OEC- I		3	0	0	3
6	HU501	Professional Communication	1	0	2	0
7	ME551	Lab I (HMT / Manufacturing Processes (SIEMENS))	0	0	3	1
8	ME552	Lab II (Machine Design)	0	0	3	1
9	ME553	Lab III (I.C. Engine)	0	0	3	1
10	ME554	Internship Assessment	0	0	2	2
<b>Total Credits</b>						<b>21</b>

Code	Professional Elective-I (Any one)	Code	Professional Elective-II (Any one)
ME511	Principles of Management	ME521	Advanced Materials
ME512	Total Quality Management	ME522	Internal Combustion Engines
ME513	Project Management	ME523	Advanced Welding Technology

Code	Open Elective-I (Any One)
ME531	Operations Research
ME532	Non-Conventional Energy Sources
ME533	Design for Manufacturing
ME534	New Venture Creation
ME535	Design and Analysis of Experiments

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Mechanical Engineering			
Code: ME501	Heat Transfer	L	T
		3	1

## Objectives:

- (1) The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- (2) Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- (3) The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

## Contents:

### Module 1

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances (7)

### Module 2

Critical thickness of insulation, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction, heat transfer by the use of Heissler charts. (6)

### Module 3

Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection. (7)

### Module 4

Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow-Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection. (6)

### Module 5

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method. (10)

### Module 6

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and  $\epsilon$ - NTU methods. Exposure of numerical technique of heat transfer. (7)

### Module 7

Boiling and Condensation heat transfer, Pool boiling curve  
Introduction mass of transfer, Fick's law, Similarity between heat and mass transfer. (7)

## Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.

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2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

### **Text Books:**

1. P. K. Nag, Heat and Mass Transfer
2. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002
3. Frank Kreith, Raj M. Manglik, Mark S. Bohn: Principles of Heat Transfer, Cengage Learning

### **References Books:**

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002

## Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
Code: ME502	Design of Machine Elements	L	T
		3	0

### Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

1. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
2. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3. An overview of codes, standards and design guidelines for different elements
4. An appreciation of parameter optimization and design iteration
5. An appreciation of the relationships between component level design and overall machine system design and performance

### Course Contents:

Design considerations - limits, fits and standardization, Review of failure theories for static and dynamic loading (including fatigue failure), Design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings, Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives, Design of springs: helical compression, tension, torsional and leaf springs, Design of joints: threaded fasteners, pre-loaded bolts and welded joints, Analysis and applications of power screws and couplings, Analysis of clutches and brakes, Engine Components. (40)

### Course Outcomes:

Upon completion of this course, students will get an overview of the design methodologies employed for the design of various machine components

### Text Books:

- [1] Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
- [2] Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
- [3] Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
- [4] Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
- [5] R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
HU501	Professional Communication	L	P
		1	2

## Course Overview:

This course is designed to help one develop communication skills in English with a sense of language. It will be of help to improve clarity, precision and overall impact in both oral as well as written communication. It will also enable one to produce clear and effective scientific and technical documents required for professional communication. We will focus on basic principles of good writing- which scientific and technical writing shares with other forms of writing- and on types of documents common in scientific and technical fields and organizations. One can learn how to gather, organize, and present information effectively according to audience and purpose. Moreover, emphasis will be on sustainable communication that will facilitate an understanding of one's role and help to align with the mission of the organization.

## Objective:

To provide you with the communication skills one needs to advance in a field, keeping in mind that, in career, one may be involved with design, development, field service and support, management, sales, customer liaison, or all of the above.

## Course Outcomes:

**CO 1:** Demonstrate effective oral and written communication with diverse audiences and produce variety in professional written documents to better support and communicate.

**CO 2:** Plan and deliver a formal presentation on a topic with confidence and poise.

**CO 3:** Appraise ethics and social responsibility as a professional.

**CO 4:** Apply analytical skills and critical thinking to solve problems and can express using sound logical arguments utilizing the best available resources for communication.

**CO 5:** Exhibit an understanding of multiculturalism and be able to work well in teams.

## Lecture 1-10

### Introduction to Communication

Communication and Self Concept

Role of Emotions

Basics of Communication

Purpose of communication- to inform, to express feelings, to imagine, to influence, to meet social expectations and others

Audience analysis- identifying audience to determine the content, language usage and listener expectations for ensuring effective communication

Cross Cultural Communication and Multi Cultural Communication

Effective Communication: Modes/ Models/Networks

LSRW Skills

Non-Verbal Communication

### Barriers to Communication

Introduction

Intrapersonal and Interpersonal Barriers

Organizational Barriers

Information Gap Principle, Noise, Filters

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### **Effective Listening and Speaking**

Traits of a good listener

Phonetics – Basic Sounds of English – Word Accent - Intonation Achieving confidence, clarity and fluency as a speaker, paralinguistic features, barriers to speaking, types of speaking, Persuasive Speaking, Public Speaking etc.

### **Additional exercises and activities based on developing Listening and Speaking skills**

#### **Lecture 11-15**

Planning, Outlining and Structuring

Choosing the mode of delivery

Guidelines for effective delivery,

Body Language and Voice, Visual Aids etc.

### **Activities and practice on developing Presentation skills**

#### **Lecture 16-20**

Introduction, Objectives, Types, Samples and Examples

Problem Solving, Networking in English

Meetings and Conferences

Minutes of Meeting, Agenda of Meeting

### **Activities and exercise based on developing GD and Business Networking skills in English**

#### **Lecture 21-30**

Introduction, Audience Recognition, Language, Grammar, Style, Techniques

The Art of Condensation

Note Making and Note Taking

Guidelines and Samples

### **Business/Official Communication**

Letters, Resumes, Memos, and e-mails

Rules, formats, Style, Etiquette

Sales and Credit letters

Letter of Enquiry

Letter of Quotation, Order, Claim and Adjustment

Government Letters, Semi- Government Letters to Authorities etc.

Characteristics, Categories, Formats, Structures, Types, Samples

Job Application

Curriculum vitae

Resumes- Chronological, Combination, Functional etc.

Reports and Proposals of different kinds

### **Exercise and activities based on developing Writing skills**

#### **Lecture 31-35**

Right Words and Phrases,

Sentence Patterns

Paragraph

Comprehension Passage etc.

**Activities and Strategies to engage in active thinking about word meanings, the relationships among words, and use of words in different situations**

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### Lecture 36-40

Types: Skimming, Scanning, Intensive, Extensive

Value Based/Motivational Materials:

Articles, Prose, Text Reading

### Activities and exercise based on developing Reading skills

### Lecture 41-45

Types and Overview

Emotional Intelligence

Decision Making and Time Management

### Activities and exercise based on developing Leadership and Management skills

### Recommended Texts:

1. Raman , Meenakshi and Sangeeta Sharma. *Technical Communication: Principles and Practice*. 2<sup>nd</sup> ed. OUP India, 2012.
2. Markel, Mike. *Technical Communication*. 7th ed. New York, NY: Bedford/St. Martin's, 2003. ISBN: 9780312403386.
3. Gamble, Teri Kwal and Michael Gamble. *Communication Works*. 9<sup>th</sup> Ed. New Delhi: Tata-McGraw-Hill, 2010.
4. Hacker, Diana. *A Pocket Style Manual*. 4th ed. New York, NY: Bedford/St. Martin's, 1999. ISBN: 9780312406844.
5. Perelman, Leslie C., James Paradis, and Edward Barrett. *The Mayfield Handbook of Technical and Scientific Writing*. New York, NY: McGraw-Hill, 1997. ISBN: 9781559346474.
6. **David F. Beer and David McMurrey, *Guide to Writing as an Engineer*, 2<sup>nd</sup> ed., Wiley, 2004, ISBN: 0471430749.**
7. Dale Jungk, *Applied Writing for Technicians*, McGraw-Hill, 2005, ISBN 0-07-828357-4.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME511	Principles of Management	L	T
		3	0

**Objectives:**

To understand the principles of management and their application to the functioning of an organization

**Contents:**

**Module 1**

Definition of management, science or art, manager vs entrepreneur; Types of managers managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches. (5)

**Module 2**

Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management. (7)

**Module 3**

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization. (5)

**Module 4**

organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management. (7)

**Module 5**

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication. Controlling, system and process of controlling, budgetary and non-budgetary control techniques. (7)

**Module 6**

use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting. Inventory Management. (11)

**Module 7**

Financial Management: Cost concepts and clarification; CUP and Break Even Analysis; Basic Concept of Financial statement; Balance sheet; Profit loss account, Cash flow statement, Sources of long term finance, Capital budgeting techniques. (10)

**Course Outcomes:**

Upon completion of this course, the students will get a clear understanding of management functions in an organization

**Text Books:**

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999



# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME512	Total Quality Management	L	T
		3	0

Objectives:

To facilitate the understanding of total quality management principles and processes.

**Contents:**

**Module 1**

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. (5)

**Module 2**

Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; cost of quality. (6)

**Module 3**

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal. (6)

**Module 4**

Continuous process improvement; PDCA cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection. (6)

**Module 5**

The seven traditional tools of quality; New seven management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types. (7)

**Module 6**

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures; TQM implementation in manufacturing and service sectors. (12)

**Module 7**

Quality systems, need for IS/ISO 9000 / ISO 9001; Quality system- elements, documentation; Quality auditing, ISO 14000- concepts, requirements and benefits; ISO 45001 (OHSMS). (8)

Course Outcomes:

Upon completion of this course, the students will be able to use the tools and techniques of TQM in manufacturing and service sectors.

**Text Books:**

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME513	Project Management	L	T
		3	0

Course Outcomes: At the end of the course, the student will be able to:

1. Understand the importance of projects and its phases.
2. Analyze projects from marketing, operational and financial perspectives.
3. Evaluate projects based on discount and non-discount methods.
4. Develop network diagrams for planning and execution of a given project.
5. Apply crashing procedures for time and cost optimization.

## Contents:

### Module 1

Introduction: Introduction to Project Management, History of Project Management, Project Life Cycle.

Project Analysis: Facets of Project Analysis.

(5)

### Module 2

Strategy and Resource Allocation, Market and Demand Analysis, Technical Analysis, Economic and Ecological Analysis.

(7)

### Module 3

Financial Analysis: Financial Estimates and Projections, Investment Criteria, Financing of Projects; Capital Budgeting.

(9)

### Module 4

Network Methods in PM: Origin of Network Techniques, Project Scheduling Techniques, CPM network, PERT network, Other network models.

(10)

### Module 5

Optimisation in PM: Time and Cost trade-off in CPM, Crashing procedure, Scheduling when resources are limited.

(6)

### Module 6

Project Risk Management: Scope Management, Work Breakdown Structure, Earned Value Management, Project Risk Management.

(9)

### Module 7

Project Information System.

(2)

## Text Books:

1. Prasanna Chandra, Project: A Planning Analysis, Tata McGraw Hill Book Company, New Delhi, 4th Edition, 2009.
2. Cleland, Gray and Laudon, Project Management, Tata McGraw Hill Book Company, New Delhi, 3rd Edition, 2007.
3. Jack R. Meredith., Samuel J. Jr. Mantel., Project Management - A Managerial Approach, John Wiley, 6th Edition, 2011.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME521	Advanced Materials	L	T
		3	0

**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand the synthesis and properties of nanomaterials
2. Evaluate the usefulness of nanomaterials in medicine, biology and sensing
3. Understand modeling of composite materials by finite element analysis
4. Differentiate superconducting materials CO5 Understand the characteristics and uses of functional materials

## Contents:

### Module 1

Nano Materials: Origin of nano technology, Classification of nano materials, Physical, chemical, electrical, mechanical properties of nano materials. Preparation of nano materials by plasma arcing, physical vapour deposition, chemical vapour deposition (CVD), Sol-Gel, electro deposition, ball milling, carbon nano tubes(CNT).Synthesis, preparation of nanotubes, nano sensors, Quantum dots, nano wires, nano biology, nano medicines. (8)

### Module 2

Biomaterials: Overview of biomaterials. Biomaterials, bioceramics, biopolymers, tissue grafts, soft tissue applications, cardiovascular implants, biomaterials in ophthalmology, orthopeadiacimplants, dental materials. (7)

### Module 3

Composites: General characteristics of composites, composites classes, PMCs, MMCs, CMCs, CCCs, IMCs, hybrid composites, fibers and matrices, different types of fibers, whiskers, different matrices materials, polymers, metal, ceramic matrices, toughening mechanism, interfaces, blending and adhesion, composite modeling, finite element analysis and design. (8)

### Module 4

Optical materials: Mechanisms of optical absorption in metals, semiconductors and insulators. Nonlinear optical materials, optical modulators, optical fibers. Display devices and materials photo-emissive, photovoltaic cells, charge coupled devices(CCD), laser materials. (7)

### Module 5

Super conducting materials: Types of super conductors, an account of mechanism of superconductors, effects of magnetic field currents, thermal energy, energy gap, acoustic attenuation, penetration depth, BCS theory, DC and AC Josephson effects, high Tc superconductors, potential applications of superconductivity, electrical switching element, superconductor power transmission and transformers, magnetic mirror, bearings, superconductor motors, generators, SQUIDS etc. (8)

### Module 6

Smart materials: An introduction, principles of smart materials, input – output decision ability, devices based on conductivity changes, devices based on changes in optical response, biological systems smart materials. Devices based on magnetization, artificial structures, surfaces, hetero structures, polycrystalline, amorphous, liquid crystalline materials. (7)

### Module 7

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Surface Acoustic Wave (SAW) Materials and Electrets: Delay lines, frequency filters, resonators, Pressure and temperature sensors, Sonar transducers. Comparison of electrets with permanent magnets, Preparation of electrets, Application of electrets. (5)

### **Text Books:**

1. T.Pradeep, Nano: The Essentials; TaTa McGraw-Hill,2008.
2. B.S. Murthy et al., Textbook of Nano science and Nanotechnology, University press
3. Krishan K Chawla, Composite Materials; 2nd Ed., Springer 2006

## Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME522	Internal Combustion Engines	L	T
		3	0

### Internal Combustion Engines

**Objectives:**

1. To familiarize with the terminology associated with IC engines.
2. To understand the basics of IC engines.
3. To understand combustion, and various parameters and variables affecting it in various types of IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications

**Course Contents:**

Review of ideal cycles; Details of fuel-air cycles. Combustion in SI and CI engines, Combustion stages, Combustion chambers and Abnormal combustion. Fuel supply systems in SI and CI engines, carburetors, Port fuel injection, Direct injection and Common rail injection. Ignition system, Lubrication system and Cooling system. Testing of IC engines. Engine emissions and control. Advanced IC Engine concepts. (40)

**Course Outcomes:**

Students who have done this course will have a good idea of the basics of IC engines and how different parameters influence the operational characteristics of IC Engines

**Text Books:**

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", The Goodheart, Wilcox Co. Inc., Illinois, 1996.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME523	Advanced Welding Technology	L	T
		3	0

## Advanced Welding Technology

**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand solid state welding processes and applications.
2. Identify suitable reinforcement and matrix materials for preparation of composites using friction stir processing.
3. Understand basic principle of electron beam and laser beam processes and its application.
4. Understand weldability of cast iron and high carbon steel.
5. Select welding power sources.
6. Understand the importance of grain growth mechanism and related properties.

### Contents:

#### Module 1

Solid state welding: classification of solid state welding processes, Adhesive bonding , advantages and applications. (5)

#### Module 2

Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer. (9)

#### Module 3

Friction stir welding: Processes parameters, tool geometry, welding of Aluminium alloys, Friction stir welding of Aluminum alloys and Magnesium alloys. (9)

#### Module 4

Electron Beam welding (EBW): Electron Beam welding process parameters, atmospheric affect Defective analysis of Electron beam welds and Electron Beam welding dissimilar materials. (6)

#### Module 5

Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric affect and Laser Beam welding of steels. (8)

#### Module 6

Selection power source : Constant voltage and constant current power sources. (6)

#### Module 7

Weldability of cast iron and steel : weldability studies of cast iron and steel. (7)

### Text Books:

1. Nadkarni S.V., Modern Welding Technology, Oxford IBH Publishers, 1996.
2. Parmar R. S., Welding Engineering and Technology, Khanna Publishers, 2005.
3. D. L. Olson, T. A. Siewert, Metal Hand Book, Vol 06, Welding, Brazing and Soldering, ASM International Hand book Metals Park, Ohio USA, 2008.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME531	Operations Research	L	T
		3	0

**Course Objectives** : This course enables the students:

- (1) Formulate a real-world problem as a mathematical programming model
- (2) Know the theoretical workings of the simplex method for linear programming and perform iterations of it
- (3) Analyze the relationship between a linear program and its dual, including strong duality and complementary slackness
- (4) Solve specialized linear programming problems like the transportation, assignment, sequencing, games theory, and queuing model problems
- (5) The use of Operations Research approaches in solving real problems in industry; mathematical models for analysis of real problems in Operations Research.

**Course Outcomes** : After completion of the course, the learners will be able to:

- (1) Capability to recognize the importance and value of Operations Research and mathematical modeling.
- (2) Ability formulate a managerial decision problem into a mathematical model;
- (3) Recognize Operations Research models and apply them to real-life problems;
- (4) Use various approaches to solve a mathematical model for various practical problems in industry.

## **Syllabus**

### **Module 1**

Introduction: Scope and limitations of O.R., **Linear Programming:** Mathematical formulation of the problem. Graphic solution. (5)

### **Module 2**

Linear Programming: The simplex method. Big-M Method, Concept of duality, Dual simplex method. (7)

### **Module 3**

Transportation Model: Basic feasible solution by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanced transportation problems. (8)

### **Module 4**

Assignment Model: Balanced and unbalanced assignments, Assignment to given schedules. (6)

### **Module 5**

Sequencing: Processing of 2 jobs through machines –graphical method, Processing of n jobs through two machines, Processing n jobs through three machines. (10)

### **Module 6**

Games Theory: Two-persons zero sum games, Pure and mixed strategies, Rules of dominance, Solution methods without saddle point. (7)

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## Module 7

Queuing Model: Queuing systems and their characteristics, The M/M/1/FIFO/ $\infty$  Queuing system. Basic concept and applications of Non-linear programming. (7)

### Text Books:

1. P. Rama Murthy , Operations Research, New Age, New Delhi
2. P.K. Gupta & D. S. Hira , Operations Research, S.Chand & Company Ltd, New Delhi.

### References Books:

1. Hamdy A Taha, 1999. Introduction to Operations Research, PHI Limited, New Delhi.
2. Sharma, J.K., 1989. Mathematical Models in Operations Research, Tata McGraw Hill publishing Company Ltd., New Delhi.
3. Beer, Stafford, 1966. Decision and Control, John Wiley & Sons, Inc., New York.



# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
<b>ME532</b>	<b>Non-Conventional Energy Sources</b>	<b>L</b>	<b>T</b>
		<b>3</b>	<b>0</b>

**Course Outcomes:** At the end of the course, the student will be able to:

1. Identify renewable energy sources and their utilization.
2. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
3. Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
4. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
5. Identify methods of energy storage for specific applications.

**Contents:**

**Module 1**

Introduction: Overview of the course; Examination and Evaluation patterns; Global warming; Introduction to Renewable Energy Technologies (5)

**Module 2**

Energy Storage: Introduction; Necessity of Energy Storage; Energy Storage Methods  
Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data. (10)

**Module 3**

Solar Thermal systems: Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems. (8)

**Module 4**

Solar Photovoltaic systems: Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems. (7)

**Module 5**

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems. (6)

**Module 6**

Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification. (4)

**Module 7**

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles. (4)

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### **Text Books:**

1. Sukhatme S.P. and J.K.Nayak, Solar Energy - Principles of Thermal Collection and Storage, Tata McGraw Hill, New Delhi, 2008.
2. Khan B.H., Non-Conventional Energy Resources, Tata McGraw Hill, New Delhi, 2006.
3. J.A. Duffie and W.A. Beckman, Solar Energy - Thermal Processes, John Wiley, 2001.
4. H. P. Garg, J. Prakash. Solar Energy – Fundamentals and Applications, Mc. Graw Hill.

## Vinoba Bhave University , Hazaribagh

<b>Mechanical Engineering</b>			
<b>ME533</b>	<b>Design for Manufacturing</b>	<b>L</b>	<b>T</b>
		<b>3</b>	<b>0</b>

**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand the design principles of design for manufacturing processes
2. Estimates the cost of dies, molds and machined components based on die life.
3. Understand the design for manual assembly and automated assembly.
4. Design typical assemblies using principles of design for X concepts.
5. Understand the design rules for machining with single point and multi point cutting tools.

**Contents:**

**Module 1**

Introduction: Overview of the course, Design for manufacturing, Typical Case studies, Innovative product and service designs. (5)

**Module 2**

Material Selection: Requirements for material selection, systematic selection of processes and materials, ASHBY charts. (5)

**Module 3**

Design for Casting: Basic characteristics and Mold preparation, Sand casting alloys, Design rules for sand castings, Example calculations, Investment casting overview, Cost estimation, Number of parts per cluster, Ready to pour liquid metal cost, Design guidelines for Investment casting, Die casting cycle, Determination of optimum number of cavities, appropriate machine size, Die cost estimation, Design principles. (10)

**Module 4**

Design for Injection molding: Injection molding systems, Molds, molding cycle time, mold cost estimation, estimation of optimum number of cavities, Assembly techniques, Design Guidelines.

Design for Hot Forging: Characteristics of the forging process, forging allowances, flash removal, die cost estimation, Die life and tool replacement costs. (12)

**Module 5**

Design for Sheet metal working: Press selection, press brake operations, Design rules.

Design for Powder Metal processing: Powder metallurgy, tooling and presses for Compaction, Sintering, materials, heat treatments, Design guidelines. (6)

**Module 6**

Design for machining: Machining using single point cutting tools, multipoint cutting tools, abrasive wheels, Assembly, cost estimation for machined components, Design guidelines. (6)

**Module 7**

Design for Assembly: Design guidelines for manual assembly, large assemblies, analysis of an assembly, rules for product design for automation, design for robot assembly, Design for manufacture and Computer aided design. (6)

**Text Books:**

1. Geoffrey Boothroyd, Dewhurst.P, Knight.W, roduct design for manufacture and assembly, CRC press, 2002
2. George E Dieter, Engineering Design- A material processing approach, 5/E. Mc Graw hill international, 2003.
3. ASM Handbook, Design for manufacture, 2000.

<b>Mechanical Engineering</b>			
<b>ME534</b>	<b>New Venture Creation</b>	<b>L</b>	<b>T</b>

# Vinoba Bhave University , Hazaribagh

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**Course Outcomes:** At the end of the course, the student will be able to:

1. Understand entrepreneurship and entrepreneurial process and its significance in economic development.
2. Develop an idea of the support structure and promotional agencies assisting ethical entrepreneurship.
3. Identify entrepreneurial opportunities, support and resource requirements to launch a new venture within legal and formal frame work.
4. Develop a framework for technical, economic and financial feasibility.
5. Evaluate an opportunity and prepare a written business plan to communicate business ideas effectively.
6. Understand the stages of establishment, growth, barriers, and causes of sickness in industry to initiate appropriate strategies for operation, stabilization and growth.

## **Contents:**

### **Module 1**

Entrepreneur and Entrepreneurship: Introduction; Entrepreneur and Entrepreneurship; Role of entrepreneurship in economic development; Entrepreneurial competencies and motivation; Institutional Interface for Small Scale Industry/Enterprises. **(12)**

### **Module 2**

Establishing Small Scale Enterprise: Opportunity Scanning and Identification; Creativity and product development process; Market survey and assessment; choice of technology and selection of site. **(8)**

### **Module 3**

Planning a Small Scale Enterprises: Financing new/small enterprises; Techno Economic Feasibility Assessment; Preparation of Business Plan; Forms of business organization/ownership. **(10)**

### **Module 4**

Operational Issues in SSE: Financial management issues; Operational/project management issues in SSE; Marketing management issues in SSE; Relevant business and industrial Laws. **(10)**

### **Module 5**

Performance appraisal and growth strategies: Management performance assessment and control; Causes of Sickness in SSI, Strategies for Stabilization and Growth. **(10)**

## **Text Books:**

1. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.
2. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013
3. Dr. S.S. Khanka, Entrepreneurial Development (4th ed.), S Chand & Company Ltd., 2012.
4. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.

# Vinoba Bhave University , Hazaribagh

Mechanical Engineering			
ME535	Design and Analysis of Experiments	L	T
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**Course Outcomes:** At the end of the course, the student will be able to:

1. Identify objectives and key factors in designing experiments.
2. Develop appropriate experimental design to conduct experiments.
3. Analyze experimental data and draw valid conclusions.
4. Develop empirical models using experimental data to optimize process parameters.
5. Design robust products and processes using parameter design approach.
- 6.

**Contents:**

**Module 1**

Fundamentals of Experimentation: Role of experimentation in rapid scientific progress, Historical perspective of experimental approaches, Steps in experimentation, Principles of experimentation.

(10)

**Module 2**

Simple Comparative Experiments: Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA; Z- test,  $x^2$  test, F- test.

(12)

**Module 3**

Experimental Designs: Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

(12)

**Module 4**

Response Surface Methodology: Concept, linear model, steepest ascent, second order model, regression.

(8)

**Module 5**

Taguchi's Parameter Design: Concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer-array design, data analysis.

(8)

**Text Books:**

1. Montgomery DC, Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, NY, 2008.
2. Ross PJ, Taguchi Techniques for Quality Engineering, McGraw-Hill Book Company, NY, 2008.