SCHEME & SYLLABUS
OF

V & VI Semesters B.E.

INDUSTRIAL ENGINEERING & MANAGEMENT

2023-24

Vision of the Department

To be a distinguished centre for the dissemination of knowledge and promoting research and consultancy in the field of Industrial Engineering and Management and for catering to the needs of the society.

Mission of the Department

1. To practice the philosophy of learning-teaching-learning and adopt the latest tools and techniques for the effective dissemination of knowledge in the field of Industrial Engineering and Management.
2. To collaborate with academic institutions, industry and research organizations to establish Centers of Excellence (COE) in emerging areas and promote research and consultancy.
3. To impart training for the overall development of students and inculcate commitment for social responsibility.

Program Educational Objectives (PEOs)

1. Graduates will excel in their chosen careers and successfully pursue higher education in Industrial Engineering and Management and related fields.
2. Graduates will manage the functioning of organization and enhance its competitiveness using contemporary tools in a socially acceptable way.
3. Graduates will demonstrate professionalism, ethical conduct, and societal responsibility and adapt to current trends by engaging in lifelong learning.

Programme Specific Outcomes (PSOs)

PSO1: Apply broad-based basic engineering and analytical tools for system design, analysis, performance evaluation and decision-making.

PSO2: Apply management concepts and principles for decision making in the area of operations, marketing, finance and human resource and analyse their impact.

PSO3: Apply the knowledge of materials, machining and manufacturing; analyse and evaluate the choices made.

PSO4: Apply the knowledge of industrial engineering for work system design and analyse, evaluate and create cost effective and safer systems and procedures.

Program Outcomes (POs)

Graduates in Industrial Engineering & Management will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

2021-22
Admitted Batch

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A^{++}' Grade & ISO 9001:2015 Certified)

B.E. in Industrial Engineering and Management

SCHEME OF TEACHING AND EXAMINATION
V Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	IPCC	N5IMI01	Quality Assurance and Reliability	I E M	3	0	2		3	50	50	100	4
2.	PCC	N5IM01	Operations Management	I E M	3	0	0		3	50	50	100	3
3.	PCC	N5IM02	Industrial Product Design	I E M	3	0	0		3	50	50	100	3
4.	PCC	N5IM03	Operations Research	I E M	3	0	0		3	50	50	100	3
5.	HSMC	NSH06	Management and Entrepreneurship	ME, IM, MBA	3	0	0		3	50	50	100	3
6.	PCC	N5IML01	Simulation Laboratory	I E M	0	0	2		3	50	50	100	1
7.	HSMC	NSH05	Environmental Science		1	0	0		2	50	50	100	1
8.	AEC	N5IMA0X	Ability Enhancement Course	I E M	If offered as Theory Course				3	50	50	100	2
					2	0	0						
					If offered as Integrated Course								
					1	0	2						
9.	NCMC	NSH07	Soft Skills	T&P	36 hrs. during the entire semester					100	--	100	0
			Total							**500**	**400**	**900**	**20**
10.	NCMC	AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

Note: **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **AEC** –Ability Enhancement Courses. **INT** –Internship, **UHV**- Universal Human Value Courses

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

Soft Skills Training Programme is a Non Credit Mandatory Course **for all the Programmes**. Dean Academic to schedule the even in the Academic Calendar.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Ability Enhancement Course – V

N5IMA01	Geometrical Dimensioning and Tolerancing	N5IMA03	Machine Elements Drawing
N5IMA02	Investment Management	N5IMA04	Mechatronics

2021-22
Admitted Batch

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B.E. in Industrial Engineering and Management

SCHEME OF TEACHING AND EXAMINATION
VI Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hrs/week				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Self Study Component	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1.	IPCC	N6IMI01	Supply Chain Management	I E M	3	0	2		3	50	50	100	4
2.	PCC	N6IM01	Project Management	I E M	3	0	0		3	50	50	100	3
3.	PEC	N6IMPE1X	Professional Elective Course-I	I E M	3	0	0		3	50	50	100	3
4.	OEC	NOExx	Open Elective Course-I		3	0	0		3	50	50	100	3
5.	PCC	N6IML01	Decision Making Laboratory	I E M	0	0	2		3	50	50	100	1
6.	MP	IMMP	Mini Project	I E M	1 full day per week					100	--	100	2
7.	Internship	N6CCA01	**INTERNSHIP –II** (4 weeks)	I E M						100	--	100	3
8.	AEC	ARAS	Aptitude Related Analytical Skills	T&P	36 Hrs. for the entire semester				2	50	50	100	1
			Total							**500**	**300**	**800**	**20**
9.	NCMC	AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									

Professional Elective - I

N6IMPE11	Financial Accounting and Management	N6IMPE13	Artificial Intelligence & Machine Learning
N6IMPE12	Enterprise Resource Planning	N6IMPE14	Human Resource Management

Note: **IPCC**: Integrated Professional Core Course; **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, **PEC –** Professional Elective Course; **OEC-** Open Elective Course; **MP**-Mini Project; **AEC** –Ability Enhancement Courses, **NCMC** – Non Credit Mandatory Course

L –Lecture, **T** – Tutorial, **P**- Practical/ Drawing, **S** – Self-Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

*** NHS06 for CV, EE, EC, EI, ET, CH, BT; Professional Core for ME, IM, CS, IS, AD**

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3: 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper.

Professional Elective Courses (PEC):

A Professional Elective Course (PEC) is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of four courses. The minimum students' strength for offering professional electives is 10.

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Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department.

However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. Selection of an open elective shall not be allowed if,

i) The candidate has studied the same course during the previous semesters of the program.

ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

iii) A similar course, under any category, is prescribed in the higher semesters of the program.

The minimum students' strength for offering open electives is 20.

Mini-Project Work:

Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. **Departments shall allocate one full day for Mini-project in the Time Table**.

CIE procedure for Mini-project:

(i) **Single discipline:** The CIE marks shall be awarded by a committee, DPEC - consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of Project Report, Project Presentation skill, Question & Answer session and Guide Assessment in the ratio of 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates.

(ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project. The CIE marks awarded for the Mini-project be based on the evaluation of Project Report, Project Presentation Skill, Question & Answer session and Guide Assessment in the ratio 40:20:20:20. The marks awarded for the project report shall be the same for all the batch mates. **No SEE component for Mini-Project**.

VII Semester Classwork and Research Internship / Industry Internship (INT3)

Swapping Facility

Departments can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester. Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the Department so that students have ample opportunity for internship. In other words, a good percentage of the students shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. There will be both CIE and SEE for the internship (INT3).

Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent examination after satisfying the internship requirements.

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INT3 Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them to learn how to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. Institute shall not bear any expenses incurred in respect of internship.

V Semester Syllabus

Quality Assurance and Reliability (N5IMI01)

(Integrated Professional Core Course)

Contact Hours/ Week	:	3(L)+0(T)+2(P)	Credits:	4.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	26	SEE Marks:	50

Unit-I

Introduction: Definition of Quality, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs, Brief discussion on sporadic and chronic quality problems, Quality of design and quality of conformance, Quality function deployment, Deming's PDCA cycle, Juran's Quality Trilogy and spiral of quality, Comparison of quality control, quality assurance and Total quality management, Quality circle.

8-Hours

Unit-II

ISO 9000 series of QMS Standards, Principles of QMS, Clauses of ISO 9001:2015 QMS, Steps in getting ISO 9001:2015 Certification, Statistical Process Control - Introduction to statistical process control – chance and assignable causes of variation. Seven QC tools, Case Studies on application of Seven QC tools. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Process capability – Basic definition, relation to product tolerance, Cp & Cpk, Methods of estimating process capability and six-sigma concept of process capability

8-Hours

Unit-III

Control Charts For Variables: Controls charts for mean ($\bar{x}$) and Range (R), statistical basis of the charts, development and use of $\bar{X}$ and R charts, interpretation of charts. Control charts for $\bar{X}$ and standard deviation (S), development and use of $\bar{X}$ and S chart. Type- I and Type- II errors, Run chart, control charts for individual measurements and moving-range charts. Cumulative-Sum chart.

8-Hours

Unit-IV

Control Chart for Attributes: Control charts for defectives **-** development and

operation of control chart for constant sample size and variable sample size. Control charts for 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.

7-Hours

Unit-V

Sampling Inspection: Concept of accepting sampling, economics of inspection, Acceptance plans – single & double sampling. Operating characteristic curves – construction and use.

Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans. Numerical problems on single and double sampling plans.

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, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations.

8-Hours

LABORATORY COMPONENT

	PART A
1	Testing the goodness of fit for Uniform Distribution.
2	Testing the goodness of fit for Binomial Distribution.
3	Testing the goodness of fit for Poisson Distribution.
4	Testing the goodness of fit for Normal Distribution.
5	Statistical Process Control for Variable Measurement Using $\bar{x}$ and R Charts.
6	Process Capability study Using Probability Paper Method, Histogram method and Control chart method
7	Repeatability and Reproducibility Studies.
8	Statistical Process control for Attribute Quality Characteristic (Defects) – c chart
9	Control Chart for Attribute Quality Characteristic (Defectives) - p Chart.
10	Application of 7 QC Tools for Process Improvement in Service Operations.
11	Experiments on Single Sampling Plan.
	PART B
12	Exercises on construction of Stem & Leaf Plot, Histogram, Box Plot, Pareto Chart, Scattered Diagram and Cause and Effect Diagram using Minitab software.
13	Exercises on construction of Control Charts for Variables & Attributes using Minitab software.
	Open Ended Experiments
1	Failure Mode and Effect Analysis (FMEA).
2	Quality Function Deployment (QFD).

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Apply the fundamental and advanced knowledge of quality engineering; thus become conscious of working in team, communicate and adopt to lifelong learning
CO2	:	Describe the QMS principles, requirements and implementation procedure
CO3	:	Demonstrate ability to collect data from a process, plot appropriate control charts and draw inferences
CO4	:	Design appropriate acceptance sampling plan for a given conditions and analyze their performance
CO5	:	Compute the reliability of a given system

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3						3	2		2		3		
CO2	3													3		
CO3	3	3	3											3		
CO4	3	3	3											3		
CO5	3	3												3		

Text Books:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	R.C.Gupta	Statistical Quality control & Quality Management, 9th Edition, Khanna Publishers, 2014, ISBN No.: 978-81-7409-1114
2.	D.C.Montgomery	Introduction to statistical Quality Control, John Wiley and Sons, 6thEdition, 2008, ISBN-13: 978-0470169926
3.	L. S. Srinath	Reliability Engineering, East West Press, 4th Edition, 2005, ISBN-13: 978-8176710480

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Grant and Leavenworth	Statistical Quality Control, McGraw Hill, 7th Edition, 1996, ISBN-13: 978-0078443541
2.	Dale H. Besterfield et al.	Total Quality Management, Prentice Hall, 3rd Edition, 2002, ISBN-13: 978-0130993069

Operations Management (N5IM01)

(Professional Core Course)

Contact Hours/ Week	:	3(L)+0 (T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

Functional Subsystems of Organizations: Systems Concept of Production; Types of Production System - Flow Shop, Job Shop, Batch Manufacturing, The Project.

Decision Making- Steps in Decision Making, Decision Tree.

Forecasting: Nature and Use of Forecasting; Factors Affecting Forecast (Demand); Types of Forecasting; Sources of Data; Demand Patterns; Forecasting Models; Measures of Forecast Accuracy

Selection of a Forecasting Technique - Simple Moving Average Method, Weighted Moving Average Method, Simple Exponential Smoothing Method, Linear Regression, Qualitative methods- Delphi Method, Market research survey.

8- Hours

Unit-II

Facility Location: Introduction - Factors Influencing Plant Location ; Single Facility Location Problem ; Multi-facility Location Problems ; Model for Multi-facility Location Problem; Break Even Analysis, center of gravity method, and Factor rating system (problems).

Plant Layout And Materials Handling: Introduction - Classification of Layout-process layout, product lay out, Group technology; Advantages and Limitations.

Materials Handling Systems - Unit Load Concept; Materials Handling Principles; Classification of Materials Handling Equipment and its selection

8- Hours

Unit-III

Aggregate Planning and Master Production Scheduling: Aggregate Planning; Nature of Aggregate Planning Decisions; Aggregate Planning Strategies; Aggregate planning methods.

Material Requirements Planning: Introduction, Product Structure/Bill of Materials (BOM), MRP Concept, MRP Calculations, Lot Sizing in MRP.

Capacity Requirements Planning: Manufacturing Resource Planning II (MRP II); Implementation Design of MRP II.

8- Hours

Unit-IV
Single Machine Scheduling - Introduction ; Concept of Single Machine Scheduling ; Measures of Performance ; Shortest Processing Time (SPT) Rule to Minimize Mean Flow Time ; Weighted Mean Flow Time ; Earliest Due Date (EDD) Rule to Minimize Maximum Lateness ; Minimizing the Number of Tardy Jobs - Hodgson's Algorithm **Flow Shop Scheduling** - Introduction; Johnson's Problem; Extension of Johnson's Rule; CDS Heuristic. **Job Shop Scheduling** - Introduction; Types of Schedules; Schedule Generation; Priority Dispatching Rules; 'Two Jobs' and 'M' Machines Scheduling..
8- Hours
Unit-V
Modern Production Management Tools **Just-In-Time Manufacturing** - Introduction; Overview of JIT; Basic Principles; Universal Problem Solving Sequence; Push/Pull Production; Kanban Systems—Pull System. **Lean Manufacturing** - Steps of Lean Manufacturing; Components of Lean Manufacturing. **Kaizen** - Key Elements of Kaizen; Classification of Kaizen; Steps of Implementation of Kaizen Blitz.
7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	• Discuss concept of production system & its types (Level-2). • Discuss the operations decision making concept.(Level-2). • Examine, analyze, evaluate, and apply Forecasting techniques to the operational, management, and strategic components of a business (Level-3)
CO2	:	• Select appropriate location for establishing industrial plants by analyzing the concepts of location selection. (Level-3). • Develop new plant layouts for typical application in industries and suggesting appropriate material handling strategies. (Level-3)
CO3	:	Evaluate and execute Aggregate, Material and capacity Requirements Plan (Level-3).
CO4	:	Discuss the various tools and techniques used for resource planning and scheduling (Level-2).
CO5	:	• Discuss the principles of lean operating systems (Level-2). • Discuss the application of JIT and Kaizen (Level-2).

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3											3		
CO2	3	3	3											3		
CO3	3	3	3											3		
CO4	3	3	2											3		
CO5	3	2												3		

Text Books:		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Pannerselvam. R.,	Production and Operations Management, Prentice Hall of India, 3rd revised Edition, 2012, ISBN-13: 978-8120345553

Reference Book:		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Lee J Karjewski and Larry P Ritzman,	Operations Management – strategy and Analysis, Prentice-Hall, 7th Edition, Pearson Education Asia, 2004, ISBN-13: 978-0131436640
2.	L. Wood. S Buffa	Modern Production/Operations Management, Wiley Eastern Ltd, 8th Edition, 2007, ISBN-13: 978-8126513727
3.	Chary S N	Production and Operations Management, Tata-McGraw Hill, 6th Edition, 2019, ISBN-13: 978-9353164812
4.	Richard Chase , F. Robert Jacobs , Nicholas Aquilano.	Operations Management for Competitive Advantage, McGraw-Hill Education, 10th Edition, 2004, ISBN-13: 978-0071215558

Industrial Product Design (N5IM02)

(Professional Core Course)

Contact Hours/ Week	:	3(L)+0 (T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

Introduction: Characteristics of Successful Product Development, Design and Development of Products, Duration and Cost of Product Development, Challenges of Product Development

Development Process and Organization: A Generic Development Process, Concept Development: The Front-End Process, Adopting the Generic Product Development Process, AMF Development Process, Product Development Organizations, AMF Organization.

8- Hours

Unit-II

Product Planning : The Product Planning Process, Identify Opportunities, Evaluate and Prioritize Projects, Allocate Resources and Plan Timing, Complete Pre Project Planning, Reflect all The Results and The Process.

Identifying Customer Needs: Gather Raw Data from Customers, Interpret Raw Data in Terms of Customer Needs, Organize the Needs into a Hierarchy, Establish the Relative Importance of Needs and Reflect on the Results and Process.

Product Specification: Specifications, Establishing the Specifications, Establishing Target Specifications, Setting the Final Specifications. Case study on QFD.

8- Hours

Unit-III

Concept Generation: The Activity of Concept Generation, Clarify the Problem, Search Externally, Search Internally, Explore Systematically and Reflect on the Results and Process.

Concept Selection: Overview of Methodology, Concept Screening and Concept Scoring

Concept Testing: Define the Purpose of Concept Test, Choose a Survey Population, Choose a Survey Format, Communicate the Concept, Measure Customer Response, Interpret the Result, Reflect on the Results and the Process. Case study on FMEA.

8- Hours

Unit-IV
Product Architecture: Product Architecture, Implications of the Architecture, Establishing the Architecture, Variety and Supply Chain Considerations, Platform Planning, Related System Level Design Issues. **Industrial Design:** Assessing the Need for Industrial Design, The Impact of Industrial Design, Industrial Design Process, Managing the Industrial Design Process, Assesses the Quality of Industrial Design.
8- Hours
Unit-V
Design for Environment: Life cycles, Environmental impact: Herman Miller's journey toward Design for Environment, Design for Environment process. **Design for Manufacture:** Definition, Estimation of Manufacturing Cost, Reducing the Cost of Components, Assembly, Supporting Production, Impact of DFM decisions on Other Factors. **Prototyping:** Prototyping Basics, Principles of Prototyping, Technologies, Planning for Prototypes. **Robust Design:** DOE, Robust design process.
7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Explain the concepts and various phases of product development (Level 2)
CO2		Identify the customer needs and articulate the product specifications (Level 2 and 3)
CO3	:	Demonstrate creative thinking skills for idea generation, translate conceptual ideas into clear sketches and choose the best concept among the various alternatives available for developing a product (Level 5 and 6)
CO4	:	Generate the product architecture and explain the need of industrial design in product development (Level 3)
CO5	:	Design product for manufacturing feasibility with respect to assembly, production, quality, safety and explain the concepts of prototyping (Level 4).

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3															3
CO2	3	3	2													3
CO3	3	3	3													3
CO4	3	3														3
CO5	3	3	3													3

Text Book:		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Karl.T.Ulrich, Steven D Eppinger	Product Design and Development, McGraw Hill Education, 7th Edition, 2020, ISBN-13: 978-9390113231

Reference Books:		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	A C Chitale and R C Gupta	Product Design and Manufacturing, Prentice Hall India Learning Private Limited, 5th Edition, 2011, ISBN-13: 978-8120342828
2.	Geoffery Boothroyd	Product Design for Manufacture and Assembly, CRC press Inc., 3rd Edition, 2010, ISBN-13: 978-1420089271

Operations Research (N5IM03)

(Professional Core Course)

Contact Hours/ Week	:	3(L)+0 (T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	--	SEE Marks:	50

Unit-I
Introduction - Definition of OR, Phases of Operations Research study, Application of OR, Advantages and Limitation of OR. **Linear Programming** - Definition, mathematical formulation, standard form, and solution space, Graphical method, multiple optimum solution, infeasible solution, unbounded solution.
7- Hours

Unit-II

Linear Programming - Simplex method, Basic feasible solution, Optimum solution, Special Cases in LPP- Multiple optimum solution, infeasible solution, unbounded solution. Degeneracy in LPP, Duality theory, Primal dual relationship.

8- Hours

Unit-III

Transportation Problem - Formulation of transportation problem, Basic feasible solution using North- West corner rule, Least Cost method, Vogel's Approximation Method. Optimum solution by U-V method (MODI method). Unbalanced transportation problem, Degeneracy in transportation problem. Applications of Transportation problem.

8- Hours

Unit-IV

Assignment Problem - Formulation of the Assignment problem, Solution of assignment problem using Hungarian method, unbalanced assignment problem, traveling salesman problem.

Game Theory - Formulation of games, two persons – Zero sum game, games with and without saddle point, Graphical solution (2Xn, mX2 game), dominance property, modified dominance property.

8- Hours

Unit-V

Queuing Theory: Introduction, real life examples of queues, elements of queuing model- arrival pattern, number of servers available, the queuing discipline, queue capacity and the numbers being served. Types of queuing models, classification of queue using Kendell and Lee notations, M/M/1:∞/FCFS model.

7- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Formulate the given situation as LPP and solve by using graphical method.
CO2	:	Formulate the given situation as LPP and solve by using simplex method.
CO3	:	Formulate and obtain optimum cost/profit solution to complex management problems using transportation algorithm.
CO4	:	Formulate given competitive situation as a game and obtain the solution.
CO5	:	Choose appropriate queuing model for a given practical application.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2										3			
CO2	3	3	2										3			
CO3	3	3	2										3			
CO4	3	3	2										3			
CO5	3	3	2										3			

Text Books		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Taha H A	Operation Research and Introduction, Pearson Education, 10th Edition, 2019, ISBN-13: 978-9352865277
2.	Philips Ravindran and Solberg	Operations Research: Principles and Practice, Wiley India, 2nd Edition, 2015, ISBN-13: 978-8126512560
3.	L S Shrinath	PERT and CPM Principles and Applications, Affiliated East-West Press (Pvt.) Ltd., 2001, ISBN-13: 978-8185336206.

Reference Book:		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Hillier and Libermann	Introduction to Operation Research, McGraw Hill, 8th Edition, 2005, ISBN-13: 978-0073211145.
2.	S.D. Sharma	Operations Research, Kedarnath, Ramnath &Co., 2020 Edition, 2014
3.	Kanti Swarup, Man Mohan, P K Guptha	Operations Research- Introduction to Management Science, Sultan Chand and Sons since 1950, 2019, ISBN-13: 978-9351611011.

Simulation Laboratory (N5IML01)

(Professional Core Course Lab)

Contact Hours/ Week	:	0(L)+0 (T)+2(P)	Credits:	1.0
Total Lecture Hours	:	0	CIE Marks:	50
Total Practical Hours	:	26	SEE Marks:	50

Part-A (Solving Problems using Excel)
1. Simulation of Flight Problem with delay in departure and varying flight time.
2. Simulation of Rainfall Problem by considering previous day event.
3. Simulation of Dentist's Clinic with fixed appointment time.
4. Simulation of Super Market
5. P-Type Inventory Problem
6. Simulation Of News Paper Problem (with 3 day types)
7. Simulation Of Automobile Manufacturing Company Problem with restriction in space available in transporter
Part-B (Solving Problems using Arena software)
1. Building simulation Models for banking service (Bank teller problem using common templates).
2. Simulation of Simple Manufacturing process.
3. Building simulation models for manufacturing operations (Electronic assembly– Basic templates and Advanced Process & Animation).
4. Simulation of airline terminal problem with five servers.
5. Simulation models for Office that dispenses automotive license plates.
6. Building simulation models for manufacturing operations with four work stations.
7. Building simulation models for manufacturing operations with layout and transport System.
8. Statistical Analysis of Simulation models (input analysis).
Open Ended Exercises
1. Simulation of Bakery Problem
2. Simulation of Company Problem to find profit/ loss.
3. Simulation Of classical News Paper Problem.
4. Simulation of automatic series workstations with failure data.
5. Building simulation models for manufacturing operations with layout.
6. Simulation of different types of customer's arrival at airline terminal.
7. Simulation of marble collection (Using advanced process & animation).

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Create Simulation Model for various real time scenarios and compute the value of critical matrix for decision making using Excel.
CO2	:	• Create Simulation Model for various real time scenarios and compute the value of critical matrix for decision making (Manufacturing and Servicing Industry) using Arena. • Conduct Input Analysis for various real time scenarios to estimate the data pattern using Arena software.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3	2	2											3
CO2	3	3	3	2	2											3

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Averill M Law, W David Kelton,	Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 2nd Edition, 1991, ISBN-13: 978-0071008037.

Geometrical Dimensioning & Tolerancing (N5IMA01)

(Ability Enhancement Course- Theory Course)

Contact Hours/ Week	:	2(L)+0(T)+0(P)	Credits:	2.0
Total Lecture Hours	:	26	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I
Introduction: Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerancing: an explanation of tolerance zone conversion.
5- Hours
Unit-II
Surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned & tolerance drawing; fits & allowances, advantages of GD&T
5- Hours

Unit-III
MMC, LMC & RFS: Maximum Material Condition (meaning & use); Least Material Condition (meaning & use); Regardless of Feature Size How to read a Feature Control Frame, Size Control Form: The Taylors principle; Gauging size limits. Rules, concepts, Characteristics, and Intolerance Dimensions: individual or related Datum's, Material Conditions; untoleranced dimensions
6- Hours
Unit-IV
Datums: Datum features; oddly configured & curved surfaces as datum features; equalizing datum's; datum feature symbols; flexible parts; direct vs indirect tolerancing. MMC and its ramifications. Relations between individual features.
5- Hours
Unit-V
Virtual Condition and Resultant condition Boundaries: Virtual condition (MMC concept & a functional boundary). Effect of LMC; wall thickness calculation.
5- Hours

Course Outcomes:		
Upon completion of this course the student will be able to:		
CO1	:	Explain the fundamental principles and concepts of GD&T, including datums, geometric controls, tolerances, and the relationship between part features.
CO2	:	Develop the ability to interpret and apply GD&T symbols correctly, understanding their meaning and implications on part geometry and tolerances.
CO3	:	Gain proficiency in applying the ASME Y14.5 or ISO 1101 standards, which provide guidelines for GD&T usage. They should be able to create technical drawings with appropriate GD&T callouts
CO4	:	Apply GD&T principles in the design process to ensure functional requirements are met, while considering manufacturing capabilities and cost constraints
CO5	:	Describe how GD&T impacts manufacturing process feasibility and cost.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3												3			
CO2	3	2											3			
CO3	3	2	2										3			
CO4	3	2	2										3			
CO5	3	2	2										3			

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	James D Meadows	Geometric Dimensioning and Tolerancing: Applications, Analysis & Measurement, James D Meadows & Assoc Inc, 2nd Revised Edition, 2010, ISBN-13: 978-0971440166
2.	P S Gill	Geometric Dimensioning and Tolerancing, S K Kataria & Sons, 3rd Edition, 2019, ISBN: 978-93-5014-378-0

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Paul J. Drake	Dimensioning and Tolerancing Handbook", McGraw Hill, 1st Edition, 1999, ISBN-13: 978-0070181311
2.	Bruce A. Wilson	GD&T: Application and Interpretation, Goodheart-Willcox Publishing, 5th Edition, 2009, ISBN-13: 978-1605252490

Investment Management (N5IMA02)

(Ability Enhancement Course- Theory Course)

Contact Hours/ Week	:	2(L)+0(T)+2(P)	Credits:	2.0
Total Lecture Hours	:	26	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I
Introduction to Investment: Investment versus speculation, Financial Markets: Functions, Classification, Portfolio management process, Approaches to investment decision making, Common errors in investment management, Qualities for successful investing.
6- Hours

Unit-II
Investment alternatives and their evaluation: Deposits, Government Savings Schemes, Money Market Instruments, , Life Insurance, Retirement Products, Real Estate, Precious Objects.
5- Hours
Unit-III
Bonds or Debentures, Mutual Funds and Financial Derivatives.
5- Hours
Unit-IV
Securities Market: Participants in the Securities Market, Secondary Equity Market (Stock Market), Trading and Settlement, Buying and Selling Shares, Buying on Margin and Short Sale.
5- Hours
Unit-V
Stock Market Quotations and Indices, SEBI and Future Challenges, Stock Market Abroad, Measuring Expected Return and Risk.
5- Hours

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Explain the characteristics of different financial assets such as money market instruments.
CO2	:	Evaluate and compare investment alternatives on key investment attributes.
CO3	:	Explain the features of Bonds, Debentures and Mutual Funds.
CO4	:	Buy and sell shares in stock markets.
CO5	:	Measure return and manage their investment risks.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2									3			3		
CO2	3										3			3		
CO3	3										3			3		
CO4	3										3			3		
CO5	3										3			3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Prasanna Chandra	Portfolio Management, Tata McGraw Hill, New Delhi, 5th Edition, 2017, ISBN-13: 978-9385965579.
2.	Bodie, Kane and Marcus	Investments, McGraw Hill., 10th Edition, 2017, ISBN-13: 978-9339212056.

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Luenberger, D. G.	Investment Science, Oxford University Press, 2nd Edition, 2013, ISBN-13: 978-0199740086
2.	Kevin.S	Security Analysis and Portfolio Management, Prentice Hall India Learning Private Limited, 2nd Edition, 2015, ISBN-13: 978-8120351301.
3.	Yogesh Maheswari	Investment Management, Prentice Hall India Learning Private Limited, 2008, ISBN-13: 9788120334267.

Machine Elements Drawing (N5IMA03)

(Ability Enhancement Course- Integrated Course)

Contact Hours/ Week	:	1(L)+0(T)+2(P)	Credits:	2.0
Total Lecture Hours	:	13	CIE Marks:	50
Total Practical Hours	:	26	SEE Marks:	50

Unit-I
Introduction to AutoCAD, Coordinate systems, drawing units, Sheet setup, Draw commands – line, spline, arc, circle, polygons, ellipse, Block, hatch, text, point, region, Revcloud.
3+5- Hours
Unit-II
Modify commands- erase, copy, move, array, stretch, mirror, rotate, scale, trim/extend, fillet/chamfer, offset, break, break at point, explode. Select tools, Zooming and Panning, Practicing 2D Mechanical drawings.
3+6- Hours
Unit-III
Parametric relationships- Parallelism, Perpendicularity, Angularity, linearity, concentricity, circularity, equal, Straightness, Symmetry, lock.
2+5- Hours

Unit-IV
Dimensioning Tools- linear, aligned, angular, radius, diameter, logged. Dimension Styles, Editing Dimensions, dimensioning a Mechanical Drawings, layer tools, save and export.
2+5- Hours
Unit-V
Isometric views, Isometric diagram practices, Mechanical diagrams- knuckle joint, flange coupling, cotter joints, universal couplings and other mechanical diagrams.
3+5- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Demonstrate proficiency in using AutoCAD software to create accurate and precise 2D drawings
CO2	:	Gain proficiency in understanding various drawing views, symbols, and annotations commonly used in engineering drawings.
CO3	:	Select appropriate tools and commands, and efficiently create, modify, and document 2D drawings using AutoCAD.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3		3								3			
CO2	3	3	3		3								3			
CO3	3	3	3		3								3			

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Randy H. Shih	AutoCAD 2022 Tutorial First Level 2D Fundamentals, SDC Publications, 1st Edition, 2021, ISBN-13:978-1630574383

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	George Omura and Brian C. Benton	Mastering AutoCAD 2022 and AutoCAD LT 2022, Sybex Publisher, 2nd Edition, 2021, ISBN-13: 978-1119715351
2.	Munir Hamad	AutoCAD 2022 Beginning and Intermediate, Mercury Learning and Information, 2021, ISBN-13:978-1683927242

Mechatronics (N5IMA04)

(Ability Enhancement Course- Theory Course)

Contact Hours/ Week	:	2(L)+0(T)+0(P)	Credits:	2.0
Total Lecture Hours	:	26	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I
Introduction-Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics, Difference between transducer and sensor, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors
6- Hours
Unit-II
Microprocessor and microcontroller- Basic elements of control systems, Difference between Microprocessor and Microcontrollers, Microprocessor architecture and terminology, Intel's 8085A Microprocessor
5- Hours
Unit-III
Programmable logic controller – Introduction to PLC's, basic structure, Principle of operation.
5- Hours
Unit-IV
Mechanical actuation systems- Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motor selection.
5- Hours
Unit-V
Electrical actuation systems- Electrical systems, Mechanical switches,

Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.
5- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Explain the evolution, objectives, advantages and disadvantages of mechatronics.
CO2	:	Differentiate between Microcontroller and Microprocessor.
CO3	:	Explain the principle of operation of PLC
CO4	:	Discuss the importance, applications of Mechanical actuation systems
CO5	:	Discuss the importance, applications of Electrical actuation systems

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3												3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Mahalik	Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, 1st Edition, 2017, ISBN-13: 978-0070483743
2.	W Bolton	Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education, 6th Edition, 2019, ISBN-13: 978-9353065881

Reference Book:

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	HMT Ltd.	Mechatronics, Tata McGrawHill, 2017, ISBN-13: 978-0074636435
2.	Anthony Esposito	Fluid Power, Pearson Education, 7th Edition, 2017, ISBN-13: 978-1292023878

VI Semester Syllabus

Supply Chain Management (N6IMI01)

(Integrated Professional Core Course)

Contact Hours/ Week	:	3 (L)+0(T)+2(P)	Credits:	4.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	26	SEE Marks:	50

Unit-I

Introduction to supply chain management & building a strategic SCM framework : Definition and development of supply chain, global optimization, managing uncertainty & risk, the evolution of supply chain management, key issues and decision phases in supply chain management, process view of supply chain management, competitive & supply chain strategies, achieving strategic fit, drivers of supply chain performance & a framework for structuring drivers.

Case studies: Dell, LL Bean and Wal-Mart Supply chains.

7- Hours

Unit-II

Inventory Management : Role of cycle inventory in supply chain, economies of scale to exploit fixed cost, aggregating multiple products in single order- lots are ordered independently and jointly, quantity discounting –single and double price breaks.

Managing uncertainty in supply chain: Role of safety stock in supply chain, determining appropriate level of safety inventory, impact of supply uncertainty on safety inventory.

Problems on: EOQ, cycle inventory, safety stock calculations.

8- Hours

Unit-III

Sourcing and Pricing Products: Role of Sourcing, Sources of supply and Supplier selection Vendor Rating supplier – scoring & assessment- supplier performance evaluation, selection & contracts. Design collaboration, procurement process.

Revenue Management: Role of revenue management in the supply chain, revenue management for: multiple customer segments, perishable assets, seasonal demand, bulk & spot contracts.

8- Hours

Unit-IV

Transportation in supply chain: Role of transportation, factors affecting transportation decisions. Modes of transportation and their performance

characteristics **Network Design in Supply Chain:** Role of facility decisions in supply chain, factors influencing network design decisions, frame work for supply chain design decisions, models and mathematical formulations for facility location and capacity allocation.
8- Hours
Unit-V
Role of IT in supply chain: Bullwhip effect, obstacles to coordination. Managerial levers to achieve co- ordination, Role of IT in supply chain, introduction to B2B, B2C, EDI, ERP, customer relationship management. **Supply chain sustainability**: Green supply chain management-reverse logistics & Recycling. **New Treads in a supply chain**: Basic concepts & benefits of new cutting edge technologies -Lean and Six sigma supply chain management, Block chain in supply chain, IOT in supply chain, AI in SCM. **Case study:** Wall mart supply chain **Super Finishing Process:** Buffing, Lapping, Broaching, Honing process-Equipment, working principles and industrial applications
8- Hours

Laboratory Component

PART A To develop a spreadsheet solution to	
1	Evaluate CSL and Product Fill Rate for a continuous review policy under which Q units are ordered when the quantity on hand drops to the ROP.
2	Evaluate safety inventory given desired cycle service level or fill rate.
3	Develop a Gravity Location Model to find locations that minimize the cost of transporting raw materials from suppliers and finished goods to the markets.
4	Develop a Demand Allocation Model to allocate the demand from different markets to the various plants that minimize the total cost of facilities, transportation and inventory.
5	Develop a Capacitated Plant Location Model to locate factories and then allocate demand to the open factories to minimize the total cost of facilities, transportation, and inventory.
6	Develop a Capacitated Plant Location Model with single sourcing to identify the plants that are to be kept open, their capacity, and the allocation of regional demand to these plants to minimize the cost of meeting global demand.

PART B	
7	Creating the Item Masters for various Engineering Designs.
8	Generating Bill of Materials for Various Engineering Designs.
9	Creating and approving Sales Order for various items.
10	Creating and approving Purchase Order for various items.
11	Receive and update inventory.
12	Generating various reports for confirmed orders.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Illustrate the impact of supply chain activities and decisions on firm's performance (Level-2).
CO2	:	Apply concepts of inventory for planning and managing inventories in supply chain Level 4).
CO3	:	Explain the various strategic alliance opportunities, procurement & outsourcing strategies & evaluate supplier performance (Level-4)
CO4	:	Evaluate the strengths and weaknesses of various transportation network design options and develop mathematical models for various supply chain networks for optimizing decisions (Level-4).
CO5	:	Apply information technology systems & new treads to support supply chain related decisions (Level-4).

Suggested Software Packages:

For part A: **Microsoft Excel**

For part B: **OfBiz**

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2											3		
CO2	3	3	2											3		
CO3	3	3	2											3		
CO4	3	3	3											3		
CO5	3													3		

Text Books		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Chopra.S.& Meindl P	Supply Chain Management: Strategy, Planning & Operation, Pearson Education, 6th Edition, 2016, ISBN: 0131730428.
2.	David Simchi-Levi, Philip Kaminasky, Edith Simchi- Levi	Designing & Managing the Supply Chain, Tata McGraw-Hill Publishing Company Ltd., 3rd Edition, 2008, ISBN: 9780070666986.

Reference Books		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Jeremy F. Shapiro	Modeling the Supply Chain, Cengage Learning India Pvt. Ltd., 2nd Edition, 2006, ISBN:0495126098

Project Management (N6IM01)

(Professional Core Course)

Contact Hours/ Week	:	3(L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

Concepts of Project Management: Concepts of a Project, Portfolio, Program, Categories of projects, Phases of project life cycle, Roles and responsibility of project leader, tools and techniques for project management Planning, Organizing and staffing the project team, Skills / abilities required for project manager, ten knowledge Areas, Authorities and responsibilities of project manager, Project organization and types, accountability in project execution, controls, tendering and selection of contractors.

8- Hours

Unit-II

Generation and Screening of Project Ideas: Generation of Ideas, Create WBS, Monitoring the Environment, Corporate Appraisal, Scouting for project ideas, Sources of positive net present value. Capital expenditures: Importance and difficulties, Phases of capital Budgeting, Levels of decision making, Facts of Project Analysis, Feasibility Study: A schematic diagram, Objectives of Capital Budgeting.

7- Hours

Unit-III
Market & Demand Analysis: Situational Analysis and Specifications of Objectives, Collection of Secondary Information, conduct of Market Survey, Characterization of the Market, Demand Forecasting, and Market Planning. Administrative aspects of capital investment. **Tools & Techniques of Project Management:** GANTT chart, bar chart for combined activities, logic diagrams and networks, Project Evaluation and Review Techniques (PERT), Critical Path Method (CPM)- Time cost/ Trade off Analysis, Resource levelling and Smoothening
8- Hours
Unit-IV
Project Scheduling, co-ordination and control: Project implementation scheduling, effective time management, different scheduling techniques, resources allocation method. PLM concepts. Project direction, communication in a project, MIS project co-ordination, role of MIS in project control, Performance-control, Schedule- Control, Cost -Control.
8- Hours
Unit-V
Performance Measures in Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management, project management and environment. **Project Management Models and Certifications:** An Introduction to SEI, CMM model and Project Management Institute USA – Importance of the same for the Industry and practitioners. **Case Studies on Project Management:** Case studies covering project planning, scheduling, communication, use of tools & techniques, project model, performance measurement.
8- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Explain the concepts of project management and roles and responsibilities of project leader (Level-1).
CO2	:	Discuss the generation and screening of project ideas and describe the procedure involved in awarding the project (Level-2).
CO3	:	Analyse the different market scenarios while allocating the project and discuss the tools and techniques used in PM (Level-3).
CO4	:	Demonstrate the ability to schedule, coordinate and control the projects (Level-3).
CO5		Describes the various performance measurement techniques in PM and analyses the PM environment (Level-4).

Assignment: Any two case studies by using MS project software.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3										3			3		
CO2	3	2	2								3			3		
CO3	3	3	3								3			3		
CO4	3										3			3		
CO5	3										3			3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Prasanna Chandra	Project planning analysis, selection, implementation & review, Mc Graw Hill Education, 8th Edition, 2017, ISBN-13: 978-9332902572
2.	Harold Kerzner	Project Management a system approach to planning scheduling & controlling, Willey, 12th Edition, 2017, ISBN-13: 978-1119165354
3.	S Choudhury	Project Management, Mc Graw Hill Education (India) Pvt. Ltd. New Delhi, 2017, ISBN-13: 978-0074600689

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Beningston Lawrence	Project Management, McGraw-Hill, 1970.
2.	Weist & Levy	A Management-Guide to PERT and CPM, Eastern Economy of PHI, 2nd Edition, 2002.
3.	L S Shrinath	PERT and CPM Principles and Applications, Affiliated East-West Press (Pvt.) Ltd., 2001, ISBN-13: 978-8185336206.
4.	Joseph J. Moder , Cecil R. Phillips	Project management with PERT and CPM, Van Nostrand Reinhold Inc.,U.S, 2nd revised & enlarged Edition, 1971, ISBN-13: 978-0442156664

Financial Accounting and Management (N6IMPE11)

(Professional Elective Course-I)

Contact Hours/ Week	:	3(L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

Introduction to Financial Management: Definition of financial management, objectives of financial management, functions of financial management, different forms of business organizations.

7- Hours

Unit-II

Working Capital Management: Definition, factors influencing working capital management, determination of operating cycle and working capital.

Budgeting: Definition, Sales budget, production budget, Budgetary control, master budget, and Flexible budget (problems).

8- Hours

Unit-III

Financial Accounting: Introduction to bookkeeping, the definition of bookkeeping, objectives, types of bookkeeping, journal, ledger, trail balance, and preparation of trial balance.

8- Hours

Unit-IV

Financial Statements and Analysis: Introduction to the trading account, preparation of trading account, profit and loss account, preparation of profit and loss account, balance sheet, preparation of balance sheet, problems on profit and loss account and balance sheet.

8- Hours

Unit-V

Costing: Definition of costing, objectives of costing, elements of costing, methods of costing. Preparation of cost sheet, Job cost sheet, and batch cost sheet (problems).

8- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Perform Journal entry, Ledger entry and prepare Profit and Loss account and Balance sheet.
CO2	:	Perform Ratio analysis and draw conclusions.
CO3	:	Explain Objectives and functions of Financial Management & Capital Budgeting.
CO4	:	Estimate working capital requirement and perform Budgeting.
CO5	:	Perform Cost analysis and Prepare Cost Sheet.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3								3			3		
CO2	3	3	2								3			3		
CO3	3	3									3			3		
CO4	3	3	2								3			3		
CO5	3	3	2								3			3		

Text Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Jain and Narang	Advanced Accountancy Kalyani Publishers: 22nd Edition, 2019, ISBN: 9789353593674
2.	Prasanna Chandra	Financial Management – Theory and Practice, Tata McGraw Hill Education, 12th Edition, 2018, ISBN: 9780071078405

Reference Books

Sl No.	Author/s	Title, Publisher, Edition, Year, ISBN
1.	Khan M Y and Jain P K	Financial Management – Text and Problems and Cases, Tata McGraw Hill Education, 7th Edition, 2017, ISBN-13: 978-9339213053
2.	I M Pandey	Financial Management, Vikas Publishing House, 11th Edition, 2016, ISBN-13: 978-9325982291

Enterprise Resource Planning (N6IMPE12)

(Professional Elective Course-I)

Contact Hours/ Week	:	3 (L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

ERP: An overview – Introduction, ERP, advantages of ERP, Enterprise – An overview – Introduction, Integrated management information. ERP : An overview, The role of the enterprise , Berrium modeling, integrated data model , Benefits of ERP, ERP related technologies – BPR, Data warehousing, Data mining, OLAP, Supply chain management.

8- Hours

Unit-II

ERP – implementation: Introduction, Evolution of ERP, ERP implementation life cycle – Introduction, different phases of implementation, ERP implementation, implementation methodology – Evolution of ERP packages, hidden costs, organizing the implementation, vendors, consultants and users. Project management and monitoring.

8- Hours

Unit-III

ERP models – Introduction , finance model / financial accounting , controlling, investment management, treasury module, business planning and budgeting , manufacturing modeling/ introduction and subsystems of manufacturing module, introduction and subsystems of human resource module , introduction and subsystems of materials management module, introduction and subsystems of sales and distribution module.

8- Hours

Unit-IV

ERP market place – market share, vendors, SAPAG, company profile, product and technology, R/3 an overview, R/3 system, R/3 application module, R/3 module SAP advantage.

People soft–company profile, business management solution, commercial solution, industry selection, people tool, people soft implementation tool kit.

BAAN – company profile, BAAN ERP modules, BAAN ERP tools,

GD Edwards- Introduction to GD Edwards.

8- Hours

Unit-V
ERP- present and future- limitations of ERP systems , extend the power of ERP systems, ERP and E–commerce, E–commerce work flows, future directions in ERP – new modules and web enabling.
7- Hours

Course Outcomes:		
Upon completion of this course the student will be able to:		
CO1	:	Identify and describe the different modules of ERP system and Technologies used in ERP.
CO2	:	Illustrate the different phases of ERP implementation process
CO3	:	Identify role and importance of different ERP Modules
CO4	:	Identify role and importance of different ERP systems in the market
CO5	:	Apply the ERP concepts in B2B and B2C real-time situations in industries

	CO – PO Mapping:															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3													3		
CO2	3													3		
CO3	3				2									3		
CO4	3				2									3		
CO5	3													3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Alexis Leon	Enterprise Resource Planning, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2019, ISBN-13: 978-9353167820

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Vinod Kumar Garg, Venkata Krishna N k	Enterprise Resource Planning- Concepts & Practices, Prentice Hall, New Delhi, New title Edition, 2004, ISBN-13: 978-8120322547
2.	Michel Hammer	Enterprise Resource Planning, Addison Wesley, New Delhi, 2000.

Artificial Intelligence & Machine Learning (N6IMPE13)

(Professional Elective Course-I)

Contact Hours/ Week	:	3 (L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I

Introduction: What is AI? Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modelling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach,

Intelligent Agents: Agents and Environments, Rationality, Omniscience, learning, and autonomy, the nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents; Agent programs, Simple reflex agents, Modelbased reflex agents, Goal-based agents, Utility-based agents, Learning agents

8- Hours

Unit-II

Solving Problems By Searching: Problem-solving agents; Well defined problems and solutions, Formulating problems, Example problems; Toy problems, Real-world problems, Searching for solution; Infrastructure for search algorithms, Measuring problem solving performance, Uninformed search strategies, Uniform-cost search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search,

Adversial Search: Games, Optimal Decisions in Games; The minimax algorithm, Optimal decisions in multiplayer games, AlphaBeta Pruning

8- Hours

Unit-III

Machine Learning Introduction: If Data had Mass, The Earth Would Be A Black Hole, Learning; Machine Learning, Types of Machine Learning, Supervised Learning; Regression, Classification, The Machine Learning Process, A Note on Programming,

Preliminaries: Some Terminology; Weight Space, The Curse of Dimensionality, Knowing What You Know; Overfitting, Training, Testing, and Validation Sets, The Confusion Matrix, Accuracy Metrics, The Receiver Operator Characteristic (ROC) Curve, Unbalanced Datasets, Measurement Precision,: Testing Machine Learning Algorithms, Turning Data into Probabilities; Minimising Risk, Some Basic Statistics, The Bias-Variance Trade-off.

8- Hours
Unit-IV
Dimensionality Reduction: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA), Relation with the Multi-layer Perceptron, Kernel PCA, Methods Comparisons, Problems on LDA and PCA, **Learning With Trees:** Using Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART); Gini Impurity, Regression in Trees, Classification Examples and Problems.
8- Hours
Unit-V
Probabilistic Learning: Nearest Neighbour Methods Unsupervised Learning; Clustering: Introduction, Hierarchical Clustering, Agglomerative Clustering, The single Linkage Algorithm, The complete linkage Algorithm, The Average Linkage Algorithm, Partitional Clustering, Forgy's Algorithm, The k-means Algorithm, Vector Quantization, The K-Means Algorithm, Isodata Algorithm, Problems.
7- Hours

Course Outcomes:		
Upon completion of this course the student will be able to:		
CO1	:	Understand and Explore knowledge representation techniques and problem-solving strategies to common Artificial Intelligence (AI) applications.
CO2	:	Discuss the structure of the agents and different types of agents commonly used in AI.
CO3	:	Differentiate between machine learning algorithms based on learning criteria and parameter employed.
CO4	:	Apply and illustrate the significances of dimensionality reduction techniques for supervised and unsupervised problem solving.
CO5	:	Design applications to solve real world problems by applying machine learning algorithms such as classification, regression, and clustering.

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3												3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			

CO5	3	3	2										3			

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Stuart J. Russell and Peter Norvig	Artificial Intelligence, A Modern Approach, Pearson India Education Services, 3rd Edition, 2015, ISBN-13: 978-9332543515
2.	Stephen Marsland	Machine Learning, An Algorithmic Perspective, CRC Press, 2nd Edition, 2014, ISBN-13: 978-1466583283
3.	Earl Gose, Richard Johnson Baugh, Steve Jost	Pattern Recognition with Image Analysis, Pearson Education, 1996, ISBN-13: 978-0132364157

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Elaine Rich, Kevin Knight	Artificial Intelligence, Tata McGraw Hill, 3rd Edition, 2017, ISBN-13: 978-0070087705.
2.	Christopher Bishop	Pattern Recognition and Machine Learning, Springer, Softcover reprint of the original 1st Edition, 2016, ISBN-13: 978-1493938438
3.	Tom M Mitchell	Machine Learning, Tata McGraw-Hill, 1st Edition, 2017, ISBN-13: 978-1259096952

Human Resource Management (N6IMPE14)

(Professional Elective Course-I)

Contact Hours/ Week	:	3(L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

Unit-I
Human Resource Management: Introduction, nature, scope of HRM, Importance and Evolution of the concept of HRM - Major functions of HRM, influencing factors for future of HRM, Business ethics in HRM **Job Analysis:** Meaning, process of Job Analysis, methods of collecting job analysis data, Job Description and Job Specification, Role Analysis.
8- Hours
Unit-II

Human Resource Planning: Objectives, Importance and process of Human Resource Planning, Effective HRP.

Recruitment: Definition, Constraints and Challenges, Sources and Methods of Recruitment, New Approaches to recruitment.

Selection: Definition and Process of Selection.

Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation

8- Hours

Unit-III

Training and development: Training v/s development, Training v/s Education, Systematic Approach to Training, Training Methods.

Performance Appraisal: Concept of Performance Appraisal, the Performance Appraisal Process, Methods of Performance Appraisal

Compensation: Objectives of Compensation Planning, Job Evaluation, Compensation Pay Structure in India.

8- Hours

Unit-IV

Employee Welfare: Introduction, Types of Welfare Facilities and Statutory Provisions.

Employee Grievances: Employee Grievance procedure, Grievances Management in Indian Industry.

Discipline: Meaning, approaches to discipline, essential of a good disciplinary system, managing difficult employees.

8- Hours

Unit-V

Industrial Relations and labour laws: Importance, approaches, settlement of industrial disputes, industrial disputes act 1947, payment of wages act, factories act, employees compensation act, minimum wages act 1948, payment of bonus act 1948, ESI act 1948, payment of gratuity act 1972, trade union movement in India

Case studies: Discussion of HRM cases to make the student aware of case study approach.

(Not for the examination)

7- Hours

Course Outcomes: Upon completion of this course the student will be able to:		
CO1	:	Describe the scope, function and ethical practices of HRM; Perform Job Analysis for recruiting right type of people for the job
CO2	:	Describe HRP, explain recruitment procedure and discuss selection process and placement.
CO3	:	Discuss difference between training and development, training methods, explain performance appraisal and compensation methods
CO4	:	Explain welfare measures and grievance redressal procedure
CO5	:	Explain various applicable statutory requirements applicable to business organization in Indian context

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2												3		
CO2	3													3		
CO3	3	2												3		
CO4	3													3		
CO5	3													3		

Text Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Rao V. S. P	Human Resource Management, Excel books, 2nd Edition, 2010, ISBN-13: 978-8174468956
2.	John M. Ivancevich	Human Resource Management, McGraw Hill, 10th Edition, 2010, ISBN-13: 978-0070667044

Reference Books		
Sl No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Luis R Gomez-Mejia, David B. Balkin, Robert L. Cardy	Managing Human Resources, Prentice Hall India Learning Private Limited, 6th Edition, 2010, ISBN-13: 978-8120341227
2.	P.Subba Rao	Personnel and Human Resource Management, Himalaya Publishing House, Mumbai, 5th Edition, 2015, ISBN-13: 978-9351425342

3.	Aswathappa K	Human Resource Management, McGraw-Hill, Standard Edition, 2023, ISBN-13: 978-9355323675

Decision Making Laboratory (N6IML01)

(Professional Core Course Lab)

Contact Hours/ Week	:	3 (L)+0(T)+0(P)	Credits:	3.0
Total Lecture Hours	:	39	CIE Marks:	50
Total Practical Hours	:	0	SEE Marks:	50

PART A (Excel, Minitab)	
1.	Determining the measures of central tendency and dispersion of a given process.
2.	Graphical/ Pictorial representation of data – Histogram, Ogive curve, Bar Chart, Column chart, Pie chart, Line chart.
3.	Conduction of simple linear regression analysis, Construction of scatter plot and determination of Karl Pearson's correlation coefficient
4.	Interval estimation and hypothesis testing on single population mean
5.	Classification of items based on ABC analysis
6.	Depreciation analysis using Various methods of Depreciation.
PART B (Operations Research Packages)	
1.	Solving & sensitivity analysis of LPP models.
2.	Solving & analysis of transportation models.
3.	Solving of assignment models.
4.	Solving of Travelling Sales men models.
5.	Determination of Critical path for CPM model and Crashing of activities using CPM model.
6.	Determination of Critical path for PERT model and its estimation.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	:	Measure central tendency and dispersion of given data set
CO2	:	Pictorially represent the given data and draw inferences
CO3	:	Analyze whether the co-relation exists between two variables and determine the co-efficient of co-relation
CO4	:	Perform hypothesis testing, ABC analysis and depreciation

CO5	:	Solve LPP, Assignment and Travelling Salesman problems
CO6	:	Perform network analysis

CO – PO Mapping:																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	3		2									3		
CO2	3	3	3		2									3		
CO3	3	3	3		2									3		
CO4	3	3	3		2						2			3		
CO5	3	3	3		2									3		
CO6	3	3	3		2						3			3		