

**Rashtreeya Sikshana Samithi Trust**

# **R. V. COLLEGE OF ENGINEERING**

**(Autonomous Institution Affiliated to VTU, Belgaum)**

**R. V. Vidyaniketan Post, Mysore Road**

**Bangalore – 560 059**



## **Scheme & Syllabus**

**V & VI Semester B.E.**

**Industrial Engineering and Management**

**(2012 Scheme)**

**R. V. College of Engineering, Bangalore – 59**  
*(Autonomous Institution affiliated to VTU, Belgaum)*  
**Department of Industrial Engineering and Management**

**RVCE Vision and Mission**

**Vision Statement**

Leadership in, Quality Technical Education, Research & Innovation through Teamwork, with a Focus on Development of Sustainable and Inclusive Technology.

**Mission Statement**

- Deliver Quality Technical Education, with an equal emphasis on theoretical and practical aspects.
- To provide state of the art infrastructure for the students and faculty to upgrade their skills and knowledge.
- To produce quality engineers who are disciplined, ethical and socially concerned.
- To create an open and conducive environment for faculty and students to carryout research and excel in their field of specialization.
- To focus especially on Innovation and Development of Technologies those are sustainable and inclusive, and thus benefit all sections of the society.
- Establish a strong Industry Academic Collaboration for teaching and research, which could lead to entrepreneurship.
- To assist weaker section of the society by providing opportunity and resources for developing skills for employability or self help / entrepreneurship.

**R.V. College of Engineering, Bangalore – 59**  
*(Autonomous Institution affiliated to VTU, Belgaum)*  
**Department of Industrial Engineering and Management**

**Department Vision and Mission**

**Vision**

Imparting innovation and value based education in Industrial Engineering and Management for steering organizations to global standards with an emphasis on sustainable and inclusive development.

**Mission**

- To impart scientific knowledge, engineering and managerial skills for driving organizations to global excellence.
- To promote culture of training, consultancy, research and entrepreneurship interventions among the students & faculty.
- To institute collaborative academic and research exchange programs with National and globally renowned Universities, industries and other organizations.
- To establish and nurture Center of Excellence in the niche area of Industrial and Systems Engineering.

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**Programme Educational Objectives (PEO's)**

- I. Conceive, design, implement and operate integrated man – machine systems, focus on appropriate measures of performance at strategic, tactical and operational levels.
- II. Exhibit competency to adapt to changing roles for achieving organizational excellence.
- III. Design and develop sustainable technologies and solutions for betterment of society, at large.
- IV. Pursue entrepreneurial venture with a focus on creativity and innovation for developing newer products, processes and systems.

**Programme Outcomes (PO's)**

1. Exhibit knowledge of basic sciences and engineering and manufacturing processes.
2. Demonstrate the ability to accomplish the integration of systems using appropriate analytical, computational and application practices and procedures.
3. Demonstrate the ability to apply knowledge of probability and statistics, optimization techniques, simulation modeling, engineering economic analysis and cost control, and other technical sciences and specialties necessary in the field of industrial engineering and management.
4. Be able to identify, formulate, solve problems and implement solutions for engineering, managerial and societal requirements.
5. Possess skills related to design / re-design and conduct experiments, analyze and interpret data through systems thinking and modeling approaches
6. Exhibit knowledge of values and professional ethics in their areas of work.
7. Develop an ability to adapt and continuously learn to pursue successful careers in chosen professional field
8. Manage projects in various sectors of economy with a focus on conceptual, technical and human aspects

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<b>FIFTH SEMESTER</b>								
Sl. No	Subject Code	Subject Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorials	Practical	Self study	
1	12HSM51	Management & Organizational Behaviour	HSS	3	0	0	0	3
2	12ME52/ IM52	Design of Machine Elements I (Professional Core -Group)	ME	3	0	1	1	5
3	12IM53	Operations Research	IEM	3	0	1	1	5
4	12IM54	Statistical Quality Control	IEM	3	0	1	1	5
5	12IM5AX	Elective A	IEM	3	1	0	1	5
6	12IM5BX	Elective B	IEM	3	0	0	0	3
								<b>26</b>
		<b>No. of Hrs.</b>		<b>18</b>	<b>02</b>	<b>06</b>	<b>16</b>	<b>42</b>

<b>SIXTH SEMESTER</b>								
Sl. No	Subject Code	Subject Title	BoS	CREDIT ALLOCATION				Total Credits
				Lecture	Tutorials	Practical	Self study	
1	12HSI61	Intellectual Property Rights & Entrepreneurship	HSS	3	0	0	0	3
2	12IM62	Operations Management	IEM	3	0	1	1	5
3	12IM63	Computer Integrated Manufacturing	IEM	3	0	1	1	5
4	12IM64	Simulation Modeling and Analysis	IEM	3	0	1	0	4
5	12IM65	Emerging Technologies	IEM	2	0	0	0	2
6	12IM6CX	Elective C	IEM	3	0	0	1	4
7	12IM6DX	Elective D	IEM	3	0	0	0	3
								26
		<b>No. of Hrs.</b>		<b>20</b>	<b>00</b>	<b>06</b>	<b>12</b>	<b>38</b>

<b>EC, CS, EE, IS</b>	V Semester 12HSI51	VI Semester 12HSM51
<b>ME, CHEM, IEM, IT, CV, BT, TE</b>	V Semester 12HSP51	VI Semester 12HSI61

\* Respective Board of Studies

HSS – Humanities & Social Sciences

IEM – Industrial Engineering and Management

ME – Mechanical Engineering

### LIST OF ELECTIVE SUBJECTS

Specialization Category	PC Elective –A (5 Credits)	PC Elective –B (3 Credits)	PC Elective –C (4 Credits)	PC Elective –D (3 Credits)
<b>Manufacturing</b>	12IM5A1- Modern Manufacturing Methods	12IM5B1- Tool Engineering & Design	12IM6C1- Hydraulics and Pneumatics	12IM6D1- Robotics
<b>Industrial &amp; Systems Engineering</b>	12IM5A2- Advanced Ergonomics	12IM5B2- Technology Management	12IM6C2- Total Quality Management	12IM6D2- Lean Manufacturing Systems
<b>Optimization Techniques</b>	12IM5A3- Design of Experiments	12IM5B3- Reliability Engineering	12IM6C3- Applied Statistics	12IM6D3- Advanced Operations Research
<b>Management</b>	12IM5A4- Financial Accounting and Costing	12IM5B4- Project Planning & Control	12IM6C4- Human Resource Management & Development	12IM6D4- Marketing Management & Research
<b>Information System Design</b>	10IM5A5 - Software Engineering	12IM5B5 - Database Management System	12IM6C5 - Management Information System	12IM6D5 - Enterprise Resource Planning & E-commerce

## V Semester

### MANAGEMENT & ORGANIZATIONAL BEHAVIOR

<b>CourseCode</b>	<b>: 12HSM51</b>	<b>CIE Marks</b>	<b>: 100</b>
<b>Periods/Week</b>	<b>: 3+0+0 +0(L+T+P+S)</b>	<b>SEE Marks</b>	<b>: 100</b>
<b>Credits</b>	<b>: 03</b>	<b>SEE Duration</b>	<b>: 3 Hrs</b>

#### Course Learning Objectives:

1. Understand the roles of managers and historical evolution of various approaches to the study of management.
2. Demonstrate the process of planning which can be used as a tool for decision-making in organizations.
3. Create logical relationships between various organizational structures and designs.
4. Implement leadership practices towards the management and development of people within organizations.

#### UNIT - I

**Introduction to Management:** Management Functions, Roles & Skills, Management History – Classical Approach: Scientific Management & Administrative Theory, Quantitative Approach: Operations Research, Behavioral Approach: Hawthorne Studies, Contemporary Approach: Systems Theory, Overview of Social Responsibility & Managerial Ethics, Case Study. **6 Hrs**

#### UNIT - II

**Foundations of Planning:** Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate & Competitive Strategies, Decision Making Process, Types of Decisions & Decision Making Conditions, Case Study. **4 Hrs**

**Organizational Structure & Design:** Designing Organizational Structure: Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Mechanistic & Organic Structures, Organizational Design: Traditional & Contemporary, Case Study. **4 Hrs**

#### UNIT - III

**Understanding Organizational Behavior:** Attitudes, Job Satisfaction & Organizational Commitment, Cognitive Dissonance Theory, Personality: MBTI & Big Five Model, Emotional Intelligence, Perception & Factors Influencing Perception, Attribution Theory, Learning: Classical & Operant Conditioning, Social Learning & Shaping Behavior, Case Study. **6 Hrs**

#### UNIT - IV

**Managing Teams:** Groups & Stages of Group Development, Group Structure, Processes & Tasks, Work Team & Types of Work Teams, Case Study. **2 Hrs**

**Motivating Employees:** Early Theories of Motivation: Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory & McClelland's Three Needs Theory, Contemporary Theories of Motivation: Adam's Equity Theory & Vroom's Expectancy Theory, Case Study. **4 Hrs**

## UNIT - V

**Managers as Leaders:** Early Leadership Theories: Trait Theories, Behavioral Theories: Ohio State Studies, University of Michigan Studies, Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: The Fiedler Model, Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership, Case Study. **4 Hrs**

**Introduction to Controlling:** The Control Process, Controlling for Organizational Performance & Tools for Measuring Organizational Performance, Case Study. **2 Hrs**

### Course Outcomes:

1. Understand the principles of management theory & Recognize the characteristics of an organization.
2. Demonstrate the importance of key performance areas in strategic management & decision-making process.
3. Design appropriate organizational structures and possess an ability to conceive organizational dynamics.
4. Evaluate attitudes and personality traits for inter personal effectiveness and development within organizations.
5. Implement the right leadership practices in organizations that would enable systems orientation.

### Reference Books:

1. Stephen Robbins, Mary Coulter & Neharika Vohra, Management, Pearson Education Publications, 10<sup>th</sup> Edition, ISBN: 978-81-317-2720-1.
2. James Stoner, Edward Freeman & Daniel Gilbert Jr, Management, PHI, 6<sup>th</sup> Edition, ISBN: 81-203-0981-2.
3. Stephen Robbins, Timothy Judge & Seema Sanghi, Organizational Behavior, Pearson Education Publications, 13<sup>th</sup> Edition, ISBN: 978-81-317-2121-6.

### Scheme of Continuous Internal Evaluation (CIE):

CIE consists of three tests, each for 45 Marks, (15 Marks for Quiz + 30 Marks for Descriptive – inclusive of case studies) out of which, the best two will be considered. In addition, there will be one seminar on emerging topics in Management and Organizational Behavior for 10 Marks.

### Scheme of Semester End Examination (SEE):

The question paper consists of Part A and Part B. Part A will be for 20 Marks covering the complete syllabus and is compulsory. Part B will be for 80 Marks and will consist of five questions, inclusive of case studies, carrying 16 Marks each. All five questions from Part B will have an internal choice and one of the two have to be answered compulsorily.

### Mapping of POs with CO's

Course Outcome	Program Outcomes
1.	1, 2
2.	1, 2
3.	2, 3
4.	1, 6,7,9



## DESIGN OF MACHINE ELEMENTS – I

<b>Course Code</b>	<b>: 12ME52/IM52</b>	<b>CIE Marks</b>	<b>: 100 + 50</b>
<b>Hrs/Week</b>	<b>: L: T: P: S:3:0:2:4</b>	<b>SEE Marks</b>	<b>: 100 + 50</b>
<b>Credits</b>	<b>: 05</b>	<b>SEE Duration</b>	<b>: 3 + 3 Hrs</b>

### Course Learning Objectives:

- Describe the functions of various mechanical elements in a machine.
- Explain the relation between properties and dimensions of components
- Analyze and quantify the forces, stresses and related parameters which are necessary to design shafts, springs, drive systems, clutches and joints.
- Demonstrate ability to Develop designs for various mechanical components

### Unit - I

#### **Design for Static Strength** **03 Hrs**

Static Load, Strength, Factor of Safety, Stress Concentration, Stress Concentration Factor, Theory of Failures: Failure of Brittle and Ductile Materials, Max. Normal Stress, Distortion Energy, Shear Stress;

#### **Design for Fatigue Strength**

S-N Curve, Low & High Cycle Fatigue, Endurance Limit, Modifying factors for Endurance Strength, Size Effects, Load & surface Effects; Stress Concentration Effects, Fluctuating Loads, Derivation of Goodman and Soderberg Relationship;  
Impact loads, stresses due to axial bending and torsional loading **03 Hrs**

### Unit - II

#### **Design of Shafts and Keys** **05 Hrs**

Design for Strength and Rigidity with Steady Loading, Torsion of Shafts, Design of Transmission Shafts, Shafts under fluctuating loads, combined loads, Key Design

#### **Design of Couplings**

Types of Couplings, Design of Rigid and Flexible Couplings flanged coupling, bush and pin type of couplings. **03 Hrs**

### Unit - III

#### **Design of Springs** **07 Hrs**

Types of spring, stresses in helical springs, deflection in helical springs - circular and non-circular cross-section, Tension and compression springs, springs subjected to fluctuating and impact loads; Design leaf springs

### Unit - IV

#### **Design of Spur & Helical Gears** **05 Hrs**

##### **Spur Gears:**

Definition, Stresses in Gear Tooth, Lewis Equation, Form Factor, Design for Strength, Dynamic Load and wear load, material selection for different velocity ratios, types of tooth systems

##### **Helical Gears:**

Number of teeth, design based on strength, dynamics and wear loads, normal and transverse pitch, module, Herringbone gears, different forces on helical gear teeth. **03 Hrs**

### Unit - V

#### **Design of Riveted and Welded Joints** **04 Hrs**

Types of riveted joints, failure of riveted joints, design of boiler joints; Types of welded joints, strength of butt, fillet welds, eccentric loaded welds.

### **Design of Cotter and Knuckle Joints**

Introduction, Applications, Design of Cotter and Knuckle joints.

**03 Hrs**

### **Unit – VI (Laboratory Work) Computer Aided Machine Drawing**

#### **SECTION – I**

**10 Hrs**

**Sections of Solids** – cubes, pyramids, cones, cylinders;

**Orthographic Projections** – Conversion of pictorial views into orthographic views.

**Threaded Forms**-Internal, External, Square, Acme, Bolts, Nuts and Washers

Riveted Joints – Single, Double, Triple, Lap and Butt Joints

#### **SECTION – II**

**14 Hrs**

**Assembly Drawings:** Screw Jack, Connecting Rod, Tail Stock of Lathe, Plummer Block, Machine Vice, Tool head of shaper.

**Course Outcomes:** On completion of the course the student will be able to

1. Explain the design procedure for specific mechanical elements & sub-systems
2. Design specific mechanical elements based on required specifications
3. Analyze different types of forces and its influence on the component design
4. Examine and relate importance of component design to complete system.
5. Evaluate the designs of specific machine elements such as shaft, springs, joints.

#### **Reference Books:**

1. Shigley J.E, Mischke.C.R., ‘Mechanical Engineering Design’, McGraw Hill International, Ed.6<sup>th</sup>, ISBN: 007049462
2. Spotts.M.F, Shoup.T.E, Hornberger.L.E, Jayram.S.R., Venkatesh C.V., ‘Design of Machine Elements’, Pearson Education, Ed.8<sup>th</sup>; ISBN9788177584219
3. Bhandari.V.B., ‘Design of Machine Elements’, Tata McGraw Hill Publishing Company Ltd., Ed.2<sup>nd</sup>; ISBN: 9780070611412.
4. K.R.Goplakrishna, Machine Drawing, Subhas Stores, 19<sup>th</sup> Edition, 2005

#### **Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

#### **Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered

#### **Scheme of Continuous Internal Evaluation (CIE) for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

#### **Scheme of Semester End Evaluation (SEE) for Lab:**

Laboratory examination is conducted for 50 marks; Students are required to answer two questions out of three from Section I of 10 marks each and one question on assembly out of two from Section II for 30 marks.

**PO & CO Mapping**

<b>MEPO1</b>	<b>MEPO2</b>	<b>MEPO3</b>	<b>MEPO4</b>	<b>MEPO5</b>	<b>MEPO6</b>
<b>M</b>	<b>H</b>	<b>H</b>	<b>L</b>	<b>M</b>	<b>M</b>
<b>Course Assessment Method</b>		<b>Assessment Intervals</b>			
		<b>1</b>	<b>2</b>	<b>3</b>	
Quiz		<b>X</b>	<b>X</b>	<b>X</b>	
Tests		<b>X</b>	<b>X</b>		
Seminar / Presentation					<b>X</b>
Lab					<b>X</b>
Semester End Examination					<b>X</b>

## OPERATIONS RESEARCH

Course Code	: 12IM53	CIE Marks	: 100 + 50
Hrs/Week	: L: T: P: S:3:0:2:4	SEE Marks	: 100 + 50
Credits	: 05	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Develop mathematical formulation for linear programming and transportation problem
- Define Queuing system and their characteristics.
- Construct the required activities in an efficient manner so as to complete it on or before a specified time limit and at the minimum cost.
- Develop mathematical model for interactive decision-making situations, where two or more competitors are involved under conditions of conflict and competition.

### Unit - I

07 Hrs

**Introduction:** OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR.

**Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method.

**Simplex methods:** Variants of Simplex Algorithm – Uses of Artificial Variables.

### Unit - II

06 Hrs

**Transportation Problem:** Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems

### Unit – III

06 Hrs

**Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).

### Unit – IV

06 Hrs

**Project Management Using Network Analysis:** Network construction, determination of critical path and duration, floats. PERT- Estimation of project duration, variance. CPM - Elements of crashing, least cost project scheduling.

### Unit – V

07 Hrs

**Queuing Theory:** Queuing system and their characteristics, The M/M/I Queuing system, Steady state performance analyzing of M/M/1 queuing models.

**Game Theory:** Introduction, Two person Zero Sum game, Pure strategies – Games with saddle point, Graphical Method, The rules of dominance, solution method of games without saddle point – Arithmetic method.

### Self Study:

12 Hrs

Case study, Design and Emerging Technologies to be discussed pertaining to the course.  
1 Credit: 4 Hrs / Week

### Unit – VI (Laboratory Work)

- Introduction to Operations Research Packages - using MAT Lab, AMPL, Excel and TORA
- Exercise on application of Operations Research Models to various sector of economy including Manufacturing, Health Care, Infrastructure, Insurance, Bnaking, Retail, Agriculture and Governance

**Course Outcomes**

After the successful completion of the course, the students will be able to:

1. Understand the basic concepts of different advanced models of operations research and their applications.
2. Apply the models to incorporate rational decision making process in real life situations.
3. Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.
4. Validate output from model to check feasibility of implementations.
5. Create innovative modeling frameworks for a given situation.

**Reference Books:**

1. Taha H A, Operation Research An Introduction, PHI, 8<sup>th</sup> Edition, 2009, ISBN: 0130488089.
2. Philips, Ravindran and Solberg - Principles of Operations Research – Theory and Practice, PHI, 2<sup>nd</sup> Edition, ISBN :0471086088.
3. Hiller and Liberman, Introduction to Operation Research, Tata McGraw Hill 8<sup>th</sup> Edition, 2005, ISBN : 0073017795.
4. J K Sharma, Operations Research Theory and Application, Pearson Education Pvt Ltd, 2<sup>nd</sup> Edition, ISBN: 0333-92394-4.
5. Prof. J Govardhan, Principles, Methodology and Applications of Operations Research, JEM Consultants, 3<sup>rd</sup> Edition, 2012

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered

**Scheme of Continuous Internal Evaluation (CIE) for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

**Scheme of Semester End Evaluation (SEE) for Lab:**

Experiment from Part - I : 20 Marks  
 Experiment from Part - II : 20 Marks  
 Viva Voce : 10 Marks  
 Total : 50 Marks

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2
2.	1, 2, 3
3.	2, 3, 6
4.	2, 9

## STATISTICAL QUALITY CONTROL

Course Code	: 12IM54	CIE Marks	: 100 + 50
Hrs/Week	: L: T: P: S: 3: 0: 2: 4	SEE Marks	: 100 + 50
Credits	: 05	SEE Duration	: 3 + 3 Hrs

### Course Learning Objectives:

- Explain basics of quality control and quality improvement.
- Construct control charts for variables and attributes to monitor processes, and interpret the charts.
- Perform process homogenization & process harmonization, & to estimate capability of various processes.
- Perform Reliability evaluation of Mechanical, Electrical, Electronics and Software Technology Systems.
- Perform Design of Experiments and use it for process improvements

### Unit – I

06 Hrs

**Introduction:** Dimensions of Quality, Statistical Methods for Quality, Quality costs. SIPOC, DMAIC Problem Solving Process: Define, Measure, Analyze, Improve, Control steps, Tools used in DMAIC process, Examples of DMAIC

**Statistical Process Control:** Chance and assignable causes of variation. Statistical basis of control charts, Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational sub groups. Analysis of patterns of control charts.

### Unit – II

06 Hrs

**Control Charts For Variables:** Controls charts for  $\bar{X}$  (mean) and Range, statistical basis of the charts, development and use of  $\bar{X}$  and R charts, Process Homogenization, interpretation of charts. Control charts for  $\bar{X}$  and standard deviation ( $\sigma$ ), development and use of  $\bar{X}$  and  $\sigma$  chart. Brief discussion on – Pre control, control charts for individual measurements, moving-range charts.

### Unit – III

06 Hrs

**Control Charts for Attributes:** Controls chart for fraction non- conforming (defectives), Control chart for non-conformities (defects) – development and operation of control chart for constant sample size and variable sample size. Choice between variables and attributes control charts. Guidelines for implementing control charts.

**Process capability** – definition, standardized formula, methods of estimating process capability, Process capability indices- cp and cpk, Process Harmonization.

### Unit – IV

07 Hrs

**Acceptance Sampling:** Concept of acceptance sampling, economics of inspection, Acceptance sampling plans – Single, Double and Multiple Sampling. Operating Characteristic curves – construction and use. Determination of Average Outgoing Quality (AOQ), Average Outgoing Quality Level, Average Total Inspection, Production Risk and Consumer Risk, Published Sampling Plans.

### Unit – V

07 Hrs

**Basic Experimental Design for Process Improvement:** General model of a process, Examples of designed experiments in process improvement, ANOVA for single factor experiments, Guidelines for designing experiments, Factorial experiments –  $2^2$  design.

**Introduction to Reliability And Life Testing:** Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation

in simple cases of exponential failures in series, parallel and series-parallel device configurations.

**Self Study:**

**12 Hrs**

Case study, Design and Emerging Technologies to be discussed pertaining to the course.

1 Credit: 4 Hrs / Week

**Unit – VI  
(Laboratory Work)**

**Part – I**

To test the Goodness of fit for the given quality characteristic using Uniform & Binomial distribution

To test the Goodness of fit for the given quality characteristic using Poisson distribution

To test the Goodness of fit for the given quality characteristic using Normal distribution

Experiments on correlation and Simple regression

Conduction of Repeatability and Reproducibility studies for the given measurement system

Estimation of process variability using Deming's funnel Experiment / Quincunx Apparatus (Demonstration)

Developing Quality Function Deployment Matrix for a Product / Service (Open ended)

Performing Quality Audit of a System (Open ended)

Construction of control chart for variable quality characteristics (manual & using MS Excel / SYSTAT / SQC PC IV software)

**Part – II**

Construction of control chart for attribute quality characteristics (manual & using MS Excel / SYSTAT / SQC PC IV software)

Assessing Process Capability of the given manufacturing process using Normal probability paper method and process capability indices

Exercises on Attribute Sampling Plans-Single, Double and Multiple sampling plans

Conduction of Design of Experiments-Full Fractional approach for the given quality characteristics for machining operation.

Exercises to demonstrate Taguchi's orthogonal Array technique through

a. Catapult or

b. Paper helicopter

Performing Failure Modes and Effects Analysis for a system (Open ended)

Estimation of System Reliability using Reliability Software Package

Performing Quality Audit of a System (Open ended)

**Recommended Software Packages:**

- SPC-IV, DOE-IV, Rel Tec, Systat, Minitab, Rational Rose, M S Excel

**Note:** A minimum 6 experiments to be conducted from each part covering the entire syllabus in Unit VI .

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Explain the DMAIC process and list the tools to be used in each phase
2. Estimate capability of various processes to identify opportunities for improvement.
3. Construct control charts for variables and attributes to monitor and stabilize the processes
4. Design acceptance sampling procedures to economically arrive at an accepted level of quality
5. Design simple full factorial experiments for process improvement studies

**Reference Books:**

1. D C Montgomery “Statistical Quality Control : A Modern Introduction”, John Wiley and Sons, 6th Edition, 2009, ISBN 978-81-265-2506-5.
2. Grant and Leavenworth, “Statistical Quality Control” McGraw Hill, 7th Edition, 2008, ISBN – 0-07-043555-3.
3. Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, McGraw-Hill International Editions, 1997, ISBN0070188521
4. J M Juran, Frank M Gryna, Quality Planning & Analysis, Tata McGraw Hill, 4th Edition ISBN – 0070393680.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Scheme of Continuous Internal Evaluation (CIE) for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

**Scheme of Semester End Evaluation (SEE) for Lab:**

Experiment from Part - I : 20 Marks  
Experiment from Part - II : 20 Marks  
Viva Voce : 10 Marks  
Total : 50 Marks

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2
2.	2, 3
3.	2, 3, 4
4.	2, 3, 4
5.	2, 3, 4



## MODERN MANUFACTURING METHODS

(Elective)

Course Code : 12IM5A1

Hrs/Week : L: T: P:S 3: 2: 0 :4

Credits : 05

CIE Marks : 100

SEE Marks : 100

SEE Duration : 3 Hrs

### Course Learning Objectives:

- Explain range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selected processes.
- Apply physics to the factors that control the rate of production and influence the quality, cost and flexibility of processes.
- Explain the impact of manufacturing constraints on product design and process planning.
- Demonstrate the working principle of various Modern Manufacturing methods
- Develop new modern manufacturing methods by using hybrid combination

#### Unit – I

07 Hrs

**Introduction:** History, Classification, Comparison between Conventional and Non-Conventional Machining, Process Selection.

**Mechanical Processes:** Ultrasonic Machining (USM): Introduction, Working Principles, Theory of Miller & Shaw, effect of parameters in Material Removal Rate, Applications, Advantages & Disadvantages of USM. Abrasive Jet Machining (AJM): Introduction, equipment, Variables in AJM. Application, Advantages and Disadvantages of AJM, Friction Welding, Orbital Riveting.

#### Unit - II

07 Hrs

**Electrochemical Metal Removal Process:** Introduction, study of ECM Machine, Elements of ECM Process, Chemistry of the Process, ECM Process Characteristics, Tooling Techniques and example, Arrangements, Applications of ECM process such as Electrochemical Turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

**Chemical Metal Removal Processes:** Introduction, Elements of Process, Chemical Blanking Process, Applications of Chemical Blanking, Chemical Milling Process steps – Characteristics of CHM, Hydrogen Embattlement, Advantages and Applications of CHM.

#### Unit - III

06 Hrs

**Thermal Metal Removal Processes:** Electrical Discharge Machining (EDM) – Introduction, machine, Mechanism of Metal Removal, EDM tool design; Choice of Machining Operations, Electrode Material Selection, EDM Process Characteristics, Applications.

**Plasma Arc Machining (PAM):** Introduction, Equipment Non-Thermal Generation of Plasma, selection of Gas, Mechanism of Metal Removal, PAM Parameters and Process Characteristics. Safety Precautions, Applications, Advantages, and Limitations.

#### Unit – IV

06 Hrs

**Rapid Prototyping and Rapid Tooling:** Introduction, Importance of rapid prototyping, Stereolithography, Polyjet, Fused-deposition modeling, Selective laser sintering, Electron beam melting, Three dimensional printing, Direct manufacturing and rapid tooling

**Sheet-Metal forming processes:** Introduction, Sheet-Metal Characteristics, Shearing, Bending of Sheet and plate, Miscellaneous forming processes, Deep drawing, Formability of sheet metals and modeling, Equipment of Sheet metal forming, Design Considerations, and Economics of sheet metal forming.

## Unit - V

06 Hrs

**Fabrication of Micro-electronic, Micro-mechanical, and Micro-chemical devices:** Introduction, Clean Rooms, Semiconductors and Silicon, Crystal Growing And Wafer Preparation, Films and Film Deposition, Oxidation Lithography, Diffusion and Ion Implantation, Printed Circuit Boards, Mesoscale Manufacturing, Nano Scale Manufacturing

### Self Study:

12 Hrs

Case study, Design and Emerging Technologies to be discussed pertaining to the course.  
1 Credit: 4 Hrs / Week

**Tutorials:** 12 hours of tutorials classes to be conducted pertaining to the course.

12 Hrs

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Through understanding of the various factors that affect the advanced metal cutting/joining processes.
2. Knowledge of implementing these techniques on different materials including the latest ones.
3. Apply physics to the factors that control the rate of production and influence the quality, cost and flexibility of processes.
4. Demonstrate the working principle of various Modern Manufacturing methods
5. Develop new modern manufacturing methods by using hybrid combination

### Reference Books:

1. Pandey P C and Shah H S, Modern Machining Process, TMH Publication, 2007, ISBN – 9780070965539
2. Roy A Lindberg, Processes and Materials of Manufacture, Prentice Hall of India Pvt. Ltd., New Delhi, 4<sup>th</sup> Edition, 2002, ISBN – 81 – 203 – 0663-5.
3. HMT, Production Technology, TMH Publication, HMT, 1980, Reprint 2006, ISBN – 0070964432.
4. Serope Kalpakjian, Steven R Schmid, Manufacturing Processes For Engineering Materials, PEARSON Publication, 5<sup>th</sup> Edition, 2009, ISBN-978-81-317-0566-7

### Scheme of Continuous Internal Evaluation (CIE):

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one self study component on new topics for 20 marks.

### Scheme of Semester End Examination (SEE):

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

### Mapping of POs with CO's

Course Outcome	Program Outcomes
1.	1, 2, 3
2.	2, 3
3.	1, 2, 3
4.	2, 3, 6
5.	2, 3, 4, 8

## ADVANCED ERGONOMICS

(Elective)

Course Code	: 12IM5A2	CIE Marks	: 100
Hrs/Week	: L: T: P: S: 3: 2: 0 :4	SEE Marks	: 100
Credits	: 05	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- To analyze the three key aspects of ergonomics- information input, human out put, influence of environmental conditions in the design of workstations.
- To Express certain desirable human values, including improved safety, reduced fatigue & improved quality of life.
- To Apply the basic parameters of human factors in designing the work systems that directly help on improving the efficiency & effectiveness

#### Unit – I

06 Hrs

**Introduction:** Human Factors and Systems: Human factors defined, focus & objectives of human factors, History of Human factors, Systems Concept; Human-Machine Systems. Classification & characteristics of systems, Systems Reliability, Ergonomics Assessment, Ergonomics Effectiveness Index. Ergonomic Evaluation Tools: Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REBA)

#### Unit – II

07 Hrs

**Information Input:** Process of seeing, Visual Capabilities, Text: Hard Copy & VDT screens, Graphic Representations, Symbols, Codes.

**Displays of dynamic information:** Uses of Dynamic information, Quantitative Visual Displays, Qualitative Visual Displays, Signals and Warning Lights, representational displays. Hearing, Auditory Displays, Cutaneous Senses, Tactual displays, Olfactory Sense, Olfactory Displays.

#### Unit – III

06 Hrs

**Human Output and control:** Physical work: Muscle physiology, work physiology, measures of Physiological Strain. Physical workload, keeping energy expenditure within bounds, Strength and endurance, Manual Materials Handling (MMH), Recommend limits for MMH tasks, reducing the risk of MMH over exertion. Functions of controls, factors in control design.

#### Unit – IV

06 Hrs

**Environment conditions - Illumination:** Nature of Light, Lamps and Luminaries, Visibility, effects of lighting on performance, distribution of Light, Glare, Lighting for VDTS.

**Climate:** Heat Exchange Process, Measurement of Thermal Conditions. Thermal Comfort and Sensations, Heat Stress, Cold Stress.

**Noise:** Measuring Noise Level, Noise and Learning Loss, Effects of Noise, Noise exposure limits, Handling Noise Problems.

**Motion:** Whole-Body Vibration, Acceleration, Weightlessness, Illusions during motion, Motion Sickness.

#### Unit – V

07 Hrs

**Human Factors applications:** Human error, Accidents and Safety, Human factors and the automobile. Human factors in system design. Arrangement of components: Principles of arranging components and methodologies. Location of controls & displays within workspace, spacing of control devices. Interpersonal aspects: The office as a built environment dwelling units, special purpose dwellings.

**Self Study:**

**12 Hrs**

Case study, Design and Emerging Technologies to be discussed pertaining to the course.  
1 Credit: 4 Hrs / Week

**Tutorials:** 12 hours of tutorials classes to be conducted pertaining to the course.

**12 Hrs**

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Recognize the role of ergonomics and its areas of application in the work system.
2. Explain and apply the ergonomic concepts in the evaluation of existing systems and design of new systems.
3. Demonstrate an understanding of concepts of ergonomics and human body mechanics.
4. Analyze the relationship between work attributes and ergonomic risk factors.
5. Evaluate the effect of ergonomic risk factors on the physiological and bio-mechanical mechanisms of human worker.
6. Design, develop, conduct and analysis ergonomic related experiments.

**Reference Books:**

1. Mark S. Sanders and Ernest J Mc McCormick; Human Factors in Engineering and Design; McGraw-Hill and Co. Singapore, 7<sup>th</sup> Edition, 1992, ISBN: 0-07-112826-3.
2. R S Bridger, Introduction to Ergonomics, Taylor & Francis, 2<sup>nd</sup> Edition, 2003, ISBN: 0415273781.
3. Gavriel. Salvendy-Editor, Handbook of Human Factors and Ergonomics, Wiley, Hoboken, New Jersey, USA, 3<sup>rd</sup> Edition, 2006, ISBN: 0471116904.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	2, 3
2.	1, 2
3.	2, 3
4.	2, 3
5.	2, 3, 4

## DESIGN OF EXPERIMENTS

(Elective)

Course Code : 12IM5A3  
Hrs/Week : L: T: P:S 3: 2: 0:4  
Credits : 05

CIE Marks : 100  
SEE Marks : 100  
SEE Duration : 3 Hrs

### Course Learning Objectives:

- Explain basic principles of design of experiments.
- Develop factorial and fractional factorial designs for product and process optimization.
- Design and conduct orthogonal array experiments for process improvement.
- Illustrate robust design concepts.

### Unit – I

06 Hrs

**Introduction:** Strategy of experimentation, applications, Basic principles, Terminology, Guidelines, History of statistical design.

**Principles of quality engineering** - Tools used in robust design, Applications and benefits, Quality loss function, Quadratic loss function, Noise factors, P diagram, Optimization of product & process design, Role of various quality control activities.

### Unit - II

07 Hrs

**Factorial Experimentation-** The  $2^2$  design, The  $2^3$  design, The general  $2^k$  design, A single replicate of the  $2^k$  design, The  $3^2$  design. Problems.

### Unit - III

07 Hrs

**Blocking and Confounding in the  $2^k$  Factorial Design:** Blocking a replicated  $2^k$  factorial design, Confounding in the  $2^k$  factorial design, Confounding the  $2^k$  factorial design in 2 & 4 blocks. Problems.

**Fractional Factorial Designs:** The one – half fraction & one – quarter fraction of the  $2^k$  design, Resolution III, IV & V designs. Problems.

### Unit - IV

06 Hrs

**Constructing Orthogonal Arrays:** Counting degrees of freedom, selecting a standard orthogonal array, dummy level technique, and compound factor method. Linear graphs and interaction assignment, modification of linear graphs, column merging method, branching design. Strategy for constructing an orthogonal array. Problems. Grey Taguchi Method.

### Unit - V

06 Hrs

**Steps In Robust Design** Case study discussion illustrating steps in Robust Design.

**Signal-To-Noise Ratio:** Evaluation of sensitivity to noise. S/N ratios for static problems, S/N ratios for dynamic problems. Analysis of ordered categorical data. Minimizing variability and optimizing averages. Taguchi Inner and Outer Arrays. Software packages for design of Experiments.

**Tutorials:** 12 hours of tutorials classes to be conducted pertaining to the course.

12 Hrs

**Self Study:** Case Study, Design and Emerging Technologies to be discussed pertaining to the course. 1 Credit: 4 Hours / Week

12 Hrs

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Remember the basic terms as used and applied in the context of design of experiments
2. Understand the process of developing strategic plans for experimentation in scientific and engineering research projects.
3. Apply the principles of DoE to generate experimental designs.
4. Analyze alternative designs for experimentation and carry out output analysis for quality improvement projects.
5. Evaluate the performance of the research investigations based on factorial and fractional factorial designs.
6. Create experimental designs for product and process quality improvement projects for various scientific and engineering applications.

**Reference Books:**

1. D.C. Montgomery, Design and Analysis of Experiments, Wiley India, 5<sup>th</sup> Edition, 2006, ISBN – 812651048-X.
2. Madhav S. Phadke, Quality Engineering Using Robust Design, Prentice Hall PTR, Englewood Cliffs, New Jersey 07632, 1989, ISBN: 0137451679.
3. Robert H. Lochner, Joseph E. Matar, Designing for Quality - an Introduction Best of Taghuchi and Western Methods or Statistical Experimental Design, Chapman and Hall, 1990, ISBN – 0412400200
4. Philip J. Ross, Taguchi Techniques for Quality Engineering: Loss Function, Orthogonal Experiments, Parameter and Tolerance Design, McGraw-Hill, 2nd Edition, 1996, ISBN: 0070539588

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2
2.	1, 2, 3
3.	2, 3
4.	2, 3, 6
5.	2, 3, 4, 8

## FINANCIAL ACCOUNTING AND COSTING

(Elective)

Course Code	: 12IM5A4	CIE Marks	: 100
Hrs/Week	: L: T: P:S 3:2:0:4	SEE Marks	: 100
Credits	: 05	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- To introduce the basic tools and techniques required in financial accounting.
- To provide an over view of nature of costing and cost accounting.
- To give an understanding on activity based costing.

### Unit – I 06 Hrs

**Financial Accounting:** Generally Accepted Accounting Practices (GAAP), Book keeping: double-entry accounting, journal & ledger posting.

### Unit – II 07 Hrs

**Financial Statements:** Trial balance, preparation of Trading and Profit & Loss account, Balance sheet.

### Unit – III 07 Hrs

**Costing:** Objectives of costing, Elements of costing, preparation of cost sheet.

**Job Costing:** Introduction, Batch Costing, Process Costing, Cost accumulation in process costing.

### Unit – IV 06 Hrs

**Standard Costing:** Components of standard cost, Material cost variance, labour cost variance, overhead cost variance.

### Unit – V 06 Hrs

**Budgeting:** sales budget, production budget, cash budget, flexible budget, master budget.

**Tutorials:** 12 hours of tutorials classes to be conducted pertaining to the course. 12 Hrs

**Self Study:** Case Study, Design and Emerging Technologies to be discussed pertaining to the course. 1 Credit: 4 Hours / Week. 12 Hrs

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Define the needs of the various users of accounting data and demonstrate the ability to communicate such data effectively, as well as the ability to provide knowledgeable recommendations.
2. Apply appropriate judgment derived from knowledge of accounting theory, to financial analysis and decision making.
3. Demonstrate an understanding of different accounting methods to evaluate business performance.
4. Define and illustrate various cost terms and concepts and evaluate their relevancy for different decision-making purposes.

### Reference Books

1. Khan M Y; “Cost Accounting”, Tata McGraw-Hill, 2000, 2<sup>nd</sup> Edition, ISBN 0070402248
2. Khan M Y and Jain P K; “Financial Management”; Tata McGraw-Hill, 1982, 2<sup>nd</sup> Edition, ISBN 0070964653.
3. Prasanna Chandra; “Financial Management: Theory and Practice”; Tata McGraw-Hill, 1995, 6<sup>th</sup> Edition, ISBN 0074620630.
4. T.R.Banga, S.C.Sharma, Mechanical Estimating & Costing, Khanna Publishers, 16th Edition, 2011, ISBN 8174091009

### Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

### Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

### Mapping of POs with CO's

Course Outcome	Program Outcomes
1.	1, 2, 4, 9
2.	1, 2, 9
3.	1, 2, 4, 6, 9



## SOFTWARE ENGINEERING

(Elective)

Course Code	: 12IM5A5	CIE Marks	: 100
Hrs/Week	: L: T: P: S:3:2:0:4	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Explain the importance of all phases of the software development life cycle.
- Analyze organization's software process and be able to contribute to improvements in that process.
- Ability to analyze, design, verify, validate, implement, apply, and maintain software systems
- Articulate their understanding of social and ethical issues related to computing and software engineering.

### Unit – I

06 Hrs

**Introduction to Software Engineering:** The evolving Role of Software Engineering, The Changing Nature of Software, Legacy software: The Quality of Legacy Software, Software Evolution, and Software Myths, Industrial Engineering Tools for Software Engineering.

**The Software Process:** A generic view of process Software Engineering A layered Technology, A process Framework, The capability Maturity model Integration (CMMI), Process patterns, Process assessment, Personal and Team Process Models: Personal Software Process (PSP), Team Software Process (TSP), Process Technology, Product and Process.

### Unit – II

07 Hrs

**Process Models:** Prescriptive Models, The Waterfall Model, Incremental Process models, The Incremental Model, the RAD model, Evolution Process Model: Prototyping, The Spiral model, Concurrent Development Model.

**Agile View of Process:** Agility, Agile Process, The politics of Agile development, Human Factors, Agile Process Models: Extreme Programming (XP)

### Unit – III

07 Hrs

**Project Management:** Management Activities, Project Planning, Project scheduling, Risk management. **Requirements Management:** A bridge to design and construction, Requirements Engineering. Tasks, Initiating the Requirements Engineering. Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

**Design Engineering:** Design Process and Design Quality, Design Concepts, the Design Model, Software Architecture, Data Design, Architectural Styles and Patterns. Modeling component level Design, Conducting Component level design, Object Constraint language

### Unit – IV

06 Hrs

**Testing Strategies:** A Strategy to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Test Strategies for Object – Oriented Software, Validation Testing, System Testing, The art of Debugging. Black-Box and White-Box Testing, Basis Path Testing, Control Structure Testing, Object Oriented Testing Methods.

### Unit – V

06 Hrs

**Software Quality Management:** Quality concepts, Software quality assurance, software reviews, Formal technical reviews, Formal approaches to Software Quality Assurance(SQA), Statistical software quality assurance, software reliability, ISO 9000 quality standards, The SQA plan.

**Tutorials:** 12 hours of tutorials classes to be conducted pertaining to the course.

**12 Hrs**

**Self Study:** Case Study, Design and Emerging Technologies to be discussed pertaining to the course. 1 Credit: 4 Hours / Week. **12 Hrs**

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Appreciate the wider engineering issues that form the background to developing complex and evolving software-intensive systems.
2. Plan and deliver an effective software engineering process, based on knowledge of widely used development lifecycle models.
3. Translate a requirements specification into an implementable design, following a structured and organised process.
4. Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.
5. Evaluate the quality of the requirements, analysis and design work done during the module.

**Reference Books:**

1. Ian Sommerville, Software Engineering, Pearson Education, 7<sup>th</sup> Edition, 2008, ISBN: 978-81-7758-530-8.
2. Pressman Roger S, Software Engineering A Practitioner’s Approach, TATA McGraw-Hill Publications, 6<sup>th</sup> Edition, 2005, ISBN No. 007-301933X.
3. Martin L Shooman, Software Engineering – Design Reliability and Management, TATA McGraw-Hill Publications, 2<sup>nd</sup> Edition, 1983, ISBN: 0070570213.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO’s**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4, 9
2.	2, 4, 6, 9

## TOOL ENGINEERING & DESIGN

(Elective)

Course Code	: 12IM5B1	CIE Marks	: 100
Hrs/Week	: L: T: P: S: 3:0:0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Design cutting tools for various machining applications.
- Design Jigs and fixtures for holding different types of work pieces.
- Develop a familiarity and understanding of Single point and multipoint cutting tools.
- Develop a recognition and understanding of the integrated design of Jigs and fixtures
- Emphasize on design of die casting and injection Molding.

### Unit – I

07 Hrs

**Introduction to tool design:** Tooling, tool design, duties of a tool designer, general tool design procedure.

**Design of Single point Cutting Tools:** Design of single point lathe tool: Solid type tool, brazed tip tool, long index able insert, throwaway index able insert types and chip breakers.

### Unit – II

07 Hrs

**Design of Multi Point Cutting Tool:** The twist drill, elements of a twist drill, Drill specification, Cutting speed, feed, depth of cut of drill tool, forces on a drill, Machining time, forces acting on drill, power of drilling, selection of tool geometry.

**Design of milling cutter:** Milling operations, Elements of milling cutter, Design of elements like number of teeth, Cutting speed, feed, depth of cut of milling cutter, machining time, power required at the cutter, problems.

### Unit – III

06 Hrs

**Design of Jigs:** Functions and differences between jigs and fixtures, Design principles, Principles of location -3-2-1, choosing a locating surfaces, locating methods and devices. Clamping – Clamping devices, types of clamping devices.

**Drill jigs** - Types, selection of a jig, Design of jigs for simple components.

### Unit – IV

06 Hrs

**Design of Fixtures:** Types of Turning fixtures, types of milling fixture, types of grinding and broaching fixtures, indexing fixtures, Design of fixtures for simple components.

### Unit – V

06 Hrs

**Die Casting Dies:** Types of Dies: Single cavity, multicavity dies, combination dies, unit dies. Die casting alloys, defects in die casting, finishing trimming and inspection of die casting components, safety, problems.

**Injection Molding:** Injection moulding machine and its elements, general configuration of a mould, problems.

Introduction to compression, transfer moulding, blow moulding, extrusion moulding, Emerging Trends.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Understand the terminologies that are used and applied in context of tool engineering & design.
2. Explain the process of designing cutting tools for various areas of application

3. Applying the principles of location and clamping as applied to design of jigs and fixtures.
4. Analyzing the performance of various cutting tools based on the tool life equations.
5. Evaluating the alternative design options for development of dies in industrial applications
6. Creating tool geometries for various new requirements in industrial applications.

**Reference Books:**

1. C. Donaldson, G.H.Le Cain, V.C. Gold, Tool Design, Tata McGraw Hill Publication, 1976, ISBN -0-07-099274-6.
2. G.R Nagpal, Tool Engineering and Design, Khanna Publishers, 4<sup>th</sup> Edition, 2000, ISBN-81-7409-092-4
3. Arshinov V, Alekseev G, Metal Cutting Theory and Cutting Tool Design, MIR Publishers, Moscow, 3<sup>rd</sup> Edition, 1976.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3
2.	2, 3, 7, 8
3.	2, 3, 7, 8
4.	2, 3, 7, 8
5.	1, 2, 3, 7, 8

## TECHNOLOGY MANAGEMENT

(Elective)

Course Code	: 12IM5B2	CIE Marks	: 100
Hrs/Week	: L: T: P: S 3:0:0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Explain the concepts and Meaning of technology with an emphasis on technology as a commodity.
- Identify the challenges in adoption of new technology.

### Unit – I 06 Hrs

**The Concept of Technology:** Introduction, The nature of knowledge, Aspects of classification, Concept and Meaning of technology, the character of a specific technology, Scope of technology, Levels of technology, technology portfolios, technology as an environment.

### Unit – II 06 Hrs

**The Nature of Technological Change:** Introduction, Meaning of technological change, Concept of invention, Nature of innovation, Emergence of new technologies, Life cycle of a technology, Motivation for technological change, Nature of technological progress, Nature of mature technology, Nature of diffusion, Technological convergence.

### Unit – III 06 Hrs

**The Economics of Technology:** Introduction, Meaning of technological economics, Examples of technological economics, Scope of technological economics, Engineering economics, Production economics, Concept of economy of scale, Concept of optimum size, technology as a commodity, technology at the macro-economic level.

### Unit – IV 06 Hrs

**Corporate Technology Strategy:** Introduction, The business mission, Where is the business? Concept of business strategy, Capability for strategic planning, Corporate technology strategy, Competitive technology, Focus of strategy, technological alliances, Realization of strategy, technology crisis.

### Unit – V 08 Hrs

**Technology an Instrument of Competition:** Introduction, Securing competitive advantage, Technological competition analysis, Technological leadership, Adoption of new technology, marketing a new technology product, Retention of competitive advantages.

**Concurrent Engineering** – Introduction, Basic principles, components of CE models, Benefits, co-operative concurrent teams, Types of CE organisations.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Explain the concepts and principles of technology management.
2. Analyse the impact of technology changes in an organization
3. Design corporate technological strategy to gain competitive advantage
4. Perform life cycle analysis and costing of technology

**Reference Books:**

1. Paul Lowe, The Management Of Technology – Perceptions & Opportunities, Chapman & Hall, London, 1995
2. Frederick Betz, Strategic Management of Technology, McGraw- Hill Inc 1993.
3. Rastogi, P. N , Management of Technology & Innovation: Competing Through Technological Excellence, Sage Publications, 1995
4. Hartely R John, Concurrent Engineering – Shortening Lead Times, Raising Quality & Lowering Costs, Productivity Press, Portland, Oregon 1998, ISBN – 1563271893.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	2, 8, 9
2.	2, 7, 8, 9

## RELIABILITY ENGINEERING

(Elective)

**Subject Code** : 12IM5B3  
**Hrs/Week** : L: T: P: S 3:0:0:0  
**Credits** : 03

**CIE Marks** : 100  
**SEE Marks** : 100  
**SEE** : 3 Hrs

### Course Learning Objectives:

- I. Provide an insight into various tools and techniques of Reliability Engineering.
- I. Review the various mathematical, physical and logical modeling tools for estimation and evaluation of component and system level reliability.
2. Appraise failure phenomena and there by provide valuable inputs for product design to achieve higher levels of reliability standards.
2. Assessment and evaluation of reliability goals and their improvements.

### Unit - I

06 Hrs

**Introduction:** Introduction to reliability engineering, Scope of reliability engineering, Reasons for engineering items to fail, Probabilistic reliability, Repairable and non repairable items, Reliability Program activities, Reliability Economics and Management, The development of reliability engineering, Organizations involved in reliability work, The study of reliability and maintainability, Concepts, terms and definitions, Applications.

### Unit - II

07 Hrs

#### Basic Reliability Models

**Failure distribution:** The reliability function, Mean time to failure, Hazard rate function, Hazard rate function, Bathtub curve, Conditional reliability

**Time dependent failure models:** The Weibull distribution, Normal distribution, The Log Normal distribution

### Unit - III

06 Hrs

#### Basic Reliability Models

**Constant failure rate model:** The exponential reliability function, Failure modes, Applications, The Two Parameter Exponential distribution, Poisson process, Redundancy and CFR model exercises

### Unit - IV

07 Hrs

**Reliability of Systems:** Serial Configuration, Parallel Configuration, Combined Series-Parallel system, System structure function, Minimal cuts and Minimal paths. Common mode failure, Three state devices, State space analysis (Markov analysis), Load sharing systems, Standby systems, Graded systems. Fault Tree Analysis, Failure Modes and Effects Analysis.

### Unit - V

06 Hrs

**Failure Data Analysis:** Data Collection, Empirical Methods, Static Life Estimation, Product Testing, Reliability Life Testing, Test Time Calculations, Burn-In Testing, Acceptance Testing, Accelerated Life Testing, Experimental Design, Competing Failure Modes

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Develop an appreciation of basic terminologies as applied to reliability engineering.
2. Enhance ability to design systems and process for reliability improvement.
3. Analyse failure phenomenon of components and systems so as to develop strategies for eliminating/minimising product failures.
4. Generate estimates for reliability through different modeling approaches for component and system level reliability in real life contexts.

**Reference Books:**

- 1 Charles E. Ebling, An Introduction to Reliability and Maintainability Engineering, Tata McGraw Hill MLM1004, 2000, ISBN: 007 0421382.
- 2 Patrick D.T. Oconnor, etal - Practical Reliability Engineering, John Wiley and Sons, 2002, 4<sup>th</sup> Edition, ISBN: 9812-53-045-2.
- 3 Dr. E. Balaguru Swamy – Reliability Engineering, McGraw Hill, 2003, 4<sup>th</sup> Edition,.
- 4 L.S. Srinath, Reliability Engineering, Affiliated East West Press Pvt Ltd, 1991, 3<sup>rd</sup> Edition, ISBN: 81 85336393

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4
2.	2, 3, 4
3.	2, 3, 4, 8, 9
4.	2, 3, 4
5.	2, 3, 7, 8



## PROJECT PLANNING & CONTROL

(Elective)

Course Code	: 12IM5B4	CIE Marks	: 100
Hrs/Week	: L: T: P:S:3:0:0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Explain the concepts, tools and techniques of project planning.
- Illustrate PERT and CPM techniques for planning and implementing projects.
- Develop project schedules and allocate resources for various types of projects.
- Monitor projects and control cost and effort variance.

#### Unit – I

04Hrs

**Generation and Screening of Project Ideas:** Generation of ideas, Monitoring the environment, Corporate Appraisal, Tools for identifying investment opportunities, Scouting for project ideas, preliminary screening, project rating index

#### Unit – II

07 Hrs

Market and demand analysis, specification of objectives collection of secondary information, conduct of market survey. Demand forecasting, Technical analysis, Manufacturing process / technology, Technical arrangement, Materials input and utilities, Location and site, machinery and equipments, environmental aspects, project charts and layouts, Schedule of projects implementation.

#### Unit – III

07 Hrs

**Project Risk Analysis:** Sources measures and perspectives on Risk, Sensitivity analysis, Scenario analysis, Simulation analysis, managing risk, Project selection under risk.

**Social Cost benefit analysis:** Rationale for SCBA UNIDO approach, Net benefit in terms of economic efficiency / prices, savings impact and its value.

#### Unit – IV

07 Hrs

**Financing Infrastructure Projects:** Typical project configuration, key project parties, Project contracts, Financial structure and corporate Governance, Financing a power Project, Financing Telecommunication Project, Managing risk in private infrastructure project, public private partnership, Recommendations of the committee on Infrastructure financing.

#### Unit – V

07 Hrs

**Implementation:** Project Management, Forms of project Organization, Project Planning, Project Control, Human aspects of project management, Prerequisites for successful project implementation, Essence of project management. Development of project network, Time Estimation determination of critical path, scheduling when resources are limited, PERT, CPM model, Network cost system.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Explain the concepts, tools and techniques of project planning.
2. Understand basic techniques for quality improvement, and fundamental knowledge of statistics and probability.
3. Apply the PERT & CPM techniques for planning and implementing projects.
4. Analyze project schedules and allocate resources for various types of projects.

**Reference Books:**

1. Prasanna Chandra, Project Planning Analysis Selection Financing Implementation and Review, Tata McGrawHill Publication, 7<sup>th</sup> Edition, 2010, ISBN: 0-07-007793-2.
2. Harold Kerzner, Project Management, A Systems Approach to Planning Scheduling and Controlling, CBS Publishers & Distributors, 2<sup>nd</sup> Edition, 2006, ISBN-10: 8123908679
3. Pennington Lawrence, Project Management, Mc Graw Hill
4. A Moder Joseph and Philips, Project Management with CPM and PERT, Van Nostrand Reinhold Co., 2nd Edition, 1970, ISBN: 0442156669

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 9
2.	1,2, 3, 4,9
3.	2, 8, 9

## DATABASE MANAGEMENT SYSTEM

(Elective)

Course Code	: 12IM5B5	CIE Marks	: 100
Hrs/Week	: L: T: P:S: 3:0:0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Explain the role of database administration.
- Apply the theory of various database models.
- Explain query languages to design databases for different applications.
- Work in group settings to design and implement larger programming projects.

### Unit – I

**06 Hrs**

**Databases and Database Users:** Introduction, characteristics of data base approach, intended uses of a DBMS, advantages and implication of database approach.

**Database Systems Concepts and Architecture:** Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management systems.

### Unit – II

**06 Hrs**

**Data Modeling:** High level conceptual data models for database design. Entity types, entity sets, attributes, and keys. Relationships, relationship types, roles, and structural constraints. Weak entity types. ER diagrams and design issues.

### Unit – III

**06 Hrs**

**Relational Data Model and Relational Algebra:** Brief discussion on CODD rules, relational model concepts, constraints, and schemas. Update operation on relations, basic and additional relational algebra operations, and queries in relational algebra.

### Unit – IV

**07 Hrs**

**Structured Query Language (SQL):** Data definition etc. in SQL2. Basic and complex queries in SQL. Insert, delete, update statements, and views in SQL, embedded SQL.

**Database Design:** Design guidelines for relational schemas, functional Dependencies, normalization -1st, 2nd, 3rd, 4th and 5th normal forms. Database design process, factors influencing physical database design guidelines, and guidelines for relational systems.

### Unit – V

**07 Hrs**

**Record Storage and Primary File Organizations:** Secondary storage devices, buffering of blocks, placing file records on disk, operations on files, heap files and sorted files, hashing techniques.

**Index Structure of Files:** Single-level and multilevel ordered indexes, dynamic multi level indexes using B-trees and B+ trees.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Describe the terminologies, features and associated concepts embodied in database systems and their design.
2. Analyse different information storage scenarios and derive appropriate data models.
3. Demonstrate and understanding the design of relational databases

4. Formulate solutions to a broad range of query and data update problems.

**Reference Books:**

1. Ramez Elmasri and Shamkanth B. Navathe, “Fundamentals of Database Systems”, Pearson Education, 5<sup>th</sup> Edition, 2008, ISBN: 978– 81– 317 – 1625-0.
2. Raghu Ramakrishnan, “Database Management System”, McGraw Hill, 3<sup>rd</sup> Edition, 1997, ISBN: 0071230572
3. Gary W. Hansen and James V. Hansen, “Database Management and Design” PHI Pvt. Ltd., 2<sup>nd</sup> Edition, 1995 ISBN: 81-203-1465-4
4. Date C J, Kanna A, “Database Systems”, Pearson Education, 8<sup>th</sup> Edition, 2006, ISBN: 978-81-775-8556-8

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO’s**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4
2.	2, 3, 4
3.	2, 3, 5,7
4.	2, 3, 5,9

**VI Semester**

<b>INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP</b>					
<b>Subject Code</b>	: 10HSI61		<b>CIE Marks</b>	:	<b>100</b>
<b>Hrs/Week</b>	: L:T:P:S 3:0:0:0		<b>SEE Marks</b>	:	<b>100</b>
<b>Credits</b>	: 03		<b>SEE Duration</b>	:	<b>3 Hrs</b>
<b>Course Learning Objectives:</b>					
<ul style="list-style-type: none"> <li>• To build awareness on the various forms of IPR and to educate on the link between technology innovation and IPR.</li> <li>• To encourage invention, investment and innovation and disclosure of new Technology and to recognize and reward innovativeness.</li> <li>• To promote linkages with industries and stimulate research through developing and utilizing novel technologies.</li> <li>• To trigger the entrepreneurial thinking amongst the student community and to provide necessary inputs and motivation for promoting entrepreneurial careers.</li> </ul>					
<b>Unit – I</b>					<b>08 Hrs</b>
<p><b>Introduction:</b> Types of Intellectual Property, International Scenario in IPR: WIPO, WTO, TRIPS.</p> <p><b>Patents:</b> Introduction, Basic concepts, Object and value of patent law, Advantages of patent to inventor, patentable inventions, inventions are not patentable, Over view of Patent Procedure, Biotechnology patents and patents on computer program, Patent rights on micro-organism, plant breeding and breeders right, protection of biodiversity, protection of traditional knowledge, Infringement of patents and remedy for infringement, Case study for patent engineering.</p> <p><b>Trade Secrets:</b> Definition, Significance, Tools to protect Trade secrets in India.</p>					
<b>Unit – II</b>					<b>05 Hrs</b>
<p><b>Trade Marks:</b> Basic concepts, Definition, Functions, different kinds of trademarks like service marks, collective trademarks, certification trademarks and textile trade marks, registrable and non registrable marks, Establishing trade mark right, Good will, infringement and action for trademarks, Passing off, Trade mark and Eco Label, Comparison with patents, industrial design and copy right, Case Studies.</p>					
<b>Unit – III</b>					<b>08 Hrs</b>
<p><b>Industrial Design:</b> basic concepts and scope and nature of rights process of registration rights, available after registration, transfer of interest or rights. Reliefs and Remedies and Action for infringement of the rights; Appeals, Case studies.</p> <p><b>Copy Right:</b> Introduction, Nature and scope, Subject matter, Related or allied rights, the works in which copy right subsists, Rights conferred by copy right, Copy right protection in India, transfer of copy rights, right of broad casting organizations and of performer, computer soft ware and IPR and Case Studies.</p> <p><b>Cyber laws</b> – Co-relation to Intellectual Property.</p>					
<b>Unit – IV</b>					<b>07 Hrs</b>
<p><b>Entrepreneur and Entrepreneurship:</b> Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an entrepreneur and a manager, Functions of an entrepreneur, types of entrepreneur, Intrapreneur, Concept of Entrepreneurship ,Growth of entrepreneurship in India, Role of Entrepreneurship in economic development, overview on entrepreneurial development models, Case discussions on a couple of successful entrepreneurs.</p>					

<b>Unit – V</b>		<b>07 Hrs</b>
<b>Micro Small &amp; Medium Enterprises (MSME):</b> Definition, Characteristics, Need and rationale, Objectives, Scope, role of MSME in Economic Development, Advantages of MSME, Steps to start an MSME – Government policy towards MSME, Impact of Liberalization, Privatisation & Globalization on MSME, Effect of WTO / GATT. Sustainability and MSME.		
<b>Institutional Support to entrepreneurs:</b> Over view on National and State Agencies. Identification of Business Opportunities: Market Feasibility studies; Technical Feasibility Studies; Financial Feasibility Studies and Social Feasibility studies.		
<b>Course Outcomes:</b>		
<ol style="list-style-type: none"> <li>1. Identify and understand the applicable source, scope and limitations of the core Intellectual Property disciplines such as Patent, Copyright, Trademark and Trade secret Law.</li> <li>2. Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights</li> <li>3. Demonstrate and develop basic skills of legal reasoning, individual critical thinking and group interaction, as well as interpretative, analytical and argumentative skills in oral and written forms of communication.</li> <li>4. Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career</li> </ol>		
<b>Text Books:</b>		
1.	P Narayan, “Intellectual Property Law”, Eastern Law House, New Delhi and Kolkata, 2005, EAN: 9788171771813. (Covers Unit I, II, III with case studies)	
2.	Entrepreneurship Development & Small Business Enterprises – Poornima M Charantimath, Pearson Education, 2007, ISBN: 81-7758-260-7. (Covers Unit IV & V with case studies)	
<b>Reference Books:</b>		
1.	Prabuddha Ganguly, “Intellectual Property Rights: Unleashing Knowledge Economy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1 <sup>st</sup> Edition, 2001. ISBN: 0074638602.	
2.	Cornesh W.R, “Intellectual Property Rights – Patents, Copy Right, Trade Mark, Allied Rights”, Universal Law Publishing Company Pvt. Ltd, Delhi, 2001, ISBN – 0199263078.	
3.	S.R Myneni, “Law of Intellectual Property”, Asia Law House, Hyderabad, 2001, SKU – 664773841.	
4.	SS Khanka, Entrepreneurial Development, S Chand & Co, 2008, ISBN:81-219-1801-4	
<b>Scheme of Continuous Internal Evaluation:</b>		
CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.		
<b>Scheme of Semester End Examination:</b>		
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.		

#### Mapping of POs with CO's

Course Outcome	Program Outcomes
1.	5.6
2.	1.2.5
3.	5.6

## OPERATIONS MANAGEMENT

<b>Course Code</b>	<b>: 12IM62</b>	<b>CIE Marks</b>	<b>: 100 + 50</b>
<b>Hrs/Week</b>	<b>: L: T: P: S 3: 0:2:4</b>	<b>SEE Marks</b>	<b>: 100 + 50</b>
<b>Credits</b>	<b>: 05</b>	<b>SEE Duration</b>	<b>: 3 + 3 Hrs</b>

### Course Learning Objectives:

- Apply the various methods of forecasting.
- Define capacity and utilization and their relationship to financial performance measures.
- Define the key performance measures to consider the need for the schedule.
- Design of Conversion process systems in manufacturing and service organizations.
- Illustrate the role of operations, and their interaction with the other activities of a firm: finance, marketing, organization, corporate governance, etc.

### Unit – I

**07 Hrs**

**Competing With Operations:** Operations and Supply Chain Management across the organization, Process View, The Supply Chain View, Competitive Priorities and Capabilities, Operations Strategy as a Pattern of Decisions, Trends in Operations Management, Operations Management as a set of Decisions, Addressing the Challenges in Operations Management.

**Process Strategy:** Process Strategy across the Organization, Process strategy Decisions, Process Structure in Services, Process Structure in Manufacturing, Customer Involvement, Resource Flexibility, Capital Intensity, Strategic Fit, Strategies for Change

### Unit – II

**06 Hrs**

**Capacity Planning:** Planning Capacity across the Organization, Planning Long-Term Capacity, Capacity Timing and Sizing Strategies, A Systematic Approach to Long-Term Capacity Decisions, Tools for Capacity Planning

**Constraint Management:** Managing Constraints across the Organization, The Theory of Constraints, Identification and management of Bottlenecks, Managing Constraints in a Line Process

### Unit – III

**07 Hrs**

**Forecasting:** Forecasting across the Organization, Demand Patterns, Key decisions on making Forecast, Judgment Methods, Casual Methods: Time Series Method, Choosing a Time Series Method, Using Multiple Techniques

### Unit – IV

**06 Hrs**

**Resource Planning:** Resource Planning across the Organization, Enterprise Resource Planning, Material Requirement Planning, Resource Planning for Service Provider

### Unit – V

**06 Hrs**

**Operations Planning and Scheduling:** Operations Planning and Scheduling across the Organizations, Stages in Operations Planning and Scheduling, Managing Demand, Sales and Operations Plan, Scheduling

### Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course. **12 Hrs**  
1 Credit: 4 Hrs / Week

**Unit – VI**  
**(Laboratory Work)**

**Part - I**

1. Features of Ofbiz, Creation of sales order from E-commerce website
2. Preparation of Bill of Materials
3. MRP Run- Generating of Various reports for confirmed orders
4. Carrying out business process cycles – Purchase
5. Creating Production Run for the items

**Part – II**

6. Features of Sixth Sense ERP Package.
7. Sales Order Processing using Sales and Marketing Management Modules
8. Creating Item Master for various Engineering Designs
9. Preparation of Bill of Materials
10. Generating Purchase Order and carrying out Purchase Flows.
11. Development of an integrated ERP module for a product

**Suggested Software Packages**

ERP Packages : SIXTH SENSE and OfBiz

**Note:** A minimum of 12 experiments to be conducted covering the entire syllabus in Unit VI.

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Explain the concept and scope of operations management in a business context
2. Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage.
3. Appraise the appropriateness and applicability of a range of operations management systems/models in decision making.
4. Assess a range of philosophies for improving the efficiency and effectiveness of organizational operations.
5. Evaluate a selection of frameworks used in the design and delivery of operations

**Reference Books:**

1. Lee J Karjewski and Larry P Ritzman, Manoj Malhotra, Operations Management – Processes and Supply Chain, Pearson Education Asia, 9<sup>th</sup> Edn, 2010, ISBN: 9788131728840.
2. R.Paneerselvam, Production and Operations Management, PHI, 2<sup>nd</sup> Edn, 2006, ISBN:81-203-2767-5
3. B. Mahadevan, Operations Management – Theory and Practice, PHI, 2010, 2<sup>nd</sup> Edn, ISBN: 978 8131730706

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 20 marks.



**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Scheme of Continuous Internal Evaluation (CIE) for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

**Scheme of Semester End Evaluation (SEE)for Lab:**

Experiment from Part - I : 15 Marks  
Experiment from Part - II : 25 Marks  
Viva Voce : 10 Marks  
Total : 50 Marks

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3,4,9
2.	2, 3, 4,9
3.	2, 4, 8, 9
4.	1, 3, 4,8
5.	1,2, 3, 4
6.	1,2,3,4
7.	1,2,9
8.	1,2,3

## COMPUTER INTEGRATED MANUFACTURING

**Subject Code:** 12IM63

**CIE Marks:** 100 + 50

**Hrs/Week:** L: T: P: S:3:0:2:4

**SEE Marks:** 100 + 50

**Credits:** 05

**SEE : 3 Hrs**

### Course Learning Objectives:

- Explain basic concepts of computer integrated manufacturing systems and interactions amongst its elements.
- Develop and implement computer integrated manufacturing systems for various applications.
- Analyze automation system to achieve optimum productivity.
- Demonstrate computerized process planning.

### Unit – I

**05Hrs**

**Introduction to CAD/CAM:** Evolution of CAD/CAM, Need for CAD System, CAD/CAM in Automation, benefits & advantage of CAD/CAM.

**Computer Aided Design:** Introduction, Design process, The application of Computers for design, Creating the manufacturing data base, Benefits of Computer Aided Design

### Unit – II

**07 Hrs**

**NC, CNC & DNC Technologies:** Co-ordinate systems, basic motion control system. Application of NC System, Advantages and limitations of NC Machines. Need for CNC, CNC system, Functions and advantages of CNC System. Components of DNC system, Functions and advantages of DNC System

**CNC Programming:** Steps in Part Programming, NC manual part programming, G & M codes for turning and milling, Canned Cycles, Problems on Milling and turning using G & M codes.

### Unit – III

**06 Hrs**

**Automation:** Introduction, Types of Automation, Organization & information processing in manufacturing, Production concepts, Automation Strategies.

**High Volume Production System:** Automated flow lines, work part Transport, Transfer Mechanism, and Buffer Storage.

### Unit – IV

**06 Hrs**

**Automated Assembly System:** Types, Parts feeding Devices, Analysis of Single Station Assembly Machine, Analysis of Multi station Assembly machine, Automated Material handling System, Automated guided vehicle system.

### Unit – V

**08 hrs**

**Computerized Manufacturing Planning System:** Computer Aided Process Planning, retrieval types, Generative type.

**CAD/CAM Implementation:** Introduction, Turkey CAD/CAM systems, Selection Criteria, Evaluation of alternative Systems

**Flexible Manufacturing Systems:** Definition, FMS workstations, Materials handling & storage system, Computer control, Applications & benefits

**Shop Floor Control:** Factory Data Collection System, Bar code technology, bar code symbol, bar code reader.

**Self Study:** Case Study, Design and Emerging Technologies to be discussed pertaining to the course. 1 Credit: 4 Hours / Week. **12 Hrs**

### Unit – VI

#### (Laboratory Work)

#### Part – I

Analysis of Simple & Compound bars Subjected to Axial Loads.

Analysis of Trusses subjected to point loads.  
 Analysis of Beams Subjected to concentrate & UDL loads.  
 Analysis of Shafts subjected to twisting moment.

**Part - II**

- I. Simulation of Turning & Milling operation on CNC Train Software.
- I. Two Experiments on CNC turning machines

**Suggested Software Packages:** ANSYS, CNC Train.

**Note:** A minimum of 10 experiments to be conducted covering the entire syllabus in Unit VI.

**Course Outcome:**

After the successful completion of the course, the students will be able to:

1. Remembering the various technologies as used and applied to the area of Computer Integrated Manufacturing.
2. Understand the various elements of CNC technology and their role in a CIM environment.
3. Apply the principles of automation in manufacturing technology to improve overall organizational productivity.
4. Analyze the various manufacturing strategies for automation for various industry environments.
5. Evaluate alternative automation strategies for the volume-variety production environment.

**Reference Books:**

1. Mikell. P. Grover & E.W. Zimmer, CAD / CAM, by PHI, New Delhi 2003, ISBN: 0131101307
2. Ibrahim Zeid, CAD / CAM, McGraw Hill. 2000, ISBN – 0070728577.
3. Mikell.P.Groover, Automation, Production system and Computer Integrated Manufacturing, PHI New Delhi, 2007, ISBN – 0132393212

**Scheme of Continuous Internal Evaluation:**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.

**Scheme of Semester End Examination:**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Scheme of Continuous Internal Evaluation (CIE) for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

**Scheme of Semester End Evaluation (SEE) (Laboratory Work, Unit VI): 50 Marks**

- Question I : 20 marks
- Question II : 20 marks
- Viva Voce : 10 marks
- Total : 50 marks

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2
2.	1,2, 3, 4
3.	1,2
4.	1, 3, 4,8
5.	1,2, 8

## SIMULATION MODELING & ANALYSIS

<b>Course Code</b> : 12IM64	<b>CIE Marks</b> : 100 + 50
<b>Hrs/Week</b> : L:T:P:S 3:0:2:0	<b>SEE Marks</b> : 100 + 50
<b>Credits</b> : 04	<b>SEE Duration</b> : 3 Hrs

### Course Learning Objective:

- Define the basics of simulation modeling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

### Unit – I

**07 Hrs**

**Introduction to Simulation:** Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study.

**Simulation Examples:** Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.

### Unit – II

**06 Hrs**

**General Principles:** Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling.

**Random Numbers:** Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.

### Unit – III

**06 Hrs**

**Random Variate Generation:** Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique

**Optimisation Via Simulation:** Meaning, difficulty, Robust Heuristics, Random Search.

### Unit – IV

**07 Hrs**

#### Analysis of Simulation Data

**Input Modelling:** Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis.

**Verification and Validation of Model –** Model Building, Verification, Calibration and Validation of Models.

### Unit – V

**06 Hrs**

**Output Analysis – Types of Simulations with Respect to Output Analysis,** Stochastic Nature of output data, Measures of Performance and their estimation, Output analysis of terminating simulation, Output analysis of steady state simulations.

**Simulation Softwares:** Selection of Simulation Software, Simulation packages, Trend in Simulation Software.

### Unit – VI (Laboratory Work)

#### Part – I

Features of Promodel Package and Input Modeling  
Simulation of Manufacturing System I  
Simulation of Manufacturing System II  
Simulation of Service Operations I  
Simulation of Service Operations II

## Part – II

Features of Arena Package and Input Modeling  
Simulation of Manufacturing System I  
Simulation of Manufacturing System II  
Simulation of Service Operations I  
Simulation of Service Operations II  
Simulation of JIT Kanban Multi Product Assembly line System  
Modelling a Live Problem

### **Suggested Simulation Packages;**

Promodel, Arena, Quest, Witness, Extend, Simio

**Note:** A minimum of 12 exercises to be executed covering the entire syllabus in Unit VI.

### **Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Describe the role of important elements of discrete event simulation and modeling paradigm.
2. Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.
3. Develop skills to apply simulation software to construct and execute goal-driven system models.
4. Interpret the model and apply the results to resolve critical issues in a real world environment.

### **Reference Books:**

1. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete Event system Simulation, Pearson Education, Asia, 4<sup>th</sup> Edition, 2007, ISBN: 81-203-2832-9.
2. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2<sup>nd</sup> Edition, 1978, ISBN: 81-203-0140-4.
3. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4<sup>th</sup> Edition, ISBN: 0-07-100803-9.
4. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3<sup>rd</sup> Edition, 2004, ISBN : 0-87692-028-8.

### **Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

### **Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

### **Scheme of Continuous Internal Evaluation (CIE)for Lab:**

CIE consists of 50 marks out of which 40 marks for maintaining record and 10 marks for internal test.

### **Scheme of Semester End Evaluation (SEE) for Lab:**

Experiment from Part - I : 20 Marks  
Experiment from Part - II : 20 Marks  
Viva Voce : 10 Marks  
Total : 50 Marks

### **Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4
2.	1,2, 3, 4
3.	1,2, 3, 4, 6,8, 9

## EMERGING TECHNOLOGIES IN INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code : 12IM65 CIE Marks : 50  
Hrs/Week : L:T:P:S :: 2:0:0:0  
Credits : 02

### Preamble:

The curriculum of Industrial Engineering and Management is formulated based on generic needs of field in Industrial Engineering and Management. However the dynamics of industry is such that there are rapid advances in technology and systems that drive product, process and organisations. Therefore there is a need for providing opportunities to students for keeping abreast with the latest practices. This course on Emerging technologies is conceptualized with that need in mind.

This course would help in preparing the students to meet industry requirements and preparing them for their future professional career. The outcome of the course would be to ensure that the graduates are prepared to meet the future challenges and emerging needs of the society.

**Course Learning Objectives:** The students are expected to

1. Acquire knowledge about various emerging technologies within the present society.
2. Be aware of positive and negative outcomes that arise from changing technological cultures.
3. Utilize gained knowledge to research areas of emerging technology and develop hypotheses regarding future developments.
4. Be aware of new career opportunities that are emerging as a result of emerging technologies.
5. Utilize acquired knowledge to research and develop innovative ideas by putting knowledge into practice.

### UNIT -I

12 Hrs

#### Intelligent Transport Systems:

Advanced traveler information systems; transportation network operations; commercial vehicle operations and intermodal freight; public transportation applications; ITS and regional strategic transportation planning, including regional architectures: ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility, travel demand management, electronic toll collection, and ITS and road-pricing.

### UNIT –II

12 Hrs

Transportation performance, control and management of transportation systems; urban systems; the deployment of advanced technology systems; and transportation policy and societal issues. Perspectives of an Environmentalist, Cost/Benefit Analysis of ATIS Technology, Network Algorithms, Traffic Light/Expressway Coordination: State of the Art, Regional Development and ITS, ITS and Sprawl, ITS and Intermodal Freight

#### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Explain emerging technologies in the field of Industrial and Systems Engineering.
2. Evaluate and select the emerging technologies for problem solving.
3. Identify and improve the existing process using emerging technologies

**Suggested References :**

1. Sussman, Joseph. *Perspectives on Intelligent Transportation Systems (ITS)*. New York, NY: Springer, 2005. ISBN: 0387232575
2. Francois, Francis B. *Intelligent Transportation Primer*. Washington, DC: Institute of Transportation Engineers, 2000.
3. Nelson, Donna. *Intelligent Transportation Primer*. Washington, DC: Institute of Transportation Engineers, 2000.
4. McQueen, Bob, Rick Schuman, and Kan Chen. *Advanced Traveler Information Systems*. Boston, MA: Artech House, 2002.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of 2 phases.

Phase 1: Test + Assignment (20+5 = 25 marks).

Phase 2: Test + Assignment (20+5 = 25 marks).

Total: 25+25 = 50 marks

*Note: There is no SEE for this course.*

**Pedagogy**

Discussions in the class room shall be based on the journal articles published on the current research activities in the mentioned emerging technology. Emphasis should be placed on technology selection, and modeling using techniques of optimization, heuristics, simulation and statistical methodologies.

**Course Deliverables:** The student have to prepare any one of the following as part of the assignment; Caselet, Review paper in journal format, Report on status study, Digital or physical prototype with analysis using available softwares and equipments, Technical / Working paper.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	6,7,8
2.	2, 4
3.	3, 4, 6,8, 9

## HYDRAULICS AND PNEUMATICS

(Elective)

Course Code	: 12IM6C1	CIE Marks	100
Hours./ Week	: L: T: P:S: 3:0:0:4	SEE Marks	100
Credit	: 04	SEE Duration	3 Hrs

### Course Learning Objectives:

- Evaluate the performance of pumps and motors by determining the volumetric, mechanical, and overall efficiencies.
- Explain the operation of gear, vane, and piston pumps, various types of control valves.
- Identify and improve the safety considerations for working with the hydraulic system.
- Design hydraulics and pneumatics circuits for various applications.

### Unit - I

**Introduction to Hydraulic System:** Hydraulic oils – Desirable properties, Viscosity index, General type of fluids, Reservoir system, Filters and strainer. Pascal's Law and its applications, Application of Continuity equation, Structure of a typical Hydraulic circuit and the components of it. (Numerical Treatment). **06 Hrs**

### Unit - II

**Hydraulic Actuators, Pumps & Motors:** Linear Hydraulic Actuators (Cylinders), Mechanics of Hydraulic Cylinder Loading, Cylinder cushioning, Hydraulic Rotary Actuators, Pumping theory, Pump Classification, Gear Pumps, Vane Pumps- Simple and Balanced, Piston Pumps, Pump performance, Pump selection (Numerical Treatment), Gear Motors, Vane Motors, Piston Motors, Hydrostatic Transmission – open and close circuit. (Numerical Treatment). **07 Hrs**

### Unit - III

**Study Of Different Hydraulic Circuits :** Control of single and Double acting Hydraulic cylinder, Regenerative circuit, Counter balance Valve application, Hydraulic Cylinder sequencing Circuits, Cylinder Synchronizing Circuits, Speed Control of Hydraulic Cylinder – Meter in & Meter out, speed control of Hydraulics Motors, Accumulators and their applications in Auxiliary and Emergency power source. **06 Hrs**

### Unit - IV

**Introduction To Pneumatic Control:** Choice of working medium, Characteristics of compressed air, Structure of Pneumatic control system, Production of compressed air, Preparation of compressed air – Driers, Filters, Regulators, Lubricators. Linear Cylinder – Types, Conventional type of cylinder – working, End position cushioning, Directional control valve-3/2 4/2 & 5/2 **07 Hrs**

### Unit - V

**Pneumatic Actuators, Valves & Pneumatic Logic Circuits :** Memory valve, Shuttle valve, Quick exhaust valve, Twin pressure valve, Direct and indirect actuation of pneumatic cylinder. Use of Logic functions – OR, AND, NOR, NAND, NOT functions in pneumatic applications, Practical examples involving the use of logic functions, Pressure dependent controls and Travel dependent controls. **06 Hrs**

### Self Study:

Case study, Design and Emerging Technologies to be discussed pertaining to the course.  
1 Credit: 4 Hrs / Week **12 Hrs**



**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Evaluate the performance of pumps and motors by determining the volumetric, mechanical, and overall efficiencies.
2. Explain the operation of gear, vane, and piston pumps, various types of control valves.
3. Identify and improve the safety considerations for working with the hydraulic system.
4. Design hydraulics and pneumatics circuits for various applications.

**Reference Books:**

1. Anthony Esposito, Fluid Power with Applications, Pearson Prentice Hall, Upper Saddle River, New Jersey, 7<sup>th</sup> Edition, 2009, ISBN-13:978-0-13-513690-4
2. Andrew Parr, Hydraulics and Pneumatics: A Technician's and Engineer's Guide, Jaico Publishing House, 1<sup>st</sup> Edition, 1993, ISBN 0-202-41639-5
3. S.R. Majumdar, Oil Hydraulic Systems - Principles and Maintenance, Tata Mc Graw Hill publishing company Ltd., 1<sup>st</sup> Edition, 2001, ISBN: 0074637487
4. S.R. Majumdar, Pneumatic Systems: Principles and Maintenance, Tata Mc Graw Hill publishing Co., 1996, ISBN: 0074602314

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4
2.	2, 3, 4
3.	2, 3, 4
4.	2, 3, 4, 9

<b>TOTAL QUALITY MANAGEMENT</b>				
<i>(Elective)</i>				
<b>Course Code</b>	<b>:</b>	<b>12IM6C2</b>	<b>CIE Marks</b>	<b>:</b> <b>100</b>
<b>Hrs/Week</b>	<b>:</b>	<b>L: T: P:S 3:0:0:4</b>	<b>SEE Marks</b>	<b>:</b> <b>100</b>
<b>Credits</b>	<b>:</b>	<b>04</b>	<b>SEE Duration</b>	<b>:</b> <b>3 Hrs</b>
<b>Course Learning Objective:</b>				
<ul style="list-style-type: none"> <li>• Develop an understanding on the necessary information and skills needed to manage, control and improve quality practices in the organizations through TQM philosophy.</li> <li>• Explain the four revolutions in management thought processes.</li> <li>• Apply the reactive and proactive improvement methodologies for problem solving in organizations.</li> <li>• Demonstrate the importance of team work in problem solving processes.</li> <li>• Define the business excellence models implemented in various organizations.</li> </ul>				
<b>Unit – I</b>				<b>07 Hrs</b>
<b>Quality Pioneers:</b> Deming’s approach, Juran’s quality trilogy, Crosby and quality treatment, Imai’s Kaizen, Ishikawa’s company-wide quality control, and Feigenbaum’s theory of TQC.				
<b>Evolution of Quality Concepts and Methods:</b> Quality concepts, Development of four fitness’s, evolution of methodology, evolution of company integration, quality of conformance versus quality of design, from deviations to weaknesses to opportunities. Future fitness’s, four revolutions in management thinking, and four levels of practice				
<b>Unit – II</b>				<b>06 Hrs</b>
<b>Four Revolutions in Management thinking, Focus on customers:</b> Change in work concept, market-in, and customers. <b>Continuous Improvement:</b> Improvement as problem solving process: Management by process, WV model of continuous improvement.				
<b>Reactive Improvement:</b> Identifying the problem, standard steps, seven steps case study, General guidelines for managers diagnosing a QI story. BOSCH 8D Process. <b>Proactive Improvement:</b> Introduction to proactive improvement, standard steps for proactive improvement, semantics, example-customer visitation, Seven Management and Planning Tools.				
<b>Unit – III</b>				<b>06 Hrs</b>
<b>Total Participation;</b> Teamwork skill, Dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, Initiation strategies, CEO involvement. Strategies for TQM introduction. Infrastructure for mobilization. Phase-in.				
<b>Hoshin Management:</b> Definition, Concepts, Phases in Hoshin Management – overview. <b>Societal Networking:</b> Networking and societal diffusion, infrastructure for networking. TQM as learning system , a TQM model for skill development.				
<b>Unit – IV</b>				<b>07 Hrs</b>
<b>Introduction to Six Sigma:</b> Benefits, fundamentals, myths, essentials and costs of Six Sigma. Assessing readiness for Six Sigma, five key players, Planning for the Six Sigma initiative. Case discussions.				
<b>Statistical Foundation:</b> Variation & causes, normal distribution, process capability, rolled throughput yield, Cost of poor quality. <b>Metrics for Six Sigma:</b> The critical-to-quality concept, criteria to metrics, universal standard, baselines, benchmarking, guidelines for metrics.				

<b>Unit –V</b>		<b>06 Hrs</b>
<b>Project Selection:</b> Project selection process, evaluating projects. Project selection matrix, project review. DMAIC phases.		
<b>Design for Six Sigma:</b> Overview of DFSS, DMADV Method. <b>Beyond Six sigma:</b> Supply chain management using Lean and Six Sigma, Knowledge management and Six Sigma, Growth Management System – building blocks and architecture.		
<b>Self Study:</b> Case study, Design and Emerging Technologies to be discussed pertaining to the course. 1 Credit: 4 Hrs / Week		<b>12 Hrs</b>
<b>Course Outcomes:</b> After the successful completion of the course, the students will be able to:		
<ol style="list-style-type: none"> <li>1. Explain the TQM &amp; Six Sigma principles and concepts for organizations.</li> <li>2. Compare TQM and Six Sigma methodologies.</li> <li>3. Evaluate and select the appropriate framework for continuous improvement.</li> <li>4. Design &amp; implement TQM &amp; Six Sigma projects in organizational situations.</li> </ol>		
<b>Reference Books:</b>		
1	Shoji Shiba, Alan Graham and David Walden, A New American TQM – Four Practical Revolutions in Management, Productivity Press, Portland (USA), 2 <sup>nd</sup> Edition, 1993, ISBN: 9781563270321	
2	Greg Brue and Rod Howes, Six Sigma, TATA McGraw-Hill Edition 2006, ISBN: 0-07-063468-8	
3	N Logothetis , Managing for total quality: from Deming to Taguchi and SPC, Prentice Hall of India, 1993, ISBN: 978-0133535127	
4	Dale H. Besterfield, Carol Besterfield-Michna, Glen Besterfield, Mary Besterfield - Sacre, Total Quality Management, Pearson Education, 2002, 3 <sup>rd</sup> Edition, ISBN-81-297-0260-6.	
5	R P Mohanty, R R Lakhe, Handbook of Total Quality Management, Jaico Publishing House, 2 <sup>nd</sup> Impression, 2000, ISBN: 81-7224-833-4.	
<b>Scheme of Continuous Internal Evaluation (CIE):</b>		
CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.		
<b>Scheme of Semester End Examination (SEE):</b>		
The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.		

#### **Mapping of POs with CO's**

<b>Course Outcome</b>	<b>Program Outcomes</b>
1.	1, 3, 4
2.	1, 3, 4
3.	2, 3, 4, 6
4.	1, 2, 3, 4, 6, 8

## APPLIED STATISTICS

Course Code	: 12IM6C3	CIE Marks	: 100
Hrs/Week	: L:T:P:S 3:0:0:4	SEE Marks	: 100
Credits	: 04	SEE Duration	: 03

### Course Learning objectives:-

This course is an advanced course on basic statistics that the students have undergone at the 5th semester level.

- Develop the concepts of Multivariate Statistical Modeling Approaches to problems in engineering and Management Science.
- Upgrade the Knowledge related to probability modeling from uni-variate to Bivariate e and Multivariate situations.
- Build up the process of decision making using statistical models and statistical thinking to manage product development and process engineering activities.
- Develop & Construct statistical models to help in prediction using causative models.
- Construct estimates and perform test of hypothesis on the basis of statistical evidence in sample data sets.

### Unit – I

06 Hrs

**Probability and Random Variables:** Probability Distributions & Probability Mass Functions, Functions of random variables, moment generating functions

### Unit – II

06 Hrs

**Discrete and Continuous Probability Distributions:** Geometric & Negative Binomial Distributions, Hypergeometric distribution, Poisson distribution, Erlang & Gamma distribution, Weibull distribution, Lognormal distribution, Beta distribution

### Unit – III

06 Hrs

**Two of More Random Variables:** Joint Probability, Marginal Probability, Conditional Probability, More Than Two Random Variables, Multinomial Distribution, Bivariate Normal Distribution, Linear Functions of Random Variables

**Estimation:** Properties of Estimators, Method of Moments, Method of Maximum Likelihood, Bayesian estimation, Sampling distribution.

Hypothesis testing and Confidence intervals for single sample

### Unit – IV

06 Hrs

**Hypothesis Tests and confidence intervals:** Testing for Goodness of Fit, Contingency Table Tests, Nonparametric Procedures - Sign Test, Wilcoxon Signed Rank Test, Comparison to the t-test

Hypothesis Tests and confidence intervals on the Difference in Means, Two Population Proportions, Wilcoxon Rank-Sum Test, F Distribution, Inference on the Variances of Two Normal Distributions, Ratio of Two Variances

Type II Error and Choice of Sample Size - single and double samples

### Unit – V

08 Hrs

**Regression:** Hypothesis Tests in Simple Linear Regression - t-Test & ANOVA, Confidence Intervals on the Slope, Intercept and Mean Response, Adequacy of the Regression Model - R<sup>2</sup> and Residual Analysis

Multiple Linear Regression - Least squares estimation, matrix approach

Multiple Regression Modeling - Polynomial Regression Models, Categorical Regressors & Indicator Variables, Selection of Variables & Model Building, Multicollinearity

**Introduction to Sample Surveys and Sampling Techniques**

**Self Study:**

**12 Hrs**

Case study, Design and Emerging Technologies to be discussed pertaining to the course.

1 Credit: 4 Hrs / Week

**Course Outcomes:**

After going through this course the student will be able to:

1. Characterize large data sets by fitting distributions.
2. Derive and estimate process parameters through sampling processes, using point and interval estimation techniques.
3. Evaluate and test research hypotheses using means and variances.
4. Analyze and interpret large data sets based on statistical techniques.
5. Create empirical models and test for adequacy using performance measures.

**Reference Books:**

- 1 Douglas C Montgomery, George C Runger, Applied statistics and Probability for Engineers, Wiley, Asia Student Edition, 5<sup>th</sup> Edition, 2010, ISBN: 978-04-700-5304-1
- 2 Prem S Mann, Introductory Statistics, John Wiley and Sons, 5<sup>th</sup> Edition, 2007, ISBN 978-81-265-1484-7
- 3 Walpole, Myers, Myers, Ye, Probability and Statistics for Engineers and Scientists, Pearson Education Inc., 8<sup>th</sup> Edition, 2007, ISBN: 978-81-317-1552-9.
- 4 Richard I Levin, David S Rubin, Statistics for Management, Prentice Hall India, 7<sup>th</sup> Edition, 1997, ISBN: 9780134762920.

**Scheme of Continuous Internal Evaluation:**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.

**Scheme of Semester End Examination:**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 4, 6
2.	1, 2, 4
3.	1, 2, 4
4.	1, 2, 4
5.	1, 2, 4, 8

## HUMAN RESOURCE MANAGEMENT & DEVELOPMENT

(Elective)

<b>Course Code</b>	<b>: 12IM6C4</b>	<b>CIE Marks</b>	<b>: 100</b>
<b>Hrs/Week</b>	<b>: L: T: P: S: 3:0:0:4</b>	<b>SEE Marks</b>	<b>: 100</b>
<b>Credits</b>	<b>: 04</b>	<b>SEE Duration</b>	<b>: 3 Hrs</b>

### Course Learning objectives:-

1. Understand the basic functions & practices of human resource management and the processes of recruitment and selection in organizations.
2. Demonstrate the various techniques of appraising human resources in organizations and the importance of communication skills in organizational teams.
3. Analyze the trends in managing human resources in various organizational contexts.

### Unit – I

06 Hrs

**Introduction:** Evolution of HRM, Objectives, Functions and Policies, Human Resource for Corporate Excellence, HRM vs HRD.

**Man Power Planning:** Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, Job Description, Job Specification.

### Unit – II

07 Hrs

**Recruitment And Selection Strategies:** Sources and Techniques of Recruitment, Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and Limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotions, exit interview.

**Developing Human Resources:** Competency Mapping, Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods.

### Unit – III

06 Hrs

**Performance Appraisal Systems:** Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports, 360° Appraisal, Emerging trends in performance Appraisal Process, Legal issues associated with performance appraisal.

### Unit – IV

07 Hrs

**Employee welfare & Statutory issues:** Overview of employee welfare measures, Types of welfare activities, Statutory and Non statutory provisions and benefits, Approaches to employee welfare, administration of employee welfare facilities.

### Unit – V

06 Hrs

**Emerging Trends in HRM:** Human Resource Accounting, Human Resource Audit, International Human Resource Management, Employment and Human Resource Services: Flexible working, Attendance Management, Ethnic Monitoring, Managing Diversity, Work life balance: Human Resource Practices in IT / ITeS Industries, Retention Management, HR Information Systems.

Statutory Issues in HRM: Compensation and Rewards.

### Self Study:

12 Hrs

Case study, Design and Emerging Technologies to be discussed pertaining to the course.  
1 Credit: 4 Hrs / Week

**Course Outcomes:**

After the successful completion of the course, the students will be able to:

1. Explain basic functions and practices of Human Resource Management and principles of human resource development.
2. Explain the processes of recruitment and selection in organizations.
3. Define various techniques of appraising human resources in organizations.
4. Assess various employee welfare and statutory measures prevailing in various organizations.
5. Analyze the trends in managing Human Resources in various organizational contexts.

**Reference Books:**

1. Dr. K Ashwathappa, Human Resources Management, Tata McGraw Hill, 5<sup>th</sup> Edition, 2007, ISBN : 0070660204.
2. David A.Decenzo, Stephen P.Robbins, Fundamentals of Human Resources Management, John Wiley India Pvt. Ltd, 8<sup>th</sup> Edition, 2004, ISBN: 0471656801.
3. Hersey and Blanchard, Management of Organisations Behaviour - Prentice Hall of India Edition – 6<sup>th</sup> Edition, 1998, ISBN: 0135312689.
4. Micheal Armstrong, A Handbook of Human Resource Management Practice, Kogan Page, 10<sup>th</sup> Edition, 2006, ISBN: 0-7494-4851-2

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 4, 5
2.	1, 2, 4
3.	1, 2, 4
4.	1, 2, 4, 7
5.	1, 2, 4, 7, 8

## MANAGEMENT INFORMATION SYSTEM

(Elective)

Course Code	: 12IM6C5	CIE Marks	: 100
Hrs/Week	: L: T: P: S: 3:0:0:4	SEE Marks	: 100
Credits	: 04	SEE Duration	: 3 Hrs

### Course Learning Objectives:

- Explain the relevance of information systems for enhancing the quality of decision making processes for organisational competitiveness.
- Express the business applications of instituting information systems in organizations.
- Design information systems for various decision making situations.
- Identify several ethical, security and societal challenges of IT.

#### Unit-I

06 Hrs

**Foundation Concepts:** Foundations of Information systems in business, Competing with Information Technology.

**Review of Information Technologies:** Trends in Computer hardware & software, Data Resource management, Data Warehousing & Data Mining, Telecommunications and networks.

#### Unit-II

06 Hrs

**Business Applications:** Introduction to e-business systems, Functional Business systems Enterprise business systems, Customer Relationship Management

**e-Commerce systems:** Fundamentals of e-Commerce, e-Commerce applications and Issues, Electronic Data Interchange (EDI) and Electronic Fund Transfer (EFT)

#### Unit-III

07 Hrs

**Information Systems for Decision Making:** Decision Support in Business, Artificial Intelligence Technologies in Business.

#### Unit-IV

06 Hrs

**Development Processes:** Developing Business and IT strategies, Developing business and IT solutions, Case study discussion

#### Unit-V

07 Hrs

**Management Challenges:** Security and Ethical Challenges, Enterprise and Global management of IT, Case study Discussion

**Implementation of Information Systems:** Information systems success models, Critical Success Factors of IS implementation, Implementation through Change management, Case study discussion.

### Self Study:

12 Hrs

Case study, Design and Emerging Technologies to be discussed pertaining to the course.

1 Credit: 4 Hrs / Week

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Develop an appreciation of the basic terminologies as applied to design and development of information system in an organizational context.
2. Enhance the quality of information system to aid decision making process in an organization.
3. Develop strategies and techniques for the management and use of management information systems.
4. Create reports using the information system to assist the tactical and strategic decision making process



in an organization.

**Reference Books:**

1. James. A O'Brien & George Marakas, Managing Information Systems, McGraw Hill publishing company limited, 9<sup>th</sup> Edition, 2008, ISBN-10: 0073376760.
2. Mahadeo Jaiswal & Monika Mital, Managing Information Systems, Oxford University Press, 2010, ISBN-10:0195669851.
3. Sanjay Mohapatra, Cases in Management Information Systems, PHI Learning Pvt Ltd, 2009, ISBN-9788120336148.
4. Ravi Kalakota, Andrew B. Whinston, Frontiers in Electronic Commerce, Addison – Wesley (Indian reprint), 1996, ISBN – 0201845202.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 40 marks (15 marks for Quiz + 25 marks for descriptive) out of which best of two will be considered. In addition there will be self study component on new topics for 20 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 3, 4, 6
2.	1, 4, 6
3.	1, 4, 6, 7
4.	1, 4, 6, 7, 8, 9

## ROBOTICS

(Elective)

Course Code : 12IM6D1  
Hrs/Week : L: T: P: S: 3:0:0:0  
Credits : 03

CIE Marks : 100  
SEE Marks : 100  
SEE Duration : 3 Hrs

### Course Learning Objectives:

- To explore concepts of Robot technologies that is playing vital role in manufacture.
- Describe various Robot technology applications.
- Develop an understanding of Robot Kinematics and dynamics.
- Explain and summarize Robot End effectors and Sensors.
- Explore conceptual understanding of Robot programming.

#### Unit – I

06 Hrs

**Introduction:** Automation and Robotics, Brief history of Robotics, Robotic market and future prospects.

**Fundamental of Robot Technology and Applications:** Robot anatomy, Work volume, Robot Drive Systems, Control Systems and Dynamic Performance, Precision of Movement, Robot Applications

#### Unit – II

07 Hrs

**Robot motion analysis and control:** Introduction to Manipulator Kinematics, Homogeneous Transformations and Robot Kinematics, Manipulator Path control, Robot Dynamics, Configuration of Robot Controller, Problems

#### Unit – III

07 Hrs

**Robot End Effectors:** Types of End Effectors, Mechanical Grippers, other types of End Effectors, Robot/End Effector interface, Considerations in Gripper Selection and Design, Problems

#### Unit – IV

07 Hrs

**Sensors in Robotics:** Transducers and Sensors, Sensors in Robotics, Tactile Sensors, Proximity and Range Sensors, Miscellaneous Sensors and Sensor based systems, Uses of Sensors in Robotics

**Machine Vision:** Introduction, Sensing and Digitizing Function in Machine vision, Image processing and Analysis, Training and Vision System, Robotic Applications Problems

#### Unit – IV

05 Hrs

**Robot Programming:** Methods of Robot Programming, Leadthrough Programming Methods, Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL and DELAY commands, Branching, Capabilities and Limitations of Leadthrough Methods.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Explain Robot anatomy, its drive systems and dynamic performance along with applications.
2. Develop an understanding of Robot Kinematics and dynamics. Configure robot controller in order to apply it in robot control.
3. Select appropriate grippers and end effectors for designing a robot
4. Apply suitable sensors in Robotic applications
5. Demonstrate conceptual understanding of Robot programming

### Reference Books:

1. Mikell P Groover, Mitchell Weiss, Roger N Nagel & Nicholas G Odrey, “Industrial Robotics-Technology, Programming and Applications”, McGraw-Hill Book Company, Edition 2008, ISBN-13:978-0-07- 026509-7
2. John J. Craig, “Introduction to Robotics-Mechanics and Control”, 3<sup>rd</sup> Edition, Pearson Education South Asia, Fifth impression-2011, ISBN: 978-81-317-1836-0
3. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic Engineering- an Integrated Approach”, Prentice Hall of India Pvt.Ltd, Edition:1989, print: 2005, Digitized in 201, ISBN: 81-203-0842-5

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO’s**

Course Outcome	Program Outcomes
1.	1, 3, 7
2.	1, 2, 4, 8
3.	2, 3, 4, 8, 9
4.	2, 3, 4, 8, 9
5.	2, 3, 7, 8

## LEAN MANUFACTURING SYSTEMS

(Elective)

<b>Course Code</b>	<b>: 12IM6D2</b>	<b>CIE Marks</b>	<b>: 100</b>
<b>Hrs/Week</b>	<b>: L: T: P:S:3:0:0:0</b>	<b>SEE Marks</b>	<b>: 100</b>
<b>Credits</b>	<b>: 03</b>	<b>SEE Duration</b>	<b>: 3 Hrs</b>

### Course Learning Objectives:

- Explain the practices of lean manufacturing in Toyota production system
- Implement lean in different projects.

#### Unit - I

06 Hrs

**Lean Manufacturing and the Toyota Production System:** Definition of Lean, Ohno's thought about the Toyota Production System, The TPS and Lean Manufacturing Defined, The Two Pillars of the TPS, Several Revolutionary Concepts in the TPS, The TPS Is Not a Complete Manufacturing System, Where Lean Will Not Work... or Not Work Quite so Well.

#### Unit - II

06 Hrs

**Inventory and Variation:** Background, Need of the Inventory, disadvantages of Inventory, About Variation, Buffers, Kanban, Kanban Calculations, Finished Goods Inventory Calculations, Kanban Calculations, Make-to-Stock versus Make-to-Order Production Systems

**Lean Manufacturing:** The Philosophy and Objectives, the Foundation of Quality Control, Quantity Control

#### Unit – III

07 Hrs

**The Significance of Lead Time:** History of Lead Time, Benefits of Lead-Time Reductions, Lead-Time Reductions, Techniques to Reduce Lead Times

**How to Do Lean—Cultural Change Fundamentals:** Three Fundamental Issues of Cultural Change, Some Cultural Aspects of a Lean Implementation

**How to Do Lean—the Four Strategies to Becoming Lean:** Overview of the Lean Implementation Strategies, Implementing Lean Strategies on the Production Line

#### Unit – IV

07 Hrs

**How to Implement Lean—The Prescription for the Lean Project:** An Overview on How to Implement Lean and steps: Assess the Three Fundamental Issues to Cultural Change, Complete a System wide Evaluation of the Present State, Perform an Educational Evaluation, Document the Current Condition, Redesign to Reduce Wastes, Evaluate and Determine the Goals for the Line, Implement the Kaizen Activities, Evaluate the Newly Formed Present State, Stress the System.

#### Unit – V

06 Hrs

**Planning and Goals:** Hoshin-Kanri Planning, importance of Goals and Goal Deployment, Policy Deployment, Leadership in Goal Development and Deployment.

**Sustaining the Gains:** Importance of Sustaining the Gains, existence of Process gain and loss.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Understand the principles of Lean and Toyota Manufacturing systems
2. Appreciate the utility and capability of Lean thinking
3. Apply the tools in lean manufacturing to analyse a manufacturing system and plan for its improvements
4. Develop the skills to implement lean manufacturing in industry and manage the change process to achieve continuous improvement of efficiency and productivity.

**Reference Books:**

1. Lonnie Wilson, How to Implement Lean Manufacturing, ISBN: 978-0-07-162508-1, The McGraw-Hill Companies,
2. Michael Hammer & James Champy, REENGINEERING THE CORPORATION, A Manifesto for Business Revolution, Harper Business Essentials
3. Jeffrey K. Liker, The Toyota Way, ISBN-10:0-07-058747-7, The McGraw-Hill Companies
4. M.G. Korgaonker, "Just In Time Manufacturing", Macmillan India Ltd., 2006, ISBN: 0333 926633.

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4, 6
2.	1, 2, 3, 4, 6, 8
3.	1, 2, 3, 4, 6, 8
4.	2, 3, 4, 6, 9

## ADVANCED OPERATIONS RESEARCH

(Elective)

Course Code	: 12IM6D3	CIE Marks	: 100
Hrs/Week	: L: T: P:S: 3: 0: 0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 03 Hrs

### Course learning objectives:-

The Course on advanced operation research is a sequel to the basic course on Operation Research prescribed for the 5<sup>th</sup> Semester level. The course is formulated with the following objectives in mind.

1. Enhance the awareness of the students on the advanced modeling frameworks such as Goal Programming, non Linear programming and other mathematical programs.
2. Extend the knowledge on project planning, project scheduling and project control focusing on resource leveling and resource allocation problems.
3. Provide frameworks for analyzing waiting lines using advanced queuing theory concepts.
4. Enable prediction of the future states of the processes using markov chain models.
5. Formulation and analysis of real life problems using advanced tools and techniques for resource optimization.

### Unit - I

07Hrs

**Linear Programming:** Two phase simplex techniques, revised simplex techniques, Sensitivity analysis, Integer Programming, Gomory's techniques, branch & Bound technique – two variables only, solutions of Assignment and Travelling salesman problems using Branch and Bound Approach.

### Unit - II

06 Hrs

**Goal Programming:** Introduction and simple formulation.

**Non-Linear Programming:** Kuhn – Tucker conditions, Quadratic Programming-Wolfe's Method, Convex Programming.

### Unit - III

07 Hrs

**Dynamic Programming:** Characteristics and Dynamic Programming model, Computational procedure (no problem solving, only formulation).

**Advanced CPM Techniques:** CPM - Elements of crashing, least cost project scheduling. Flow in networks; Determination of shortest route, Determination of Maximum flow through the networks, Minimal Spanning Tree. Resource Allocation for optimal utilisation of resources, Resource levelling and Smoothing, flow augmenting path, Algorithm for flow augmenting path, minimum cost flow problem, Transshipment problem.

### Unit - IV

06 Hrs

**Queuing Theory:** Prototype, Basic Structure, Real Queuing systems, Role of Exponential distribution, Birth-Death Process, Models, Non exponential distributions, Priority discipline queuing model, queuing networks.

### Unit - V

06 Hrs

**Markov Chains:** Discrete Stochastic Process, Markovian process, Stationary Markov chains, Markov diagrams, Ergodic and Absorbing Markov chains, Steady State probabilities, stochastic matrix, transition, matrix and their applications.

### Course Outcomes:

After the successful completion of the course, the students will be able to:

1. Understand the basic concepts of different advanced models of operations research and their applications.
2. Apply the models to incorporate rational decision making process in real life situations.
3. Analyze various modeling alternatives & select appropriate modeling techniques for a given situation.
4. Validate output from model to check feasibility of implementations.
5. Create innovative modeling frameworks for a given situation.

**Reference Books:**

1. Taha H A, Operation Research, Macmillan, 8<sup>th</sup> Edition, 2007, ISBN: 0130488089.
2. Ravindran, Phillips and Solberg, Operations Research, Wiley International, 2<sup>nd</sup> Edition, 2007, ISBN: 8126512563.
3. Hiller, Leiberman, Introduction to Operation Research, Mc Graw Hill Publication, 2004, 8<sup>th</sup> Edition, ISBN: 0073017795.
4. Maurice W. Sasieni, Arthur Yaspan, Lawrence Friedman, Operation Research Methods and Problems, Wiley International, 3<sup>rd</sup> Edition, 1959, Digitized 2007

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 2, 3, 4, 6
2.	2, 3, 4, 6, 7
3.	2, 3, 4, 6, 8, 9

## MARKETING MANAGEMENT & RESEARCH

(Elective)

Course Code	: 12IM6D4	CIE Marks	: 100
Hrs/Week	: L: T: P:S 3: 0: 0:0	SEE Marks	: 100
Credits	: 03	SEE Duration	: 3 Hrs

### Course Learning Objectives

1. To analyze markets and identify appropriate segmentation criteria to discover promising market niches.
2. To develop an effective marketing strategy, including a marketing mix, for a product/service.
3. To list and explain the critical components of a marketing plan.
4. To demonstrate an awareness of the opportunities and challenges of marketing in a global environment.

**Unit – I** **06 Hrs**

**Marketing Management-Introduction:** Historical development marketing management, Definition of Marketing, Core marketing concepts, Marketing Management philosophies Micro and Macro Environment, importance of marketing.

**Unit – II** **05 Hrs**

**Marketing Information Systems and Research:** Components of marketing information system – benefits and uses marketing research system, marketing research procedure, measurement of market demand.

**Unit – III** **08 Hrs**

**The Nature of Marketing Research:** Function of Marketing Research, Information and Decision making, Marketing information and Decision support system, Nature of Marketing Research Design, Steps in Research Design Process,

#### **The Sources of Research Data:**

Nature of Secondary Data, Internal and external sources of secondary data, Commercial Surveys, Survey research, Experimentation in Marketing research, Experimental Environment, Case studies

**Unit – IV** **07 Hrs**

#### **Measurement Techniques in Marketing Research**

Concept of measurement in Marketing Research, Questionnaire Design, Direct Response Attitude Scales and Measure of Emotions, Derived Attitude Scales-Conjoint Analysis, Perceptual Mapping, Qualitative Research, Observation and Physiological Measures, Case studies.

**Unit – V** **06 Hrs**

**Sampling and Data Analysis -** Sampling process, Sample size Determination, Data reduction and Estimation, Univariate Hypothesis Tests, Multivariate Hypothesis Tests, Measures of Association, Sales forecasting, Marketing Research Reports and Ethical issues in Marketing Research, Case studies

#### **Course Outcomes:**

After going through this course the student will be able to

1. Identify market and appropriate segmentation criteria to discover promising market niches.
2. Describing the benefits and the emerging trends of marketing research.
3. Apply steps of research design in marketing research for a product and list out the source of research data in collecting data needed to the market research.
4. Construct the structured format for preparing the questionnaire to analyse the market.
5. Evaluate the optimum sample size required for hypothesis testing.
6. Plan a research report by synthesizing the marketing information and applying it to the real world.



**Reference Books:**

1. Philip Kotler, Marketing Management, Prentice – Hall, 14<sup>th</sup> Edition, 2013, ISBN –9780132102926
2. S.A. Sherlekar, Marketing Management, Himalaya Publishing House, 13<sup>th</sup> Edition, 2005, EAN: CHIMPUB100874
3. Donald S Tull, Del I Hawkins ,Marketing Research, Prentice Hall India, Sixth Edition, ISBN: 8120309618
4. Aaker,Kumar,Day - Marketing Research, Wiley India, Ninth Edition,ISBN: 978-265-1791-6

**Scheme of Continuous Internal Evaluation (CIE):**

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

**Scheme of Semester End Examination (SEE):**

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered.

**Mapping of POs with CO's**

Course Outcome	Program Outcomes
1.	1, 3
2.	1, 2, 3, 6
3.	1, 2, 3, 6, 8
4.	2, 4, 6
5.	2, 3, 4
6.	6, 9

<b>ENTERPRISE RESOURCE PLANNING AND E-COMMERCE</b> (Elective)						
<b>Course Code</b>	:	<b>12IM6D5</b>		<b>CIE Marks</b>	:	<b>100</b>
<b>Hrs/Week</b>	:	<b>L: T: P:S: 3: 0: 0:0</b>		<b>SEE Marks</b>	:	<b>100</b>
<b>Credits</b>	:	<b>03</b>		<b>SEE Duration</b>	:	<b>3 Hrs</b>
<b>Course Learning Objectives:</b>						
<ul style="list-style-type: none"> <li>Review the transition from MRP to ERP; identify the levels of ERP maturity.</li> <li>Appraise how ERP is used to integrate business processes; define and analyze a process; create a process map and improve and/or simplify the process; apply the result to an ERP implementation.</li> <li>Identify the elements of a value chain, and explain how core processes relate; identify how the organizational infrastructure supports core business processes.</li> </ul>						
<b>Unit - I</b>						<b>06 Hrs</b>
<b>Enterprise–An Overview:</b> Introduction, Business Functions and Business Processes, Integrated Management Information, Role of Enterprise in Implementing the ERP System, Business modeling, Integrated Data Model.						
<b>Introduction To ERP:</b> Introduction, Common ERP Myths, A Brief History of ERP, Advantages of ERP, Reasons for the growth of the ERP market, Problems in ERP Implementation, Roadmap for successful ERP implementation.						
<b>Unit – II</b>						<b>06 Hrs</b>
<b>ERP and Related Technologies:</b> Introduction, Business Process Reengineering, Data Warehousing, Data Mining, On-line Analytical Processing, Product Life Cycle Management, Supply Chain Management, Customer Relationship Management, Geographical Information Systems, Intranet and Extranets, Advanced technology and ERP security, Middleware, Computer Crimes, Security and ERP, Crime and Security.						
<b>ERP Modules:</b> Introduction, Finance Management, Manufacturing Management, Marketing and Sales Distribution, Materials and Supply Chain Modules, Plant Maintenance, Quality Management, Human Resource.						
<b>Unit - III</b>						<b>07 Hrs</b>
<b>ERP Implementation Life Cycle:</b> Pre-evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, End user Training, Post implementation.						
<b>Vendor, Consultants and Users:</b> Introduction, In-house implementation – Pros and Cons, Vendors, Consultants, End-users.						
<b>Future Direction in ERP:</b> Introduction, New Markets, New Channels, Faster Implementation Methodologies, Easier Customization Tools, Business models and BAPIs, Application Platforms, New business segments, Need based applications, Reduction in Implementation Time, Open Source, Web enabled and Wireless Technologies, Enterprise Application Integration, Market Snapshot, Shifting Revenue Models, The SOA Factor.						
<b>Unit - IV</b>						<b>07 Hrs</b>
<b>History of E-Commerce and Indian Business Context :</b> Worldwide E-commerce Growth, Early Business Information Interchange Efforts, Emergence of Internet, Advantages and disadvantages of E-commerce, Transition to E-commerce in India, E-commerce opportunities for industries, E-transition challenges for Indian corporate, The Information Technology Act 2000.						
<b>Business Models for E-Commerce:</b> The Birth of Portals, E-business Models based on the relationship of Transaction Parties: B2C, B2B, C2C, C2B, E-business Models based on the						

relationship of Transaction Types	
<b>Unit - V</b>	<b>06 Hrs</b>
<b>Advances in E-Commerce:</b> Enabling Technologies of the World Wide Web, E-marketing, E-security, E-payment systems, E-CRM, E-SCM, E-Strategy, Mobile commerce.	
<b>Course Outcomes:</b>	
After the successful completion of the course, the students will be able to:	
<ol style="list-style-type: none"> <li>1. Demonstrate the core interactions and dependencies that exist between the key functions of a business.</li> <li>2. Appraise the role of information systems in the support of business functions and, particularly, cross-functional business processes</li> <li>3. Explain the way Enterprise planning Systems have developed, their functional capabilities and the role of the underpinning technologies</li> <li>4. Demonstrate an understanding of the foundations and importance of E-commerce</li> <li>5. Analyze the impact of E-commerce on business models and strategy</li> </ol>	
<b>Reference Books:</b>	
1.	Alexis Leon, "Enterprise Resource Planning", 2 <sup>nd</sup> Edition, Tata McGraw Hill Publishing Company Ltd., 2010, ISBN: 978-0-07-065680-2
2.	P. T. Joseph, S.J., "E-Commerce An Indian Perspective", 2 <sup>nd</sup> Edition, PHI, 2005, ISBN-81-203-2788-8
3.	Ravi Shankar and S. Jaiswal, "Enterprise Resource Planning", Galgotia Publication Pvt. Ltd., 1999, 1 <sup>st</sup> Edition
4.	Thomas Volloman, etal, "Manufacturing Planning & Controls", Iwrin / McGraw hill, 1997, 2003
<b>Scheme of Continuous Internal Evaluation (CIE):</b>	
CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.	
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### Mapping of POs with CO's

Course Outcome	Program Outcomes
1.	1, 2, 3, 4, 6, 9
2.	1, 2, 3, 4, 6, 8
3.	1, 2, 3, 4, 6, 8, 9
4.	2, 3, 4, 6, 9
5.	2, 3, 4, 6, 9