NOIDA INTERNATIONAL UNIVERSITY
GAUTAM BUDH NAGAR,UP

EVALUATION SCHEME & SYLLABUS

FOR

MASTER OF TECHNOLOGY

In

INDUSTRIAL -PRODUCTION (Regular)

AS PER
AICTE MODEL CURRICULUM
[Effective from the Session: 2019-20]

M.Tech (Industrial-Production)

Mechanical engineering is one of the oldest and broadest fields of engineering. Mechanical engineering deals with the design, construction, and use of machines with maintenance of mechanical systems to help the society building.. It is more helpful when it is taught at Post Graduate level. Master of Technology in Industrial- Production Engineering is helpful to students who are interested in building their carriers in manufacturing sector and to conduct independent research in R&D labs in industries and higher educational institutes. It is branch of engineering that involves mechanical power of machines to develop the economical product and built the customer base and market to distribute and sale the product .

Program Educational Objectives (PEOs)

PEO-1: To demonstrate a high level of competency and problem-solving aptitude to find innovative solutions to theoretical and practical problems
PEO-2: To provide the knowledge for design and analysis of systems based on the laws of industrial and production engineering
PEO-3: To improve the skills in communication, decision making and foster the neck of developing technological innovation to compete globally
PEO-4: To impart students to develop sustainability with regards to work, and develop the values which are ethically, economically and socially viable**.**

Program Specific Outcomes (PSOs)

PSO-1: Students will be able apply the knowledge of production and design aspects of engineering
PSO-2: Students will be able to develop the to develop the problems solving skills by imbibing different simulation and mathematical tools.
PSO-3 : Students will be able to Conduct independent research in the field of production Engineering by using different software tools in the area of manufacturing.
PSO-4 : Students will be able to Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility

Program Learning Outcomes (PLOs)

PLO-1 : Ability to apply advanced knowledge for design, evaluation and analysis of manufacturing and industrial systems
PLO-2: Capability to apply modern tools for product conceptualization, design and development
PLO-3: Ability to judiciously employ state-of-the art research techniques
PLO-4: Ability to investigate and design complex problems through experimentation
PLO-5: Capability to develop independent thinking in assessing and evaluating technical solutions

Credit System-Credit requirement for award of M.Tech:

- Every semester shall offer a minimum of **16 credits** and a maximum of 18 **credits**.
- Credits for the Dissertation project vary from 10 to16 credits.
- The total number of credits for the M. tech Degree Course is 68 credits
- All courses of study put together would engage the students for a **minimum of 24 periods of** or hours of study a week and a **maximum of 26 periods** or hours a week.

Under the choice based credit system, which is a student or learner centric system, the courses of study in the B.Tech Degree course shall be as under:

a) Program Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Elective Course: Generally a course which can be chosen from a pool of courses and are of two types:
    (i) Program Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
    (ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate‘s proficiency or skill
c) Mandatory course :Research Methodology and IPR course is more profound of all course as it teaches different techniques of research and understanding to conduct independent research.Apart from this an indepth knowledge of Patent and copyright laws are also part of this curriculum.
d) Audit course: Which enables the exposure towards building blocks of society. The cultural, social values and understanding of India’s growth and reform policy to nuture candidate understanding and enhancing skill to bring gap between industry and curriculum .

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits	Percentage
1	Program core	12	
2	Program Elective	15	
3	Open Elective	3	
4	Audit course	0	
5	Seminar, Dissertation Phase- I and II and Labs	36	
6	Mandatory Courses	2	
		68	

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 2 Hours Practical (Lab)/week 1 credit
- 1 Hr. Dissertation Phase -I and II (P) per week 0.5 credit
- 2 hr Seminar /week 1 credit
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Credit distribution in each semester (68 credits to 4 semesters)

Semester	**Credits**		
	Theory	Practical	Total
1st	14	4	18
2nd	12	6	18
3rd	6	10	16
4th	0	16	16
Total	32	36	68

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
IPCT1	Advance Welding Technology	3	0	0	40	60	100	3
IPCT2	Machine Tool Design	3	0	0	40	60	100	3
IPE1x	Program Elective-1 (1) Design Of Production System (2) Optimizations Technique (3) Design of Welded Joints	3	0	0	40	60	100	3
IPE2x	Program Elective-2 (1) Production Technology (2) Robotics and Automation (3) Operation Planning and Control	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
IPCL1	Welding Lab	0	0	4	40	60	100	2
IPCL2	CAD Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
IPCT3	Advanced Metal Forming	3	0	0	40	60	100	3
IPCT4	Computer Integrated Manufacturing	3	0	0	40	60	100	3
IPE3x	Program Elective-3 (1) Statistics of Decision Making (2) Additive Manufacturing (3) Advance Machining Process	3	0	0	40	60	100	3
IPE4x	Program Elective-4 (1) Advanced Material Processing Technique (2) Finite Element Method (3) Mechatronics	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project with Seminar	0	0	4	100	0	100	2
IPCL3	Metal Forming Lab	0	0	4	40	60	100	2
IPCL4	Computer Integrated Manufacturing Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
IPE5X	Program Elective-5 (1) Design and Analysis of Experiment (2) Supply Chain Management (3) Surface engineering	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

SEMESTER-I

DETAILED CURRICULUM CONTENTS

Paper Code: IPCT1 **Course Name** : Advanced Welding Technology

Course Credit : 3 **Total Contact hrs :** 40 hrs

Course Objective:

- To identify the tools and techniques associated with welding-related fabrication and quality control.
- To impart knowledge on various advanced welding processes so that the students can apply them in engineering industry applications.
- To develop the knowledge on the design of welded joints and the quality control of weldments.

Course Description:

This course provides students with opportunities to effectively perform cutting and welding applications of increasing complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the welding technology course while learning additional techniques not covered in previous courses. Specifically, students will be proficient in fundamental safety practices in welding, gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), shielded metal arc welding (SMAW), and quality control methods.Upon completion of this course proficient students will be prepared to complete the American Welding Society (AWS) Entry Welder qualification and certification.

Course content:

UNIT-1 Welding Metallurgy: Welding as compared with other fabrication processes, Classification of welding processes; Heat affected zone and its characteristics; Effects of alloying elements on weldability, Weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys, Weld testing standards, Hydrogen embrittlement, Lammellar tearing, residual stresses and its measurement, heat transfer and solidification, Analysis of stresses in welded structures, Pre and post welding heat treatments, Metallurgical aspects of joining, Conditions of soldering, Brazing and welding of materials.

UNIT-2 Weld Design & Quality Control: Principles of sound weld design, Welding joint design, Welding defects; Testing of weldament, Material joining characteristics, Welding positions, Allowable strength of welds under steady loads, Weld throat thickness; Weld quality, Discontinuities in welds, their causes and remedies and quality conflicts.

UNIT-3 Modern Trends in Welding: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Plasma arc welding, Laser welding.

UNIT-4 Mechanisation in Welding: Mechanisation of flat/circular joints, Thin/thick sheets (resistance/arc weld), Mechanisation of I beams (arc weld), Longitudinal circumferential SA welding (roller blocks, column booms, flux supports), Circular/spherical welding joints (rotating tables positioners), Manufacture of welding longitudinal welded pipes by induction, TIG, Plasma and SA welding of spiral welded pipes.

UNIT-5 Robotics in Welding: Robot design and applications in welding, Programming of welding robots, tolerances for assemblies for robot welding, New generation of welding robots, Self alignment by current arc variation, Robots for car body welding, Microelectronic welding and soldering, Efficiency of robotics in welding.

Course Learning outcome (CLOs):

At the end of course student will be able to

- Understand the basics of welding technology
- Formulate and implement the weld joint design procedure and problems
- Learn and gained elementary knowledge regarding weld design

Text Books:

- Advanced Welding Processes Nikodaco & Shansky MIR Publications
- Welding Technology and Design VM Radhakrishnan New Age International

Reference Books:

- Source Book of Innovative welding Processes M.M. Schwariz Americal Society of Metals (Ohio)
- Advanced Welding Systems, Vol. I, II, III J. Cornu Jaico Publishers
- Manufacturing Technology (Foundry, Forming and Welding) P.N. Rao Tata McGraw Hill

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107090/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code : IPCT2 **Course Name :** Machine Tool Design

Course Credit Hour: 3 hr **Total Contact Hour :** 40hr

Course Objective :

- The student can identify different areas of Machine Tool Design.
- Can find the applications of all the areas in day to day life.

Course Description :

This course emphasizes on the fundamental of Tool design. This course has been developed with orientation towards research related activities and recognizing the knowledge as property. It will create consciousness for Machine tool design and its constituents. The course demonstrates the Tool design techniques, the tool designs needed according to research problem.

Course Contents :

UNIT-1.

Introduction-Calculation Data (Forces, Velocities and Power Requirements during metal cutting: Turning: Cutting force, Cutting Speed and Feed Rate. Drilling: Cutting forces, Cutting Speed and Feed Rate. Milling: Chip Section, Cutting force, Milling with Cutter Heads. Grinding: Grinding Forces, Cutting Speed, Feed Rate, and Depth Setting. Planning, Shaping and Broaching.

UNIT-2.

General Requirements of the Machine Tool: Accuracy of Shape, Dimensional accuracy and surface finish of the components produced. High Productivity. High Technical and Economic Efficiency.

UNIT-3.

Design Principles: Stiffness and Rigidity of the Separate Constructional Elements and their Combined behavior Under Load, Static Rigidity, Dynamic Rigidity, Natural frequencies, Damping, Mode of Vibration. Standardization of Spindle Speeds and Feed Rates: Layout of Speed Change Gears. Saw Diagrams for Arithmetic Progression, Geometric Progression, Harmonic Progression and Logarithmic Progression of spindle speeds for Mechanical Stepped Drives for Machine Tools. Establishment of Gear Ratios, Layout of the Intermediate Reduction Gears,

UNIT-4

Calculation of Transmission Ratios, Pulley Diameter, Gear Wheel Diameters and Number of Teeth. Ray Diagram. Speed Diagram. Electrical, Mechanical and Hydraulic Drives for the Operational Movements: Electric Drive and Control Equipment. Mechanical and Hydraulic Drives. Drives for Producing Rotational Movements, Stepped Drives, Step less Drives. Drives for Producing Rectilinear Movements. Backlash Eliminator in the Feed Drive Nut.

UNIT-5

Automatic Control: Principles and Constructional Elements. Automatic Driving of the Cutting Movements, Feed Movements, and Return Movements. Automatic control of movements for Starting, Stopping and Reversing. Automatic Clamping and Unclamping the work piece. Automatic Selection of Required Speeds, Automatic Setting of Tools. Automatic Measurement of Machined Shape and Surfaces. Transport of Components from One Machine to the Next. Applications (Examples of Automatic Machines). Design of Constructional Elements: Machine Tool Structures, Structural Elements Design for Centre Lathe, Drilling Machine, Knee Type Milling Machine, Planning Machine, Boring Machine, and Grinding Machines. Design of Slide Ways: Design of Slide ways for Tables, Saddles and Cross-slides. Antifriction Bearings for slide ways. Hydrostatically Lubricated Slide ways.

Course Learning Outcomes(CLOs) :

- Understand the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal/oblique cutting.
- Identify basic of machine tools design about precision and operation on various tools.
- Design under factor of stiffness , load, vibration , harmonic motion of the machine tools to produce a component.
- Select a machining operation like rotational, transverse movements used for designing corresponding machine tool for a specific application in real time.
- Select a measuring instrument to inspect the dimensional and geometric features of a given component.

Text books :

- Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger
- Machine Tool Design by N. K. Mehta. McGraw Hill Publishing

Reference books :

- Machine Tool Design by Acherkan, Mir publishing
- Machine Tool Design by S.K, Basu, Oxford and IBH Publishing
- Machine tool design by Sen and Bhattacharya, CBS Publication

Online links for study & reference materials :
https://www.youtube.com/watch?v=hRexymJSf
U&list=PLOiT2XTdTTBeHMfMrUlfDZRyDoK4Hw2vW

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE11 **Course Name**: Design of Production System

Course Credit: 3 **Total Contact Hour**: 40 hr

Course Objective:

- To impart state-of-the-art knowledge of principles and techniques for the efficient design and analysis of mechanical systems and structural components.
- To impart training in research methodology and current industrial practices with enhanced emphasis on theoretical, experimental and computational skill development.
- To inculcate out-of-box thinking, effective communication skills and sensitivity to ethical issues.

Course Description:

The course is designed to build on a customer-cantered perspective, understanding and skills to meet future industrial situation. By working in an industrial project the students will be trained to identify and analyse problems based on given conditions in an actual industrial context. In the production system design process, the objective is to design the best possible. production system starting from the existing preconditions and the resources and options. available

Course Content:

UNIT 1:

Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT 2:

Properties of Engineering Materials,
Selection of Materials – I, Selection of Materials – II, Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II.

UNIT-3

Selection of Manufacturing Processes,
Review of Manufacturing Processes, Design for
Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co selection of Materials and Processes, Case-Studies – III

UNIT -4

Design for Assembly,Review of Assembly Processes, Design for Welding – I, Design for Welding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies - IV

UNIT-5

Design for Reliability,

Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization,

Course Learning Outcomes (CLOs):

- Understand the product development cycle
- Know the manufacturing issues that must be considered in the mechanical engineering design process
- Know the principles of assembly to minimize the assembly time
- Know the effect of manufacturing process and assembly operations on the cost of product (not included by others)
- Be familiar with tools and methods to facilitate development of manufactural mechanical designs

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, NY, 00.

Reference books:

- S S Rao, Engineering Optimization: theory and practice, John Wiley, NY, 1996.
- G Boothroyd, P Dewhurst and W Knight, Product design for manufacture and assembly, John Wiley, NY: Marcel Dekkar, 1994.
- J G Bralla, Handbook for Product Design for Manufacture, McGraw Hill, NY, 1998.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE12 **Course Name:** Optimization Technique
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To learn the theory of optimization method and algorithms developed for solving various types of optimization probem.
- To develop research interest in applying optimization technique in problems of engineering and technology.
- To analyze real life system with limited constraint.

Course Description:

The objective of this course is to provide the students with knowledge on the application of various optimization techniques which can help making decisions for practical problems in industries. Modeling concepts and applications of linear, integer, nonlinear, and dynamic programming as well as network models are addressed. Metaheuristic techniques are also discussed to obtain good solutions for large scale practical problems in a reasonable computational time. Optimization model and its applications are demonstrated for solving problems in Industry 4 era.

Course Contents:

Unit-I

Optimization Methods : One dimensional Optimization methods, Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods-quadratic & cubic interpolation methods. Direct search method – Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. Variable metric method.

Unit-II

Dynamic Programming: Polynomials – arithmetic – geometric inequality – unconstrained G.P – constrained G.P Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

Unit-III

Sensitivity Analysis: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation: Introduction – Types – Steps – application – inventory – queuing – thermal system..

Unit-IV

Cutting Plane Method: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

Unit-V

Probability : Basic concepts of probability theory, random variables –distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of optimization techniques
- Formulate and implement the optimization procedure and problems
- Learn and gained elementary knowledge regarding soft computing techniques

Text books:

- S.S Rao; Optimization Theory & Applications, New Age International 2016.
- M.C Joshi, K.M Moudgalya; Optimization Techniques Theory and Practice , Narosa Publications..

Reference books:

- H.A. Taha; Operation Research/ /TMH
- P. K Nag; Engineering Thermodynamics; Tata McGraw Hill Education Pvt. Ltd.; New Delhi.4th Ed.; 2008
- R.L Rardin Optimization in operations research.
- Benugundu & Chandraputla ;Optimization Techniques, Person Asia
- Kasan & Kumar; Introductory to operation research, Springar

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Online links for study & reference materials:

http:// //nptel.ac.in/courses/111/105/111105039/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE I

Course Code: IPE13 **Course Name :** Design of welded joints
Course Credit : 3 **Total Contact Hour :** 40 hr

Course Objective:

- To evaluate the static stresses in loaded welded structures
- To evaluate the developed dynamic stresses in the welding structures
- To Understand heat flow through welding joints
- To understand the destructive and non-destructive tests of the weldments

Course description:

Welding is one of the most common fabrication techniques. This course is aimed at familiarizing the students with the fundamentals weld joint design, metallurgical aspects in welding of steel, aluminium, and assessing the quality and suitability of weld joints. Topics related with weldability of metals shall also be covered to equip the students technological input for handling problems in weld joint design of selected metals and alloys.

Course content:

UNIT1

Heat flow in welding, Heat input, Effect of welding parameter on heat distribution; calculation of peak temperatures; thermal cycles; cooling rate and solidification;

UNIT-2

Residual stresses and their distribution in welds; influence of residual stresses in static and dynamic loading, distortion

UNIT-3

Design of weld joints Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading.

UNIT-4

Weld Calculations in lap, butt and fillet welds; design for fatigue loading, Introduction to Fatigue; nature of the fatigue process; fatigue strength.

UNIT-5

Factors affecting fatigue life; improvement methods for fatigue strength;reliability analysis and safety factors applied to fatigue design

Course Learning outcome (CLOs):

At the end of course student will be able to:

1. Understand the basics of welding technology
2. Formulate and implement the weld joint design procedure and problems
3. Learn and gained elementary knowledge regarding weld design

Text Books:

- The Metallurgy of Welding, 6th Edition , Lancaster, William Andrew Publishing, NY.
- Principles of Welding (Processes,Physics, Chemistry and Metallurgy), Robert and Messler, Wiley Interscience Publishers.

Reference Books:

- Welding Hand Book Vol. 5; 7th edition,AWS, 1984.
- Welding METALLURGY,S Kou, John Wiley, USA, 2003

Online links for study and reference materials:

https://nptel.ac.in/content/storage2/courses/112105125/pdf/mod10les4.pdf

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE II

Course Code: IPE21 **Course Name**: Production Technology

Course Credit: 3 **Total Contact Hour**: 40 hr

Course Objective:

To analyse and determine material fabrication processes.

- To use laboratory instrument doing routine metrological measurements>
- To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
- To recognize engine machine tool requirements and be selective in the choice of tools.
- To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
- To identify with numerical control machining and computer programming.
- To determine costs and establish basic programs in machine shop economics.

Course Description:

This course is a study of the modern techniques of design, production, and operations including material and process selection. The correct application of these concepts to engineering drawings is emphasized. The importance of concurrent engineering and computer-integrated manufacturing in design is examined.

Course Content:

UNIT 1:

Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes

UNIT 2:

Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM

UNIT-3

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT -4

Processing of ceramics : Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application , finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT-5

Fabrication of Microelectronic 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, and micromachining, High speed Machining

Course Learning Outcomes (CLOs):

- At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials.

Text books:

- Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley, 1995.
- Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.

Reference books:

- Advanced Machining Processes, V.K.Jain, Allied Publications.
- Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.
- Foundation of MEMS/ Chang Liu/Pearson, 2012.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE II

Course Code: IPE22 **Course Name**: Robotics And Automation

Course Credit: 3 **Total Contact Hour**: 20 hr

Course outcome:

At the end of course student will be able to:

1. Understand the basics of robotics and automation technology
2. Formulate and implement the automatic control procedure and problems
3. Learn and gained elementary knowledge regarding automation

Syllabus content:

UNIT-1 Introduction to Automation: Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation.

UNIT-2 High Volume Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines.

UNIT-3 Programmable Manufacturing Automation: CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations. Flexible Manufacturing Automation: Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system.

UNIT-4 Assembly Automation: Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems. Robotics: Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic.

UNIT-5 Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission methodRotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.

UNIT-6 Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.

References:

1. Automation, Production System & Computer Integrated Manufacturing Groover Prentice Hall India
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Automation in Production Engineering Oates and Georgy Newness -
4. Stochastic Models of Manufacturing Systems Buzacott & shanty Kumar Prentice Hall India
5. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
6. Robotics J.J. Craig Addison-Wesely
7. Robot Engineering: An Integrated Approach R.D. Klafter, t.a. Chmielewski and M. Negin Prentice

ELECTIVE II

Course Code: IPE23 **Course Name**: Operation Planning and Control

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- To acquire a comprehensive understanding of the principles and functions of OPC practised in manufacturing industry.
- To recognise the sequencing, balancing and scheduling problems in any operation system.
- To solve problems at operation level by using the appropriate production techniques

Course Description:

Effective Operation planning and control now stands at the core of every successful organizations as manufacturers strive to increase productivity without incurring unnecessary costs. As the need to deal effectively with the problems of production scheduling becomes more critical, staff needs to have a comprehensive understanding of the principles and functions of operation planning and control. Only then can these problems be solved through the appropriate production techniques.

Course Content:

UNIT 1:

Operations Planning Concepts: Introduction, Operations Functions in Organizations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing
systems, Definition of Operations management, Factors affecting productivity, International dimensions of productivity, The environment of operations.

UNIT 2:

Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology, Decision Tree Problems, Economic models- Break-even analysis in operations, P/V ratio. System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.

UNIT-3

Forecasting Demand: Forecasting objectives and uses, Forecasting variables, Opinion and

Judgmental methods, Delphi technique, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing,

UNIT -4

Regression and correlation methods, Application and control of forecasts-Mean Absolute Deviation, BIAS, and Tracking Signal.

UNIT-5

Aggregate Planning and Master Scheduling: Introduction- planning and scheduling, Objectives of aggregate plan, Three Pure Strategies of Aggregate planning, aggregate planning methods, Master scheduling objectives, Master scheduling methods.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:

1. Understand the basics of operation planning and control
2. Formulate and implement the operations and control procedure and problems
3. Learn and gained elementary knowledge regarding operations concepts

Text books:

- Samson Eilon, "Elements of production planning and control", Universal BookCorpn.1984.
- Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / OperationsManagement", 8th Ed. John Wiley and Sons, 2000.

Reference books:

- Kanishka Bedi, " Production and Operations management", Oxford university press,2nd Edition 2007.
- Melynk, Denzler, " Operations management –A value driven approach" Irwin Mcgrawhill.
- Norman Gaither, G. Frazier, " operations management" Thomson learning 9th edition

Online links for study and reference materials:

https://www.udemy.com/course/manufacturing-operations-planning-management-and-control/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: MTC01 **Course Name**: Research Methodology and IPR

Course Credit: 2 **Total Contact Hour**: 20 hr

Course Objective:

- Identify an appropriate research problem in their interesting domain
- To explain various research designs and their characteristics
- To explain the art of interpretation, art of writing research reports and presentation skills
- To explain various forms of intellectual property, its relevance and business impact in the changing global business environment

Course Description:

This course emphasizes on the fundamental of research. This course has been developed with orientation towards research related activities and recognizing the knowledge as property. It will create consciousness for intellectual property rights and its constituents. The course demonstrates the research formulation techniques, the research designs needed according to research problem. It also introduces aspect of effective literature review and the sources of information to be taken to conduct literature review. In concurrence with this, students will become familiar with the analysis part before the interpretation and decision on conclusion obtained. Finally concepts related to patents, trademark and copyright are also the part of this course which are of prime importance and needs to be understood.

Course Content:

UNIT 1:

Meaning of research problem, sources of research problem, characteristics of good research problem, errors in selecting a research problem, scope and objectives of research problem.

Approaches of investigation of solutions for research problem, data collection, analysis, interpretation. Necessary instrumentation

UNIT 2:

Effective literature studies approaches, analysis, plagiarism and research ethics

UNIT-3

Effective technical writing, how to write report, paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT -4

Nature of Intellectual property; patents, designs, trade and copyright. Process of patenting and development: technological research, innovation, patenting, development, International Scenario; International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

UNIT-5

Patent Rights; Scope of Patents Rights, Licensing and transfer of technology; Patent information and databases, geographical Indications.

UNIT-6

New development in IPR, Administration of patent system, New developments in IPR, IPR of Biological system, Computer software etc. Traditional knowledge case studies, IPR and IITs.

Course Learning Outcomes (CLOs):

- Understand the characteristics, objects of good research problem.
- Understand concepts of data collection, analysis
- Understand significance, effective technical writing and report
- Understand the patent rights and transfer of technology

Text books:

- Stuart Melville and Wayne Goddard,'' Research methodology: an introduction for science and engineering student''
- Wayne Goddard and Stuart Melville, '' Research Methodology: An Introduction''

Reference books:

- Ranjit Kumar, 2nd Edition,''Research Methodology: A step by step Guide for beginners''
- Halbert, '' Resisting Intellectual Property'', Taylor and Francis Ltd, 2007
- Mayali,'' Industrial Design'', McGraw Hill, 1992.

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Audit course-I

Course Structure

Course Code: MAC04 **Course Name:** Value Education
Course Credit Hour: 4hr **Total Contact Hour:** 60hr

Course Objective:

1. To make students understand the relevance of individual values in everyday lives
2. To help students imbibe different individual values in their personality
3. To help students develop good moral values and positive character
4. To help students learn the significance of self management and self-control

Course Description:

The course is an appropriate combination of theoretical and industry specific contents on values and works ethics aimed at developing students into professionals. The course enables students learn concepts related to values and description of different types of values like individual values, social values, organizational values, etc. The course emphasizes on significance of cultivation of individual values that are essential in a personality and lists out various individual values to be imbibed in a student preparing for professional world. The course also describes various practical aspects of value education like managing good health, self-control, science of reincarnation, religious tolerance and role of women, which are pre-requisites for good moral character and competence.

Course Contents: The course is divided into 4 broad units namely:

1. **Unit-1: Values and Self-development**, Social Values and Individual attitudes, work ethics and Indian vision of humanism, moral and non-moral valuation, standards and principles, value judgments
2. **Unit-2: Importance of cultivation of values**, sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanlinesss, honesty, humanity, power of faith, national unity, patriotism, love for nature, discipline
3. **Unit-3: Personality and Behaviour Development,** soul and scientific attitude, positive thinking, integrity and discipline, punctuality, love and kindness, avoid fault thinking, freedom from anger, dignity of labour, universal brotherhood, religious tolerance, true friendship, happiness vs suffering, love for truth, aware of self-destructive habits, association and cooperation, doing best for saving nature
4. **Unit-4: Character and Competence,** holy book vs blind faith, self-management and good health, science of reincarnation, equality, non-violence, humility, role of women, all religions and same message, mind your self, self-control, honesty, studying effectively

Course Learning Outcomes (CLOs):

CLO-1: The students will be able to relate to concepts related to value education in their everyday lives.

CLO-2: The students will be able to demonstrate individual values cultivated in their respective workplaces or professional world.

CLO-3: The students will be able to differentiate between the different types of values and imbibe them as part of their self-development.

CLO-4: The students will be able to learn and practice techniques of managing good health, self-control, gender sensitivity and religious tolerance.

Text books:

1. Indrani Majhi, Ganesh Das, VALUE EDUCATION, 1, 2017, Laxmi Publications Pvt Ltd, ISBN: 9789352741120, 9352741129
2. Sharma Sandeep, Encyclopedia of Indian Ethos and Values in Management, Anmol Publications Pvt Ltd, ISBN: 9788126139187, 9788126139187

Reference books:

1. UN-HABITAT, Human Values And Ethics In Workplace: Improving Leadership And Performance In The Water Education, Water Supply And Sanitation Sector, 2006, United Nations Human Settlements Programme (UN-HABITAT)
2. Ganesh A. Gayatri, Values Attitude and Practices, Publisher: Discovery Publishing Pvt. Ltd, ISBN: 9789350561287, 9789350561287
3. Atkinson Camille E., Women, Ethics and the Workplace, ABC-CLIO, ISBN: 9780275960919, 9780275960919
4. Green Connie Ragen, Rethinking the Work Ethic, Hunter's Moon Publishing, ISBN: 9781937988333, 9781937988333

Online links for study & reference materials:

1. https://www.researchgate.net/publication/228079327
2. https://www.researchgate.net/publication/49586890
3. https://www.researchgate.net/publication/258040203
4. https://www.enterpreneur.com/amphtml/310254
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3705678

Assessment method :(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Mid-term exam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course code: IPCL1 **Course Name:** Welding Lab

Course Credit: 4 **Total contact hours : 40 hrs**

Course Objective:

- To learn the practical application of fabrication of weld joint
- To understand weld procedure specification

LIST OF EXPERIMENTS

1. Arc striking practice.
2. Bead-on-plate welding
3. Effect of welding parameters on weld bead by

-GTA welding
-GMA welding
-Submerged arc welding

4. Microstructural observation of weldments

-Carbon steel
-Stainless steel
-Aluminium alloy
-Titanium alloy
-Dissimilar joints

5. Practice for preparation of welding procedure specification.
6. Practice for preparation of procedure qualification record

Course Learning outcome (CLOs):

At the end of this course students will be able to:

1. Understand the basics of welding technology
2. Formulate and implement the weld joint design procedure and problems
3. Hands on experience in fabrication of weld joint design

Online links for study and reference materials:

http://mmcoep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Course Code: IPCL2 **Course Name**: CAD Lab

Course Credit: 2 **Total Contact Hour**: 20 hr

Course Objective:

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

Course Description:

This is an introductory course in freehand sketching and computer-aided drafting/ design. Students will be taught basic CAD commands, tools, multi-view drawing and dimensioning techniques.

Course Content:

1. 3D GEOMETRIC MODELLING Introduction of 3D Modelling software

2. Creation of 3D assembly model of following machine elements using 3D Modelling software

    - Flange Coupling
    - Plummer Block
    - Screw Jack
    - Lathe Tailstock
    - Universal Joint
    - Machine Vice
    - Stuffing box
    - Crosshead
    - Safety Valves
    - Non-return valves
    - Connecting rod
    - Piston
    - Crankshaft

3. Manual Part Programming
    - Part Programming - CNC Machining Centre
      a) Linear Cutting.
      b) Circular cutting.
      c) Cutter Radius Compensati
      d) Canned Cycle Operations.
    - Part Programming - CNC Turning Centre
      a) Straight, Taper and Radius Turning.

b) Thread Cutting.
c) Rough and Finish Turning Cycle
d) Drilling and Tapping Cycle.

4. Computer Aided Part Programming
    - CL Data and Post process generation using CAM package
    - Application of CAPP in Machining and Turning Centre.

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:

1. Understand the basics of 3D modelling
2. Formulate and implement the softwares of design 2D and 3D modelling
3. Hands on experience regards design and fabrication of manufacturing components

Text books:

Reference books:

Online links for study and reference materials:

https://www.udemy.com/course/autocad-2018-course/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

SEMESTER-II

DETAILED CURRICULUM CONTENTS

Course Code: IPCT3 **Course Name:** ADVANCED METAL FORMING

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To make them learn the fundamentals of manufacturing technology.
- To impart the basic knowledge of advanced metal forming processes.
- To understand the design and analysis of complex mechanism of metal forming processes.
- To implement the above knowledge in solving the practical engineering problems in various production units.

Course Description:

This course is an advancement and elaboration of the metal forming processes used in the production technology. This course describes about various advanced metal forming processes which includes the materials metallurgical behavior and the mechanics used behind these processes. Concepts used in the manufacturing technology will be applied in this course as a pre requisite. The course addresses the difference between the conventional and un-conventional approaches in metal forming processes. This course will help students to understand the design and analysis of upcoming future production technology.

Course Contents:

UNIT-1

Advanced metal forming processes: Tube and sheet hydroforming, Theoretical analysis (theory of plasticity), Stress-strain relationship, Strain hardening, Material incompressibility, Work of plastic deformation, Work hardening, Yield criteria, Flow rule, Yield criterion and flow rule for Anisotropic material, Initiation and extent of plastic flow- Problems.

UNIT-2

High energy rate forming processes: EMF, EHF and explosive forming. Design of dies for forging,extrusion and wire drawing, Overview of various metal forming operations: Conventional Vs High velocity forming methods – Material behavior – Mechanics of Various Plastic Flow Problems Forging; Workability of testing techniques, Tribology in metal forming and other phenomena.

UNIT-3

Die design: Die design for sheet metal forming processes such as single and multi-stage deep drawing, bending and stretch forming.

UNIT-4

Mechanics and Materials in Metal forming processes: Materials used for making forming tools, Lubrication mechanisms, Metal forming equipment, Formability testing of sheet metals,

Sheet forming: Mechanics – Flow Rules – Anisotropy - Formability of sheet, Formability tests, Forming limit diagrams, Case studies.

UNIT-5

Forming Limit Diagrams: Determination of Forming Limit Diagrams and their applications, Warm forming, Micro forming. Pressing and Sintering: Workability Studies – Densification - Problems & Case Studies

Course Learning Outcomes (CLOs) :

At the end of course students will be able to:

1. Solve for strain rates, temperatures and metallurgical states in forming problems using constitutive relations
2. Develop process maps for metal forming processes using plasticity principles.
3. Estimate formability limits for sheets and bulk metals.
4. Evaluate optimum process parameters for pressing and sintering

Text/ Reference books:

1. Surender Kumar, Technology of Metal Forming Processes, Prentice - Hall, Inc., 2008.
2. Henry S. Valberg, Applied Metal Forming - Including FEM Analysis, Cambridge University Press, 2010**.**

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107250/ /

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: IPCT4 **Course name** : Computer Integrated Manufacturing

Course credit : 3 **Total contact hours** : 40 hrs

Course Objective:

- Students will be introduced to CAD/CAM/CAE concepts
- Specify appropriate manufacturing processes for the fabrication of mechanical components
- Students will learn about importance of data generation and management in CIMS.

Course description:

This course demonstrates the concepts of CIM. It describes the ways of controlling business operation by means of CIM. Through this course the students will understand the concepts of CAPP (computer-aided process planning), SQC(statistical quality control), optimization of MRP (Manufacturing Resource Planning) and JIT(Just in Time). Group technology and artificial intelligence are also useful part of CIM system.

Course content:

Unit-1 Introduction to CNC Machine Tools: Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept.

Unit-2 CNC Programming: Co-ordinate System, Fundamentals of APT programming, Manual part programming-structure of part programme, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines-IDEAS, Unigraphics, Pro Engineer, CATIA, ESPIRIT, MasterCAM etc., and use of standard controllers-FANUC, Heidenhain and Sinumeric control system.

Unit-3 Tooling for CNC Machines: Cutting tool materials, Carbide inserts classification; Qualified, semiqualified and preset tooling, Cooling fed tooling system, Quick change tooling system, Tooling system for machining centre and turning center, tool holders, Tool assemblies, Tool magazines, ATC mechanisms, Tool management.

Unit-4 Robotics and Material Handling Systems: Introduction to robotic technology, and applications, Robot anatomy,material handling function, Types of material handling equipment, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Work-in-process storage, Interfacing handling and storage with manufacturing.

Unit-5 Group Technology and Flexible Manufacturing System: group Technology-part families, Parts classification and coding, Production flow analysis, Machine Cell Design, Benefits of

Group Technology, Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.

Unit-6 Computer Integrated Manufacturing: Introduction, Evaluation of CIM, CIM hardware and software, Requirements of computer to be used in CIM system, Database requirements, Concurrent engineering Principles, design and development environment, advance modeling techniques.

Course Learning outcome (CLOs) :

At the end of this course students will be able to:

1. Understand the basics of Computer integrated manufacturing
2. Formulate and implement the CNC and NC programming tool
3. Learn and gained elementary knowledge regarding material handling system

Text Books:

- Computer Numerical Control Machines P. Radahkrishnan New Central Book Agency
- CNC Machines M.S. Sehrawat and J.S. Narang Dhanpat Rai and Co.

Reference Books:

- CNC Programming Handbook Smid Peter Industrial Press Inc.
- Automation, Production systems and Computer M.P. Groover Prentice Hall of India IntegratedManufacturing

Online links for study and reference materials:

https://nptel.ac.in/courses/112/104/112104289/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE III

Course Code: IPE31 **Course Name**: Statistics of Decision Making

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- To develop the students ability to deal with numerical and quantitative issues in business
- To enable the use of statistical, graphical and algebraic techniques wherever relevant.
- To have a proper understanding of Statistical applications in Economics and Management.

Course Description:

All of us in our day-to-day life use numbers in our calculations. Organizations today are inundated with numerical data and information. In business, it is essential for managers to carry out data analysis and be able to interpret their results for effective decision-making. For this, they need to prepare quantitative arguments to justify their decisions. The Statistical Methods for Decision Making (SMDM) course teaches you how to use statistics to help take a real-world problem and apply various techniques to make effective business decisions.

Course Content:

UNIT 1:

Data, graphs, determinism vs. stochasticity, populations vs. samples, experimental
design, sampling, inference, bivariate data; scatterplots, least squares regression and correlation

UNIT 2:

Data reduction, descriptive statistics, "normal" distribution randomness, probability concepts, random variables (r.v.'s), distribution moments (mean, variance, etc.); discrete models
continuous probability models

UNIT-3

Sampling distributions, counts and proportions, point and interval estimation: confidence, significance, statistical tests Introduction to hypothesis testing; power and inference, inference for single and two populations

UNIT -4

Hypothesis testing and inference for two populations, and for population variance Good-of-fit tests, contingency analysis, and general categorical data analysis

UNIT-5

Introduction to Analysis of variance (ANOVA), two-factor analysis; Linear regression, correlation analysis, causation, and data transformations Statistical inference for regression parameter estimates.

Course Learning Outcomes (CLOs):

At the end of course students will be able to:

- Students can perform statistical analyses, including one-way ANOVA, two-way ANOVA, simple and multiple regression, time-series analysis, chi-square tests, and nonparametric methods.
- Students can identify the limitations of statistical analyses and when they should or should not be used.
- Student can utilize statistical software to carry out appropriate statistical analyses.
- D. Students can effectively communicate the results of statistical analyses in both oral and written orm through the use of both technical and nontechnical language.

Text books:

- Business Statistics, a Decision-Making Approach, 6th ed., David Groebner, P. Shannon, P. Fry, K. Smith, Prentice Hall, NJ, 2005, ISBN: 0130477850
- Statistics for Business and Economics, by Anderson, Sweeney, Williams, Camm,and Cochran

Reference books:

- Schaum's Series for problem practice.
- Mathematical Statistics by Ray, Sharma and Choudhary

Online links for study and reference materials:

https://www.greatlearning.in/academy/learn-for-free/courses/statistical-methods-for-decision-making/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE III

ADDITIVE MANUFACTURING

Teaching Scheme **Paper Code: IPE32**

Lectures: 3hrs/week

Course outcome:

At the end of this course students will be able to:

1. Understand the basics of additive manufacturing
2. Formulate and implement the rapid prototype procedure and problems
3. Learn and gained elementary knowledge regarding 3D modelling

Syllabus contents:

UNIT-1 Introduction: Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.

UNIT-2 RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seikis' solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc..

UNIT-3 Power based rapid prototyping systems, selective Laser sintering, Soligen Diren's shell production casting (DSPC), Fraunhofer's multiphase jet solidification (MJS) and MIT's 3D printing (3DP) etc.

UNIT-4RP Database: Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.

UNIT-5 RP Applications: Development of dies for moulding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues, etc., RP materials and their biological acceptability.

References:

1. Rapid Prototyping Of Digital Systems: A Tutorial Approach Hamblen James O Kluwer Aca
2. Rapid Prototyping: Principles And Applications Kai Chua Chee World Scie
3. Rapid System Prototyping With Fpgas: Accelerating The Design Process R C Cofer Newnes
4. Rapid Prototyping of Digital Systems James O Hamblen Springer

ELECTIVE III

Course Code: IPE33 **Course Name**: Advance Machining Process

Course Credit: 3 **Total Contact Hour**: 20 hr

Course Objective:

- The objective of the course is to provide the students the knowledge of modern manufacturing processes such as Ultrasonic machining, Abrasive machining processes, Electrochemical machining, Electro discharge machining & their modifications into hybrid processes.
- Also, to introduce them to advanced topics such as Laser beam welding/machining, Electron beam welding/machining & state of art in various research areas.

Course Description:

Today's stringent design requirements and difficult-to-machine materials such as tough super alloys, ceramics, and composites, have made traditional machining processes costly and obsolete. As a result, manufacturers and machine design engineers are turning to advance machining processes. These machining processes utilizes electrical, chemical and optimal sources of energy to machine the given job. Going through this subject students will get insight of various advanced machining processes and there system components, process variables and industrial applications. This is a perfect course for anyone designing, researching or converting to a more advance machining process.

Course Content:

UNIT 1:

Introduction to advanced machining processes and their classification Ultrasonic machining and its modelling and analysis.

UNIT 2:

Abrasive jet machining (AJM) Water jet cutting (WJC) and Abrasive water jet machining (AWJM) Magnetic abrasive finishing (MAF) and its modelling Abrasive flow finishing (AFF) and its modelling Magnetorheological finishing (MRF) Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

UNIT-3

Electric discharge machining (EDM):Principle, applications, process parameters, and modelling. Electric Discharge Grinding (EDG),Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W-EDM).

UNIT -4

Laser beam machining (LBM) Plasma arc machining (PAM) Electron Beam Machining (EBM) Electro chemical machining (ECM):Principle, applications, and process parameters and modelling

UNIT-5

Electrochemical Grinding (ECG),Electrostream Drilling (ESD),Shaped Tube Electrolytic Machining (STEM) Chemical machining (ChM)

Course Learning Outcomes (CLOs):

At the end of this course students will be able to:

- Understand the basics of advance machining technology
- Formulate and implement the machining procedure and problems
- Learn and gained elementary knowledge regarding basic machining

Text /Reference books:

- V.K. Jain,Advanced Machining Processes,Allied Publishers, 2009.
- Gary F.Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987.
- J.A. McGeough,Advanced Methods of Machining, Springer, 1988.
- Hassan El-Hofy,Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005.
- V.K. Jain, Introduction to Micromachining,Alpha Science International Limited, 2010

Online links for study and reference materials:

https://nptel.ac.in/courses/112/107/112107078/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code: IPE41 **Course Name:** Advanced Material Processing Technique
Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To understand the manufacturing processes including stir casting, tape castingprocess and high energy rate forming.
- To identify suitable hybrid welding process for welding a given material.
- To learn the working principle of Electron beam, laser beam and laser hybrid welding processes and suggest their applications.
- To analyze real life system with limited constraint.

Course Description:

This course is focused on physical understanding of materials processing, and the scaling laws that govern process speed, volume, and material quality. In particular, this course will cover the transport of heat and matter as these topics apply to materials processing.

Course Contents:

Unit-I

Overview: Outline of advanced materials processing techniques: Non-Conventional Materials Removal Processes; Finishing Processes; Forming; Advanced Surface Engineering Processes; Joining Technologies.. **Advances in Non-Conventional Machining Processes**: A brief review of non-conventional machining processes, Analysis of mechanical, thermal and Electrochemical type non-traditional machining processes. Tool design for selected non-traditional machining processes

Unit-II

Modelling and Simulation of selected processes: A comparative study of various processes. Advanced Fine Finishing Process: Abrasive Flow Machining; Magnetic Abrasive Finishing; Magneto Rheological Abrasive Finishing: Process principle, process equipment; Analysis and modelling of finishing mechanism; Parametric analysis; Applications

Unit-III

Fabrication of Micro-Devices Semiconductors – films and film depurification – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process – Solid free form fabrication Laser Materials Processing Fundamentals of industrial lasers. Laser materials interaction theories. Laser processing for various industries such as metals, non-metals, photovoltaic, biomedical applications

Unit-IV

Advances in Metal Forming: Conventional processes-High Energy Rate Forming techniques-Explosive forming, electro hydraulic forming, magnetic pulse forming, super plastic forming, rubber forming , flow forming - Principles and process parametersAdvantages -Limitations and Applications. Overview of powder metal

forming technique- Advantages-applications-Powder perform forging- Hot and cold Isostatic pressing-powder rolling-Tooling and process parameters.

Unit-V

Micro-Machining : Introduction to micromachining technologies, Microelectro discharge Machining: Principles of micro-EDM, micro-EDM by Die-sinking and WEDG, micro-WEDM, micro-WEDG, micro-ECM, Principles of micro turning, micro-drilling and micro-milling, micro grinding, hybrid micromachining method, on-line measurement by machine vision and integrated probe, Measuring Techniques in micro-machining, surface integrity and other related measurements.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of advanced material processing technique
- Formulate and implement the selected modeling and simulation procedure and problems
- Learn and gained elementary knowledge regarding non-conventional machining processes
- Apply advanced casting methods including V-process, lost foam process and Magnetic molding process for ceramics and composite material.

Text books:

- Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, M P Groover Wiley
- Manufacturing Engineering and Technology, 4/e, Serope Kalpakjian, Steven R Schmid, Pearson Education..

Reference books:

- Manufacturing Processes for Engineering Materials, 5/e, Serope Kalpakjian Pearson Education
- Modeling of Metal Forming and Machining Processes by Finite Element and Soft Computing Methods, P M Dixit
- Modern Machining Processes, Pandey, P.C., and Shan, H.S. Tata McGraw-Hill Education
- Micromachining of Engineering Materials J.A. McGeough. CRC Press
- Advance Method of Machining McGeough, J.A Springer.

Online links for study & reference materials:

http:// //nptel.ac.in/courses/ 113/105/113105081/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code :IPE42 **Course Name : FINITE ELEMENT METHOD**

Course Credit Hour : 3hr **Total Contact Hour :** 40hr

Course Objective :

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code.

Course Description :

We used textbook and auxiliary handout reading assignments along with written homework assignments using both textbook problems and additional handout problems; classroom discussions including homework solutions and exam problem solutions. Computer assistanace using ANSYS that demonstrate its use for modeling/method/technique purposes, computer assignments using ANSYS augmented with hand/spreadsheet calculations to demonstrate its use for practical engineering design problems, using the computer to perform parameter studies to attain a better understanding of sources of error in FE models.

Course Contents :

Unit-1

Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational and Weighted residual approaches.

Unit-2

Shape functions,Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions, Errors, Convergence and patch test, Higher order elements.

Unit-3

Application to plane stress and plane strain problems, Axi-symmetric and 3D bodies, Plate bendingproblems with isotropic and anisotropic materials, Structural stability, Other applications e.g., Heat conduction and fluid flow problems.

Unit-4

Idealisation of stiffness of beam elements in beam-slab problems, Applications of the method to materially non-linear problems, Organisation of the Finite Element programmes, Data preparation and mesh generation through computer graphics.

Unit-5

Numerical techniques, 3D problems, FEM an essential component of CAD, Use of commercial FEM packages, Finite element solution of existing complete designs, Comparison with conventional analysis.

Course Learning Outcomes(CLOs) :

At the end of course students will be able to:

- Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer.
- Formulate and solve problems in one dimensional structures including trusses, beams and frames.
- Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems.
- Implement and solve the finite element formulations using MATLAB.

Text books :

- The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill
- An Introduction to Finite Element Method J. N. Reddy McGraw Hill
- Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill
- Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill

Reference books :

- Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
- Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India
- Finite Element and Approximation O.C. Zenkiewicy & Morgan

Online links for study & reference materials :

https://nptel.ac.in/courses/112/106/112106135/

Assessment method : (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE IV

Course Code: IPE43 **Course Name:** MECHATRONICS

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- To make them learn the fundamentals of Mechanical and Electronics.
- To learn about the various data conversion devices, mechanical systems and control systems.
- To make the students enable to implement the mathematical approach in the design and analysis of mechatronic devices.
- To implement the above knowledge in solving the practical engineering problems.

Course Description:

This course is an intermixing of introduction of mechanical engineering and electronics engineering systems and the concepts used in these engineering branches. The course describes the introduction of mechatronics along with the detail about various mechanical and data conversion devices. The course addresses about the control systems, various mathematical functions and the modeling of these functions in real practical application of various mechatronic systems.

Course Contents:

UNIT-1
Introduction to Mechatronics: Definition, Mechatronics in manufacturing, products and design. Comparison between Traditional and Mechatronics approach. Electronics: Review of fundamentals of electronics, logic gates and their operations.

UNIT-2
Data conversion devices: Sensors, microsensors, transducers, electrical contacts, actuators, and switches, contactless input devices, signal processing devices; relays, output devices. Drives: Stepper motors, servo drives.

UNIT-3
Mechanical Systems: Ball screws, linear motion bearings, transfer systems. Hydraulics: Hydraulic elements, actuators and various other elements. Design of hydraulic circuits.

UNIT-4
Control Systems: Open loop and closed loop control, block diagrams, transfer functions, Laplace transforms; Mathematical model of physical system; PI and PID controllers, 8085 microprocessor, PLC controller and Ladder diagrams, hydrualic and pneumatic controllers.

UNIT-5

Time domain analysis: Transient response of first and second order systems; Introduction to nonlinear control; State space analysis, optimal and adaptive control; Intorduction to discrete-time systems and Z-transform. Design and fabrication of mechatronics systems.

Course Learning Outcomes(CLOs)

At the end of this course the students will be able to:

1. Understand the basics of mechatronics
2. Formulate and implement the electrical and mechanical components design procedure and problems
3. Learn and gained elementary knowledge regarding electronics design

Text books:

1. Mechatronics , HMT Ltd., TMH.
2. Mechatronics by W.Bolton Addison Wesley.

Reference books:

1.AutomaticControl Engineering by F.H.Raven, 5th ed., McGrawHill International.
2. Modern Control Engineering by K.Ogata, 3rd ed., Prentice Hall.
3. Automatic Control Systems by B.C.Kuo, 6th ed., Prentice Hall.
4. Machine design for mobile and industrial applications by G.W.Kurtz, J.K.Schueller, P.W.Claar, SAE.

Online links for study & reference materials:

https://nptel.ac.in/courses/112/107/112107298/

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: IPCL3 **Course Name:** Metal Forming Lab
Course Credit: 2 **Total Contact Hour:** 40hr

Course Objective:

- To learn practical process of metal forming.

List of Experiments

1. To study and observe through demonstration the metal forming process (Rolling process)
2. To study and analyze the process of open die forging
3. Estimation of power and cutting forces required in turning process
4. To analyze tool life at different machining variables
5. To study the non-conventional machining with demonstration of Electro Discharge Machining (EDM)
6. To study and analyze the process of metal extrusion process
7. To analyze the process of Closed die Forging
8. To study and observe various stages of casting through demonstration of Sand Casting Process.
9. To study and observe the welding process through demonstration and practice. (Spot welding)
10. To study and observe the welding process through demonstration and practice. (Electric Arc Welding)
11. To study and demonstration on CNC machining and understanding CNC Coding.

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understand the basics of metal forming
- Formulate and implement the metal forming design procedure and problems
- Hand on experience regarding rolling and wire drawing

Reference materials: https://nptel.ac.in/courses/112/107/112107250/ /

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Course Code: IPCL4 **Course Name**: Computer Integrated Manufacturing Lab

Course Credit: 2 credits **Total Contact Hour**: 40 hr

Course Objective:

To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's and to impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements.

- Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle
- Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle.
- Nonlinear analysis (Exercise must include plastic deformation of simple objects or crash analysis simple structures.
- 3 Axis CNC code generations for CNC machining.
- CNC Machining of complex features like machining of hemispherical cavity, tapered hole, hole of parabolic shape etc.

LIST OF EQUIPMENTS REQUIRED:

1. Computers 18
2. CAD Workstation
3. FEA Software
4. CAM Software for
3 axis machining or more
5. CNC Production type lathe or Milling Machine

Course Learning Outcomes (CLOs):

After successful completion of Computer Integrated Manufacturing lab, the student will be able to CO

- Impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's. CO
- To impart knowledge on the use of Finite Element Analysis software to solve various field problems in mechanical engineering to optimize and verify the design of machine elements. CO
- Identify the main elements in computer integrated manufacturing systems; Apply knowledge of computer aided process planning, feature and group technology, and data exchange in manufacturing processes. CO
- Apply the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion; CO
- Process product models with CAM tools and CNC machines

Online links for study and reference materials:

https://nptel.ac.in/courses/121/106/121106007/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Teaching Scheme **Paper Code: IPCL4**

Practical: 4hrs/week

Course outcome:

At the end of this course students will be able to:

1. Understand the basics of computer integrated manufacturing
2. Formulate and implement the 3D modelling design and problems
3. Hand on experience regarding CAD software

LIST OF EXPERIMENTS

1. 3D Modeling using CAD software.

2. CNC programming on turning.

3. CNC programming on milling.

4. Simulation of CNC programming on CAM Software

5. Study and demonstration on Robots.

6. Basic Robot Programming and Simulation.

7. Study of computer controlled business functions.

8. Study of interfacing requirements in CIMS.

9. Generation of any surface using any CAD software.

10. Design/ Thermal Analysis by CAD Software

SEMESTER-III

DETAILED CURRICULUM CONTENTS

ELECTIVE V

Course Code: IPE51 **Course Name:** Design and Analysis of Experiments

Course credit : 3 **Total contact hours:** 40 hrs

Course Objectives:

- To learn the fundamental of experimental designs
- To understand analysis tools and techniques, interpretation and application.

Course description:

This the describes the ways to explore innovative strategies for constructing and executing experiments including factorial and fractional factorial designs that can be applied across the physical, chemical, biological, medical, social, psychological, economic, engineering and industrial sciences. This course will develop the ability to conduct cost-effective, efficient experiments and analyze the data that they yield in order to derive maximum value for your organization.

Course content:

UNIT-1

Introduction to DOE Overview and Basic Principles Simple Designs and Analysis of Variance Block Designs, Latin Squares and Related Designs

UNIT-2

Introduction to factorial Designs Full Factorial Designs 2-level Full Factorial and Fractional Factorial Designs , Blocking and confounding in the 2K factorial design

UNIT-3

Response surface methods and designs ANOVA, model checking, sample size, regression approach, central composite design

UNIT-4

Designs with Random Factors Nested Designs and Split-plot Designs , Fitting regression models

UNIT-5

Introduction to MINITAB , DESIGN EXPERT softwares

Course Learning outcome (CLOs):

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

1.Learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions.

2. Both design and statistical analysis issues are discussed. Students will be expected to utilize standard statistical software packages for computational purposes.

References Books:

Design and Analysis of Experiments, 8th edition, Douglas C. Montgomery

Online links for study and reference materials:

https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-mg01/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

ELECTIVE V

SUPPLY CHAIN MANAGEMENT

Teaching scheme **Paper code: IPE52**

Lectures:3hrs/week

Course outcome:

At the end of this course the students will be able to:

1. Understand the basics of supply chain management
2. Formulate and implement the forecasting design procedure and problems
3. Learn and gained elementary knowledge regarding transportation decisions

Syllabus content:

UNIT-1

Introduction to supply chain management: Supply chain basics, decision phases in supply chain, supply chain flows, supply chain efficiency and responsiveness, supply chain integration,process view of a supply chain, uncertainties in supply chain, key issues in supply chainmanagement, drivers of supply chain performance. Supply chain coordination, bullwhip effect,developing relationships in the supply chain, resolving conflicts in supply chain relationships,role of information technology in supply chain

UNIT-2

Demand forecasting in supply chain: Role of forecasting in supply chain, components of a forecast, forecasting methods, estimating level, trend and seasonal factors, Holt's model, Winter's model, measures of forecast error. Role of aggregate planning in supply chain: Aggregate planning strategies, managing supply and demand in supply chain.

UNIT-3

Supply chain inventory: Role of cycle inventory in supply chain, economies of scale, lot sizing for a single product, lot sizing for multiple products, quantity discounts, trade promotions, price discrimination. Role of safety stock in supply chain, determining appropriate level of safety inventory, inventory replenishment policies, measures of product availability.

Sourcing decisions in supply chain: Supplier selection and contracts, design collaboration, making sourcing decisions in practice.

UNIT-4

Transportation decisions: Role of transportation in supply chain, factors affecting transportation decisions. Routing and scheduling in transportation.

UNIT-5

Logistics: Definition, logistics and SCM, international considerations, inbound logistics, internal logistics and outbound logistics. Reverse logistics, green supply chain.

References:

1. Sunil Chopra and Peter Meindl, "Supply chain management - strategy planning and operation", PHI

2. Handfield R. B., Nichols Jr. E. L., "Introduction to supply chain management", Pearson Education

3. Raghuram R. and Rangaraj N., “Logistics and supply chain management”, Macmillan, 2001
4. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., “Designing & managing the supply chain: concepts, strategies & case studies.” 2nd Edition, Tata McGraw-Hill, 2003
5. Agarwal D. K., “A text book of logistics and supply chain management”, Macmillan, 2003
6. Srinivasan, G., “Quantitative models in operations and supply chain management”, PHI

ELECTIVE V

Course Code: IPE53 **Course Name:** Surface Engineering

Course Credit: 3 **Total Contact Hour:** 30hr

Course Objective:

- Learn the principles and methodology of Industrial Surface Engineering
- Learn the rules of product-design and of the relevant surface engineering.
- Learn the rules of product-design and of the relevant surface engineering tehniques.

Course Description:

Thermal Spray is means of depositing a superior coating material having desired properties over a relatively in -expensive base material (substrate).The applied coating improves the life of treated components without affecting its mechanical properties. All thermal spray processes have three steps in common; feed coating material (in form of wire, powder and rod), heat that material to semi-molten stage, and transfer the material by force of gas or compressed air to the part being coated. The objective of this course is to introduce thermal spray technology for protecting surfaces for industrial applications such as gas turbines, IC engines (automobiles), boilers and several other engineering components. An interactive session based on real life case studies will illustrate the potential of thermal spray coatings. The course will help improvise the understanding of participants on thermal spray processes.

Course Contents:

Unit-I

Introduction to surface engineering: Importance and scope of surface engineering, conventional surface engineering practices like pickling, grinding, buffing etc.

Unit-II

Surface Engineering of Materials: surface engineering by material addition like electroplating, surface modification of ferrous and non-ferrous materials like nitriding, cyaniding, aluminizing etc.

Unit-III

Advanced Surface Engineering: practices like laser assisted surface modification, electron beam assisted modification, spraying techniques like flame and plasma spraying, high velocity oxy-fuel, cold spray techniques.

Unit-IV

Surface Modification: Sputter deposition processes, PVD and CVD methods of surface coatings, surface modification by ion implantation and ion beam mixing

Unit-V

Coating: Characterization of the engineered surface and coatings like thickness, porosity and adhesion of coatings, surface microscopy and spectroscopic analysis of the modified surfaces. Functional coatings and their applications**.**

Course Learning Outcomes(CLOs) :

At the end of this course students will demonstrate the ability to

- Understanding of surface structure and surface engineering basics.
- Understanding basics of wear and corrosion problems
- Understanding the contrasts between different group of surface engineering processes.

- Industrial applications of different surface engineering technique.

Text books:

- Surface Engineering & Heat Treatment By: P.H Morton I.I.T, Brooke field, (1991).

Reference books:

- Metals Handbook Ninth Edition, Vol.5, Surface Cleaning, Finishing & Coating, ASM, Metals Park Ohio, 1982..
- Corrosion Engineering By: M.G. Fontana, M.C. Graw Hill, N. York, 1987.

Online links for study & reference materials:

http:// //nptel.ac.in/courses/112/107/112107248/

Assessment method: (Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Dissertation Phase – I

Teaching Scheme **Paper Code: MTC03**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ASME journals in the areas of design, thermal and production engineering area and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

SEMESTER-IV

DETAILED CURRICULUM CONTENTS

Dissertation Phase – II

Teaching Scheme **Paper Code: MTC04**

Lab work: 20 and 32 hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Ability to synthesize knowledge and skills previously gained and applied to an in depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – II:

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. departments laboratories and centers OR in industry allotted through departments T & P coordinator.

- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/ Springer/Science Direct/ASME journals in the areas of design, thermal and production engineering area and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.