

Savitribai Phule Pune University

Faculty of Science & Technology



Curriculum for

B. E. (Industrial Engineering)

(2019 Course)

(with effect from June 2022)

Savitribai Phule Pune University, Pune
BE (Industrial Engineering)
2019 Course
(With effect from Academic Year 2022-23)

Semester-VII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Project	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	Project	Total
411101(A)	Financial Management and Costing	3			30	70				100	3			3
411102(A)	Project Management	3			30	70				100	3			3
411103(A)	Elective III	3			30	70				100	3			3
411104(A)	Elective IV	3			30	70				100	3			3
411101(B)	Financial Management and Costing Lab		2				25	25		50		1		1
411102(B)	Project Management Lab		2				25	25		50		1		1
411103(B)	Elective III Lab		2						25	25		1		1
411104(B)	Elective IV Lab		2						25	25		1		1
411105	MOOCs						50			50		2		
411106	Project stage 1			4			50		50	100			2	1
411107	Mandatory Audit Course 7	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		12	8	4	120	280	150	50	100	700	12	6	2	20

Elective III

- 1 Simulation, Modeling and Digital Twin
- 2 Total Quality management
- 3 Artificial Intelligence in Manufacturing
- 4 World Class Manufacturing

Elective IV

- 1 Plant Maintenance and industrial safety
- 2 Surface Engineering
- 3 Reverse Engineering
- 4 Entrepreneurship and Innovations

--

Savitribai Phule Pune University, Pune BE (Industrial Engineering) 2019 Course (With effect from Academic Year 2020-21)														
Semester-VIII														
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Project	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	Project	Total
411108(A)	Reliability Engineering	3			30	70				100	3			3
411109(A)	Energy Management	3			30	70				100	3			3
411110(A)	Elective V	3			30	70				100	3			3
411111(A)	Elective VI	3			30	70				100	3			3
411108(B)	Reliability Engineering Lab		2				25	50		75		1		1
411109(B)	Energy Management Lab		2				25		50	75		1		1
411112	Project stage 2			12			100	50		150			6	1
411113	Mandatory Audit Course 8	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		12	4	12	120	280	150	100	50	700	12	2	6	20
Abbreviations:														
TH : Theory TW : Term Work PR : Practical OR : Oral TUT : Tutorial														

Elective V

- 1** Advanced Ergonomics
- 2** Logistics warehousing & Management
- 3** Material Forming
- 4** Human Resource Management

Elective VI

- 1** Industrial Laws
- 2** World Class Manufacturing
- 3** Machine Tool Technology
- 4** Development of Professional Skills

411101(A): Financial Management and Costing

Teaching Scheme

Lectures: 03 hours / week

Credit Scheme

Theory: 03

Examination Scheme

In-Sem: 30 Marks

End-Sem: 70 Marks

Course Outcomes: After learning the subjects students will be able to:

- 1) Demonstrate the applicability of the concept of Financial Management to understand the managerial Decisions and Corporate Capital Structure CO
- 2) Apply the Leverage and EBIT EPS Analysis associate with Financial Data in the corporate CO
- 3) Analyze the complexities associated with management of cost of funds in the capital Structure CO
- 4) Demonstrate how the concepts of financial management and investment, financing and dividend policy decisions could integrate while identification and resolution of problems pertaining to LSCM Sector CO
- 5) Demonstrate how risk is assessed

Unit I - Financial Management:

Financial Function, Scope, goals and tools. Sources of finance. Cost of Capital & Means of Finance

[7]

UNIT II - Ratio Analysis:

Classification, Ratio Analysis and its limitations. Index Statement & Common Size Statement

[7]

UNIT III - Working Capital Management:

Concept and design of Working Capital, types of working capital, sources of working capital, Time value of money, definition of cost and capital., Cash management, creditors management, debtors management

[7]

Unit IV - Costing:

Methods of costing and elements of cost.

[7]

Material Cost

Different methods of pricing of issue of materials.

Labour Cost

Different methods, wages and incentive plans. Principles of good remunerating system, labour turnover.

Depreciation

Concept, importance and different methods of depreciation

Unit V - Overheads:

Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads- Machine hour and labour hour rate. Under and over absorption of overheads.

[7]

UNIT VI - Standard costing:

Concept, development and use of standard costing, variance analysis.

[7]

Marginal Costing

Use of Marginal Costing in decision-making.

Capital Budgeting

Control of Capital Expenditure, Evaluation Process-Payback approach, IRR, present value method.

Text Books:

1. Bhattacharya A. K., "Principles and Practice of Cost Accounting", Prentice Hall India.
2. B K Bhar, "Cost Accounting – Methods and Problems", Academic Publishers
3. Khan M. Y., Jain P. K., "Financial Management", Tata McGraw Hill .

Reference Books:

1. Colin Drury, "Management and Cost Accounting", English Language Book Society, Chapman and Hall London

411102 (A): Project Management

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Course Outcomes: After learning the subjects students will be able to:

- 1) Demonstrate concepts of Project Management for planning to execution of projects.
- 2) Perform feasibility analysis in Project Management and network analysis tools for cost and time estimation.
- 3) Comprehend the fundamentals of Contract Administration, Costing and Budgeting.
- 4) Apply contemporary project management tools and methodologies in Indian context.

Unit 1: Introduction [7]

Definition of project, difference with respect to standard routine production. Parameters involved in Project identification. Difference in projects under private, public & joint sector.

Unit 2: Types of project [7]

Projects under BMRED - Balancing, Modernization, Replacement, Expansion & Diversification; Consideration involved in decision-making in each of these.

Unit 3: Project Formulation [7]

Preparation of feasibility Report & Specification; Budgeting; criteria for pre-investment decision; Incentives from state & central govt.; Import-substitution projects.

Unit 4: Project Finance [7]

Sources of Finance for project; Local & Foreign investments. Project Appraisal-i) Techno-commercial, ii) Financial- Discounted cash flow, rate of return, iii) Non-financial benefit, iv) Socio-economic cost benefit analysis.

Unit 5 Project costing [7]

Costs of Contracting; Labour & Equipment costs; Development & Codification of cost data; Accounting; Activity-Based costing.

Unit 6 Project Administration [7]

Cash flow planning; Project scheduling; PERT, CPM & GANTT Charts; Crashing, resource leveling, resource smoothening, Time- Cost trade -off; Project overruns costs; Participation & Team work.

Text Books:

1. Narendra Singh; Project Management & Control; Himalaya Publishing House, Mumbai.
2. Prasanna Chandra; Preparation, Appraisal, Budgeting, Implementation & Review; Tata McGraw Hill Publishing Company, New Delhi

411103(A): Simulation, Modeling and Digital Twin

Teaching Scheme

Lectures: 03 hours / week

Credit Scheme

Theory: 03

Examination Scheme

In-Sem: 30 Marks

End-Sem: 70 Marks

Pre-requisites: Engineering Mathematics, Design of Machine Elements, Computer Aided design, CAD (Computer Aided Engineering for work), basic programming (e.g. Java, Python, Matlab)

Course Outcomes: After learning this subject, the student will be able to:

1. Explain the techniques of modeling and simulation.
2. Students will learn different types of simulation techniques.
3. Simulate the models for the purpose of optimum control by using software.
4. Describe what digital twins are and their applications in industry
5. Identify the functions of a digital twin and its boundaries.
6. Develop a digital twin application.

Unit 1: Introduction to Simulation

(7)

System and System Environment, Components of System, Discrete and Continuous System, System Simulation, Model of a System, Types of Model, Use of Differential and Partial differential, equations in Modelling, Advantages, Disadvantages and Limitations of Simulation, Application, Areas, Phases in Simulation Study

Unit 2: Simulation of Continuous and Discrete System

(7)

Continuous System Models, Analog Computer, Analog Methods, Hybrid Simulation, Digital-Analog Simulators, Feedback Systems, Discrete Event Simulation, representation of time, Simulation Clock and Time Management, Models of Arrival Processes - Poisson Processes, Non-stationary Poisson Processes, Batch Arrivals; Gathering statistics, Probability and Monte Carlo Simulation, Markov Chain

Unit 3: Analysis, Verification and Validation of simulation systems

(7)

Design of Simulation Models, Verification of Simulation Models, Calibration and Validation of the models, Three-Step Approach for Validation of Simulation Models, Accreditation of Models Confidence Intervals and Hypothesis Testing, Estimation Methods, Simulation run statistics, Replication of runs, Elimination of initial bias

Unit 4: Digital twin

(7)

Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin

Unit 5: Digital Twin in a Process Industry

(7)

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise

Unit 6: Applications of Digital Twin

(7)

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.

Text books:

1. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol -Discrete Event System Simulation, III Edition, Pearson Education, Asia, (2001) ISBN - 81- 7808 - 505 - 4.
2. Narsingh Deo -Systems Simulation with Digital Computer; PHI Publication (EEE),(2011) ISBN - 0- 87692-028-8
3. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019, ISBN: 9780128176306

Reference:

1. Averill M Law, W David Kelton -Simulation Modeling & Analysis, McGraw Hill International Editions - Industrial Engineering series, (1991) ISBN - 0-07-100803-9.
2. Shyam Varan Nath and Pieter van Schalkwyk, Building Industrial Digital Twin, Packt Publishing Limited, (2021) ISBN-13 : 1839219078-978
3. Manisha Vohra, Digital Twin Technology, Wiley, 2022, ISBN: 9781119842200

411103(A): Total Quality Management (Elective-III)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Prerequisites: Industrial Engineering and Management, Production and Operations Management

Course Outcomes: After learning this subject, the student will be able to:

1. Demonstrate quality, quality dimensions, TQM principle and barriers
2. Implement principles of TQM
3. Apply seven quality tools
4. Evaluate reliability, maintainability, availability of machines
5. Perform quality audits and report writing

Unit I: Introduction

(6)

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs steps in reporting on quality cost - Basic, concepts of Total Quality Management, Historical Review, Principles of TQM, and Quality in Business and commerce, Leadership Principles, Role of Senior Management, Economic Issues - Quality and Price - Quality and Market Share - Quality and Cost, Quality Council, Quality Statements, strategic quality planning, service quality and product quality, determinants of service quality, Barriers to TQM Implementation.

Unit II: Principles of Total Quality Management

(6)

Elements of TQM, Benefits of Total TQM, customer satisfaction, customers perception of quality, Customer Complaints, Service Quality Customer Retention Employee Involvement Teamwork, Training, Recognition and reward, performance Appraisal, Continual process Improvement, Supplier partnership, Performance measures Deming's 14 Point programme - PDCA Cycle, The Juran Philosophy - The Juran Quality Trilogy. The Crosby and 14 Point programme. The Taguchi Loss Function, 5S, Kaizen,

Unit III: TQM Tools

(6)

Ishikawa's Seven Quality Tools, Ishikawa Fish bone diagram, Quality Circles, Poka Yoke (Mistake Proofing), Zero defect, JIT, Kanban, Benchmarking, Benchmarking process, code of conduct for Benchmarking, Types of Benchmarking, Steps in Benchmarking, Advantages and limitations in Benchmarking Quality, Function Deployment (QFD), House of Quality, QFD Process, Benefits,

Total Productive Maintenance (TPM) Concept, FMEA, Stages of FMEA

Unit IV: Reliability

(6)

Concept and Components, Types of failure, Reliability of system, Success and Failure models in series and parallel - Methods of achieving higher reliability - Concept of maintainability and availability, Weibull Distribution (Bath Tub curve), Comparison with reliability, MTBF, MTTF and FMEA

Unit V: Managing and organization for Quality

(6)

Need for organizing for quality, evaluation of organization for quality, requirements for quality coordination of quality activities, organizing for creating change, organizing for quality implementation, Roles in organizational changes to TQM, Various teams for TQM, Control Charts for variables and attributes, Process capability, Concept of six sigma, Auditing Techniques - Planning for an audit -Developing a Check-list -Conducting an Audit - Writing an Audit Report - Auditor Ethics- Value -addition process during Internal Audit - Mock Audits.

Unit VI: Quality Management Standards: (6)

ISO-Introduction, Major elements of ISO 9001:2000, ISO 9001:2000 QMS Requirements, Implementation of ISO 9001, ISO documentation, quality system 9000, Environmental management systems, ISO 14000 series standards, requirements of ISO14001, implementation and operation of EMS, Checking and corrective action, benefits of EMS, ISO 27001:2005 Information Security Management System, ISO / TS16949:2002 for Automobile Industry, CMMI Fundamentals and Concepts

Text Books

1. Dale H Bester, (2013) "Quality Control", Pearson Education, ISBN-13:9780135000953
2. Sundarrajan, (2011) "Total Quality Management", Pearson Education, ISBN-13: 9780130306517
3. Smith, (1998) "Quality Problem Solving", Quality Press, Wisconsin Avenue, USA, ISBN 9780873893947
4. James R.Evans and William M.Lidsay, (2002) "The Management and Control of Quality", 5th Ed., South-Western (Thomson Learning), ISBN-13:0324382358-978

Reference Books

1. Feigenbaum.A.V., (1991) "Total Quality Management", McGraw-Hill,. ISBN-13: 978-0070220034
2. Oakland.J.S., (1989) "Total Quality Management", Butterworth Heinemann Ltd., Oxford.. ISBN-13 : 0128110355-978
3. Narayana V. and Sreenivasan, N.S., (1996) "Quality Management - Concepts and Tasks", New Age International. ISBN-13 : 8122408324-978
4. Zeiri, (1991) "Total Quality Management for Engineers", Wood Head Publishers, , ISBN-13 : 1855730243-978

411103(A): Artificial Intelligence in Manufacturing (Elective-III)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Pre-requisites: Engineering Mathematics-II, Engineering Mathematics-III

Course Outcomes: After learning this subject, the student will be able to:

1. Demonstrate basic concepts of Artificial Intelligence and Machine Learning
2. Classify appropriate of Artificial Intelligence method according to different manufacturing functions
3. Develop Artificial Intelligence model of given manufacturing system
4. Apply Artificial Intelligence and soft computing methods to manufacturing problems
5. Evaluate the performance of Artificial Intelligence methods

Unit I: Introduction to Artificial Intelligence and Machine Learning

[7]

Definitions - Foundation and History of AI, Evolution of AI - Applications of AI area, Classification of AI systems with respect to environment. Industry 4.0, Application of AI in Manufacturing

Introduction to Machine Learning, Examples of Machine Learning Applications, Supervised, Unsupervised, and Semi-Supervised Learning, Reinforcement Learning, Linear Regression, Machine Learning and Big Data, Deep Learning, Artificial Intelligence vs Machine learning.

Unit II: Fuzzy Logic

[7]

Basic Concepts of Fuzzy Logic, Fuzzy Set theory, Fuzzy set versus Crisp set, Membership function, Operations on Fuzzy set, Fuzzy Relation, Fuzzification and Defuzzification, Minmax Composition, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification, Fuzzy controllers, Fuzzy expert Systems, Application of Fuzzy systems (Real life)

Unit III: Genetic Algorithm

[7]

Evolution of Genetic Algorithms (GA), Basic Concepts and working principle, Flow chart of GA, Genetic Representation, Basic GA framework and different GA architectures, GA operators: Crossover, Selection, Mutation, Fitness function, Convergence Working, Traditional Algorithm Vs Genetic Algorithm, Applications of Genetic Algorithm

Unit IV: Neural Networks

[7]

Introduction, Learning rules and activation functions, Single layer and multilayer Perceptron's, Feed forward and Back propagation networks, Architecture of Back propagation (BP) Networks, Back propagation Learning mechanism, Boltzmann Machine, Types of Artificial Neural Network(ANN), Introduction to Associative Memory, Adaptive Resonance, Self Organizing Map, Recent applications (real life)

Unit IV: AI based methods for Process Control and Monitoring

[7]

AI based Monitoring and control of discrete manufacturing process, Online process monitoring in additive manufacturing, Industrial Machine Vision.

Unit VI: AI Applications and Case Studies

[7]

Applications of AI in Manufacturing: robot, Intelligent Vehicles, factory, Autonomous Aircrafts, design and manufacturing, warehouse management, predictive maintenance, inventory control, visual inspections and quality control, etc. optimization and control.

Case studies of typical applications in tool selection, process selection, part classification, inventory control, process planning, etc.

Text Books:

1. Pratihari D. K. (2018) Soft Computing, Narosa Publishing, ISBN: 978-81-8487-495-2
2. Rich E., Knight K., Nair S. B. (2014) Artificial Intelligence, TMH, ISBN-978-0-07 008770-5 (2014).
3. Groover Mikell P. (2015) Automation, Production System and Computer Integrated Manufacturing, Pearson, ISBN 978-0-13-349961-2
4. Tom Mitchell (1997) Machine Learning, McGraw- Hill, ISBN: 0070428077

Reference Books:

1. Stuart Russell and Peter Norvig (2003) Artificial Intelligence: A Modern Approach, Prentice Hall, ISBN: 978-0-13-604259-4
2. Goldberg David E. (2002) Genetic Algorithms In Search, Optimization And Machine Learning, Pearson Education, ISBN: 9788177568293
3. Simon Haykin (2011) Neural Networks and Learning Machines, PHI Learning, ISBN: 978-0131471399

411103 (A): World Class Manufacturing (Elective III)

Teaching Scheme
Lectures:03hours/week

Credit Scheme
Theory:03

Examination Scheme
In-Sem:30Marks
End-Sem:70Marks

Prerequisites: Production Management, Industrial Engineering and Quality Assurance.

Course Outcomes:

After successful completion of course student will able to,

1. Define challenges in world class manufacturing
2. Study various world class manufacturing strategies.
3. Understand total quality and employee involvement in manufacturing
4. Discuss different world class information system for change management.
5. Identify various methods and processes for WCM using brain storming.

Unit I: Historical Perspective

[7]

World class excellent organizations- Models of world class manufacturing: Hall's framework of value -added engineering, Schonberger's framework of world class manufacturing, Various models of world class manufacturing, JIPM TPM Award, EFQM Award, RBNQA Award

Unit II: Benchmark, Bottlenecks and Best Practices

[7]

Concepts of benchmarking, Bottleneck and best practices, Best performers- Gaining competitive edge through world class manufacturing - Value added manufacturing - Value Stream mapping - Eliminating waste -Toyota Production System-Example.

UNIT III: System for World Class Manufacturing

[7]

Improving Product & Process Design - Lean Production, procurement & stores practices, total Productive maintenance, Visual Control

Unit IV: Tools for World Class Manufacturing

[7]

SQC, FMS, Poka Yoke, 5-S, 3 M, JIT, Product Mix, MURA Analysis, MUDA Analysis, Spaghetti Chart, MURI, SOP, Poka-Yoke

Unit V: Human Resource Management in WCM

[7]

Adding value to the organization- Organizational learning - techniques of removing Root cause of problems- People as problem solvers-New organizational structures. Associates-Facilitators- Teams man ship -Motivation and reward in the age of continuous improvement.

Unit VI: Indian Scenario

[7]

Case studies on leading Indian companies towards world class manufacturing -Task Ahead. Green Manufacturing, Clean manufacturing, Agile manufacturing

Text Books

1. K. Shridhara Bhat, World Class Manufacturing, Himalaya Publication House, Mumbai.(2007 edition)
2. B. S. Sahay, K B C Saxena, Ashish kumar, World Class Manufacturing Strategic Perspective, Mac Milan Publication, New Delhi

Reference Books:

1. Panner selvam, Production and Operation Management, Prentice Hall of India.
2. Martand T.Telsang Industrial Engineering and Production Management,S.Chand& Co.
3. Jeffrey K. Liker, The Toyota Way, Tata McGraw Hill.

411104 (A): Plant Maintenance and Industrial Safety (Elective IV)

Teaching Scheme
Lectures:03hours/week

Credit Scheme
Theory:03

Examination Scheme
In-Sem:30Marks
End-Sem:70Marks

Pre-requisites: Manufacturing Processes, Heat and Fluid Engineering.

Course objectives:

1. To ensure the desired plant availability at an optimum cost within the safety prescription.
2. Student able to know about the objectives of maintenance.
3. To minimize the total cost of unavailability and resources.
4. Discuss various condition monitoring techniques.
5. To know Industrial safety measures and acts.

Course outcomes

1. Describe the various categories of maintenance.
2. Assemble, dismantle and align mechanisms in sequential order.
3. Carry out plant maintenance using tribology, corrosion and preventive maintenance.
4. Student gets the exposure of Maintenance Policies and Preventive Maintenance.
5. Explain the Industrial safety measures and acts.

Unit I: Introduction, Principles and Practices of Maintenance Planning (07)

Definition and aim of maintenance engineering. Primary and secondary functions and responsibility of maintenance department. Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound Maintenance systems - Reliability and machine availability, Equipment Life cycle, Measures for Maintenance Performance: Equipment's breakdowns, Mean Time Between Failures, Mean Time To Repair, Factors of availability, Maintenance organization, Maintenance economics.

Unit II: Periodic and Preventive Maintenance and Maintenance Policies (07)

Periodic inspection-concept and need. Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation.

Unit III: Condition Monitoring (07)

Condition Monitoring: Cost comparison with and without Condition Monitoring, On-load and off-load testing. Methods and instruments for Condition Monitoring, Temperature sensitive tapes, Pistol thermometers, wear-debris analysis, noise vibration and harshness analysis of machines.

Unit IV: Introduction to the Development of Industrial Safety and Management (07)

History and development of Industrial safety: Implementation of factories act, Formation of various councils, Safety and productivity, Safety organizations. Safety committees, safety committee structure, Roll of management and roll of Govt. in industrial safety, Safety analysis.

Unit V: Accident Preventions, Protective Equipment and the Acts (07)

Personal protective equipment, Survey the plant for locations and hazards, Part of body to be protected, Education and training in

safety, Prevention causes and cost of accident, Housekeeping, First aid, Fire fighting equipment, Accident reporting, Investigations, Industrial psychology in accident prevention, Safety trials.

Unit VI: Safety Acts

(07)

Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act, Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety and health.

Text Books:

1. Srivastava, S.K., "Industrial Maintenance Management", S. Chand and Co. ISBN-10: 8121916631, ISBN-13: 978-8121916639
2. Bhattacharya, S.N., "Installation, Servicing and Maintenance", S. Chand and Co., ISBN: 9788121908313
3. Willie Hammer, "Occupational Safety Management and Engineering", Prentice Hall ISBN: 9781551642956.

Reference Books:

1. Eugene N. White, "Maintenance Planning, Control and Documentation", Gower Press, ISBN: 978-0566021442
2. Garg H.P., "Industrial Maintenance", S. Chand and Co., ISBN: 978-8121901680
3. Keith Mobley, Lindley R. Higgins, Darrin J. Wikoff, "Maintenance Engineering Hand book", 5th Edition, McGraw Hill, ISBN:9780071641012, 0071641017
4. Davies, "Handbook of Condition Monitoring: Techniques and Methodology", Springer Netherlands, ISBN:9789401149242,
5. C. Ray Asfahl, David W. Rieske, "Industrial Safety and Health Management", 5th Edition, Prentice Hall ISBN:9780132368711
6. R.C.Mishra, "Reliability and Maintenance Engineering", New Age Publishing house, ISBN:9788122417418

411104 (A) : Surface Engineering (Elective IV)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Pre-requisites: Material Science and Metallurgy, Manufacturing Processes, Machining science and technology.

Course Outcomes: After learning this subject, the student will be able to:

6. Demonstrate basic concepts of various surface treatments
7. Decide the surface treatment required for specific material and application.
8. Use various surface cleaning processes.
9. Select appropriate coating required for specific material and its application.
10. Test the surface of material for required properties.

Unit I: Introduction of Surface Dependent Properties

(7)

Introduction to various corrosion prevention methods. Classification and scope of surface modification techniques in metals, ceramics, polymers and composites, tailoring of surfaces of advanced materials. Surface dependent engineering properties, viz., wear, friction, corrosion, fatigue, reflectivity, emissivity, etc.; common surface initiated engineering failures; mechanism of surface degradation; importance and necessity of surface engineering

Unit II: Surface Cleaning Processes

(7)

Classification and Selection of Cleaning processes. Acid and Alkaline Salt bath, Ultrasonic, Mechanical cleaning, Pickling and descaling, etc. Process details, applications & Environmental concern of each method, Electrochemistry and electro-deposition; electro less deposition. Process details. Scope and application of conventionally deposited materials like Copper Nickel etc.

Unit III: Coatings

(7)

Various types like Cathodic & Anodic coatings, Hot dipping (Tinning, Galvanizing, Aluminizing), Metal cladding. Diffusion coatings like carburizing, nitriding, cyaniding, Sherardizing, Calorizing & Chromizing. Chemical conversion coatings like Phosphate; Chromate

Oxide, Anodized. Various Organic coatings like Paints, varnishes, Enamel & Lacquers Thermal spray coatings- Various types like Flame spray, Electric arc spray, Plasma spray, High velocity Oxy Fuel (HVOF). Scope, Process and application; advantages and limitations of the above mentioned processes.

Unit IV: Other Surface Engineering Processes

(7)

Influence of manufacturing processes on various surface properties of an engineering component; scope of surface engineering in augmentation of surface properties. Other processes used in surface engineering - Physical vapour deposition, Chemical vapour deposition.- Process, applications. Mass production; surface engineering problems related to substrate characteristics. Plasma enhanced Surface engineering, Ion Implantation. Diamond and Diamond like Carbon thin films and coatings for engineering surfaces.

Unit V: Testing & Characterization of Coatings

(7)

Control properties, response properties; surface geometry characterization Techniques (conventional and recent trends); coating thickness measurements - laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement, conventional methods and recent developments; Quality assurance of coating process.

Unit VI: Recent Trends in Surface Engineering

(7)

Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale, simulation of actual application environment in tribometer. High temperature coatings,

Wear resistant coatings Use of Laser in Surface Engineering, Environmental protection issues.

Text Books

1. D. Srinivasa Rao, Shrikant V. Joshi, "Surface Engineering", Daya Publishing House, ISBN: 9788170356288, 9788170356288
2. M. Kamaraj, V. M. Radhakrishnan, "Basics of Surface Technology", New Age International (p) Ltd., ISBN: 9788122439601

Reference Books

1. Bharat Bhushan, "Introduction to Tribology" John Wiley & Sons, ISBN: 0471158933
2. B. N. J. Persson, "Sliding Friction: Physical Principles and Applications" Springer, ISBN: 978-3540671923
3. Gwidon Stachowiak, A W Batchelor, "Engineering Tribology", Butterworth-Heinemann, Hardcover ISBN: 9780750678360, eBook ISBN: 9780080531038
4. ASM Hand Book, Vol. 5, "Surface Engineering". ISBN: 9780871703842
5. Bhushan B. and Gupta B. K., "Handbook of Tribology: Material, Coatings and Surface Treatments", McGraw Hill Ltd.
6. Davis J., "Surface Engineering for Corrosion and Wear Resistance", Woodhead Publishing, 2001. ISBN 10: 0871707004 ISBN 13: 9780871707000
7. Tadausz Burakowski, "Surface Engineering of Metals: Principles, Equipments and Technologies", Taylor and Francis.

411104(A): Reverse Engineering (Elective IV)

Teaching Scheme
Lectures: 03 hours/week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Pre-requisites: Computer Aided Design, Electrical & Electronics Engineering, Design of Machine Elements.

Course Outcomes: After learning this subject, the student will be able to:

1. Interpreting the terminologies related to re-engineering, forward engineering, and reverse engineering.
2. Disassemble products and specify the interactions between its subsystems and their functionality
3. Implement the Reverse Engineering methodologies.
4. Apply reverse engineering system to automotive, aerospace, medical device industries.

Unit I: Introduction to Reverse Engineering

(7)

What is Reverse Engineering, Use of Reverse Engineering, Reverse Engineering-The Generic Process, Scanning: Contact Scanners, Noncontact Scanners, Point Processing, Application Geometric Model Development.

Unit II: Methodologies and Techniques for Reverse Engineering

(7)

3-D Laser Scanners, Computer-aided Reverse Engineering, What Is Not Reverse Engineering, Computer-aided (Forward) Engineering, Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering, Coordinate Measuring Machines, Active Illumination 3-D Stereo: Benefits and Drawbacks, Structured-light Range Imaging, Source Illumination Categories, sheet-of-light Range Imaging, Scanner Pipeline, Data Collection, Mesh Reconstruction, Surface Fitting.

Unit III: Reverse Engineering–Hardware and Software

(7)

Introduction, Reverse Engineering Hardware, Contact Methods, Noncontact Methods, Destructive Method, Reverse Engineering Software, Reverse Engineering Software Classification, Reverse Engineering Phases, Fundamental Reverse Engineering Operations.

Unit IV: Selection of a Reverse Engineering System

(7)

The Selection Process: Identify the Business Opportunity and Technical requirements, Vendor and System Information Gathering, Benchmarking, Point Capture Devices, contact Devices-Hard or Manual Probe, Touch-trigger Probe, Continuous Analogue Scanning Probe, Noncontact Devices, Triangulation, “Time-of-flight” or Ranging Systems, Structured-light and Stereoscopic Imaging Systems, Issues with Light-based Approaches, Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive Systems, Positioning the Probe, Postprocessing the Captured Data, Handling Data Points, Curve and Surface Creation, Inspection Applications, Manufacturing approaches

Unit IV: Rapid prototyping for Reverse Engineering

(7)

Modeling Cloud Data in Reverse Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer-based Model Generation, The Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Correlation Coefficient, Initial Point Determination, Constructing the First Line Segment (S1), Constructing the Remaining Line Segments (Si, Determination of Adaptive Layer Thickness)

Unit VI: Applications of Reverse Engineering

(7)

Applications of Reverse Engineering in Automotive Industries, Aerospace Industries, Medical Device Industries, Legal Aspects of Reverse Engineering, Barriers to Adopt Reverse Engineering

Reference books:

1. K. Otto and K. Wood (2001) Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall (ISBN 10: 0130212717 / ISBN 13: 9780130212719).

2. Raja and Fernandes (2008) Reverse Engineering: An Industrial Perspective, Springer-Verlag (ISBN: 978-1-84628-855-5).
3. Sokovic and Kopac (2006) RE as necessary phase by rapid product development, Journal of Materials Processing Technology, Elsevier (doi:10.1016/j.jmatprotec.2005.04.047).
4. Eldad Eilam (2005) Reversing: Secrets of Reverse Engineering, Wiley (ISBN : 0-7645-7481-7).
5. Robert W. Messler (2014) Reverse Engineering: Mechanisms, Structures, Systems & Materials, McGraw-Hill Education (ISBN: 9780071825160).

411104 (A): Entrepreneurship and Innovations (Elective IV)

Teaching Scheme
Lectures:03hours/week

Credit Scheme
Theory:03

Examination Scheme
In-Sem:30Marks
End-Sem:70Marks

Pre-requisites: Industrial Engineering and Management, Production Management

Course objectives:

1. Students to learn the various aspects of innovation and methods of fostering Innovation
2. Understanding the dynamic role of entrepreneurship and small businesses
3. Organizing and Managing a Small Business
4. Financial Planning and Control
5. New Product or Service Development
6. Business Plan Creation

Course outcomes:

After Successful completion of this course students will able to:

1. learn the various aspects of innovation and methods of fostering Innovation
2. Appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
3. Start a small business enterprise by liaising with different stake holders
4. Effectively manage small business enterprise.

Unit I: Introduction to Innovation

(7)

Creativity, Invention and innovation, Types of Innovation, Relevance of Technology for Innovation, The Indian innovations and opportunities, Promoting and managing innovation, Innovators and Imitators, Patents, Trademarks, Intellectual Property, Exploring, Executing, Leveraging and renewing innovation, Enhancing Innovation Potential & Formulating strategies for Innovation

Unit II: Strategy for Commercializing Innovation

(7)

Innovation Process, Risks and barriers for introducing products and services, selecting a Strategy, setting up the Investment and establishing 19rganization, Evaluating the Costs and impact of the Project

UNIT III: Entrepreneurship

(7)

Definition. Growth of industries in developing countries; role of industries in the national economy; characteristics; demand based and resources based ancillaries and sub-control types. Government policies, stages in starting an industry, types (family business/start-ups etc.), Sources of finance.

UNIT IV: Project identification and accountancy

(7)

Assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods,

Accountancy: Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, preparation of financial reports, accounts and stores studies.

UNIT V: Project Planning and control

(7)

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure

and operations. Control of financial flows, control and communication.

UNIT VI: Laws

(7)

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act.
Role of various national and state agencies which render assistance to small scale industries.

Text Books:

1. Robin Lowe and Sue Marriott, Enterprise: Entrepreneurship and Innovation Concepts, Contexts and Commercialization, ISBN: 978-0-7506-6920-7
2. Khanka. S.S., "Entrepreneurial Development", S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013. ISBN: 978-81-219-1801-5
3. Donald F Kuratko, "Entrepreneurship - Theory, Process and Practice", 9th Edition, Cengage Learning 2014. ISBN:9781305576247, 1305576241

Reference Books

1. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998. ISBN:9780761992844, 0761992847
2. Peter F. Drucker, Innovation and Entrepreneurship, ISBN:9780750685085, 0750685085
3. John Forbat, "Entrepreneurship: The Seeds of Success", Harriman House, 2007, ISBN: 1905641257; 9781905641253.
4. Veerbhadrappa Havinal, "Management and Entrepreneurship", 2009, New Age International, ISBN:9788122426021, 8122426026
5. Joseph, L. Massod, "Essential of Management", Prentice Hall of India.

411101(B): Financial Management & Costing Lab

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 01

Examination Scheme

Oral: 50 Marks

During the practical students should be asked to solve real life cases on

1. Financial Management - theory assignment
2. Ratio Analysis
3. Working Capital Management
4. Costing
5. Depreciation
6. Overheads
7. Standard costing
8. Marginal Costing

411102 (B): Project Management Lab

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 01

Examination Scheme

Practical: 50 Marks

During the practical students should be asked to solve at least 8 real life cases on the following topics making sure that there is at least one case on each topic.

1. Project Management - General write up
2. Types of project
3. Project Formulation
4. Project Finance
5. Project costing
6. Project Administration

411103(B): Simulation, Modeling and Digital Twin (Elective-III) Lab

Teaching Scheme

Lectures: 2 hours / week

Credit Scheme

Pr/Or: 1

Examination Scheme

Term work: 25 Marks

Term work shall consist of Programming/Assignment/Case studies on Simulation, Modelling and Digital Twin, based on each unit.

411103(B): Total Quality Management (Elective-III) Lab

Teaching Scheme

Lectures: 2 hours / week

Credit Scheme

Pr/Or: 1

Examination Scheme

Term work: 25 Marks

Term work shall consist of Assignment/Case studies on Total Quality Management, based on each unit.

411103 (B): Artificial Intelligence in Manufacturing (Elective-III) Lab

Teaching Scheme
Practical: 02 hours / week

Credit Scheme
Pr/Or: 01

Examination Scheme
Oral: 25 Marks

Write computer programs in python/matlab to solve the real-world problems in manufacturing using the following artificial intelligence and machine learning methods:

1. Linear Regression,
2. Logistic Regression,
3. Multi-Class Classification,
4. Neural Networks,
5. Support Vector Machines,
6. K-Means Clustering
7. Genetic Algorithms
8. Fuzzy logic

411103(B): World Class Manufacturing (Elective-III) Lab

Teaching Scheme

02 hours/week

Credit Scheme

Pr/Or:02

Examination Scheme

Oral: 25 Marks

The term work shall be based on the following Practical Sessions:

1. Assignment on overview of Historical Perspective world class manufacturing.
2. Assignment on Benchmark, Bottlenecks and Best Practices used in world class manufacturing
3. Assignment on Lean Production and Procurement System for World Class Manufacturing
4. Assignment on SQC, FMS, Poka Yoke, 5-S, 3 M, and JIT Tools for World Class Manufacturing
5. Assignment on Human Resource Management in WCM
6. Case studies on leading Indian companies towards world class manufacturing

411104 (B): Plant Maintenance and Industrial Safety (Elective-IV) Lab

Teaching Scheme
Lectures: 02hours/week

Credit Scheme
Pr/Or:01

Examination Scheme
Oral : 25 Marks

Term work will be based on following six assignments:

1. Introduction, principles and practices of Maintenance planning
2. Periodic and preventive maintenance and Maintenance policies
3. Condition Monitoring
4. Introduction to the development of industrial safety and management
5. Accident preventions, protective equipment and the Acts
6. Industrial safety acts

411104 (B) : SURFACE ENGINEERING (Elective-IV) Lab

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 01

Examination Scheme

Oral: 25 Marks

Term work: Term work will consist of one exercise on each unit.

411104 (B): Reverse Engineering (Elective-IV) Lab

Teaching Scheme

Lectures: 02 hours/week

Credit Scheme

Theory: 01

Examination Scheme

Oral: 25 Marks

Term Work:

Students should write assignment on (with the help of research papers, case study, etc.)

1. Assignment 1. Introduction to Reverse Engineering
2. Assignment 2. Methodologies and Techniques for Reverse Engineering
3. Assignment 3. Reverse Engineering-Hardware and Software
4. Assignment 4. Selection of a Reverse Engineering System
5. Assignment 5. Rapid prototyping for Reverse Engineering
6. Assignment 6. Applications of Reverse Engineering

411104 (B): Entrepreneurship and Innovations (Elective-IV) Lab

Teaching Scheme

Lectures: 02 hours/week

Credit Scheme

Pr/Or: 01

Examination Scheme

Oral: 25Marks

Term work will be based on six assignments from following:

1. Introduction to Innovation.
2. Strategy for commercializing Innovation.
3. Introduction to Entrepreneurship.
4. Project identification and Accountancy.
5. Project planning and control.
6. Laws concerning entrepreneur.

411105: MOOCs

Teaching Scheme

NA

Credit Scheme

Theory: 02

Examination Scheme

TW: 50 Marks

Students should complete any one of the following MOOCs courses: The assessment will be either based on the online score obtained in that course or by giving the assignments on the course chosen by the student.

1. Developing Soft Skills and personality
2. Enhancing Soft Skills and personality
3. Speaking Effectively 8 Weeks
4. Introduction to Industry 4.0 and Industrial Internet of Things
5. Emotional Intelligence.
6. Patent Law for engineers and Scientist.

411106: Project Stage-I

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 02(TW-1 & Oral-1)

Examination Scheme

Term-work: 50 Marks

Pre-requisite:

1. Students are required to undergo 3 to 4 weeks industrial training / implant training /in-house project based learning/project related skill development course/ industrial survey report before commencement of first semester of Final year
2. Submit detailed report of 10-15 pages of the same.
3. Project registration will be based on completion of above activities.

The student shall take up a suitable project, the scope of the project shall be such as to complete it within the time schedule, and the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems

and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. **Students shall submit the project phase -II plan.** Above work shall be taken up individually or in groups. *The group shall not be more than 4 students, (If project work is more then group members may be increased by permission of guide)*

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the following types:
 - i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation
 - ii. Improvement of existing machine / equipment / process.
 - iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose Equipment, inspection gauges, measuring instruments for machine tool,
 - iv. Computer aided design, analysis of components such as stress analysis.
 - v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
 - vi. Energy Audit of an organization, Industrial evaluation of machine devices.
 - vii. Design of a test rig for performance evaluation of machine devices.
 - viii. Product design and development.
 - ix. Analysis, evaluation and experimental verification of any engineering problem
 - x. Quality systems and management. Total Quality Management.
 - xi. Quality improvements, In-process Inspection, Online gauging.
 - xii. Low cost automation, Computer Aided Automation in Manufacturing.
 - xiii. Time and Motion study, Job evaluation and Merit rating
 - xiv. Ergonomics and safety aspects under industrial environment
 - xv. Management Information System.
 - xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy. Two copies of project Report shall be submitted to the college. **The students shall present and submit their Project Phase-I report to the internal and external examiner from college/Industry.**

411107: Audit Course 7: Human Rights

Course outcomes

After completing the course the students will be able to:

1. Understand the importance and different approaches to Human rights
2. Understand the different mechanisms of United Nations to ensure and protect the Human Rights
3. Understand the different Constitutional provisions and legislations to protect Human Rights in India
4. Analyse the functions of NHRC, Judiciary and PIL for protecting Human Rights in India
5. Examine the challenges to Human Rights of different vulnerable sections

Unit I: Human Rights

Meaning, Evolution and Importance, Approaches: Western, Marxian, Feminist and Third World

Unit II: Uno and Human Rights

Universal Declaration of Human Rights, International Covenants on Civil and Political Rights (ICCPR), International Covenant on Social Economic and Cultural Rights (ICSECR), The Office of the United Nations High Commissioners for Human Rights (UNHCHR)

Unit III: Human Rights in India

Constitutional Provisions- Fundamental Rights, Directive Principles of State Policy, Some important Legislations- 1) Protection of Civil Rights Act-1955, 2) Prevention of Atrocities (SC and ST) Act 1989, 3) Sexual Harassment of Women at workplace (Prevention, Prohibition and Redressal) Act, 2013, 4) The Rights of Persons with Disabilities Act-2016, 5) Right to information Act 2005. Agencies Protecting Human Rights; Judiciary, Public Interest Litigation, National Human Rights Commission and Media

Unit IV: Challenges to Human Rights

Human Rights Violations against Women, Children, Other marginalised sections like Minorities, Dalits, Adivasis and Women, Refugees

Reference Books:

- 1 Andrew Clapham, Human Rights: A Very Short Introduction, Oxford University Press, New York, 2007
- 2 Darren J O Byrne, (ed), Human Rights: An Introduction, Pearson, New Delhi, 2004
- 3 Chiranjeevi Nirmal, Human Rights in India, Oxford University Press, New Delhi, 1997.
- 4 Pavithran K S, (ed), Human Rights in India: Discourse and Contentions, Gyan books, New Delhi, 2018
- 5 Ujwal Kumar Singh, (ed), Human Rights and peace: Ideas, Laws, Institutions and Movements, Sage, New Delhi, 2009

411110 (A): Advanced Ergonomics (Elective V)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

- Unit 1- Introduction** [7]
Historical background. Modern ergonomics, Future direction. Human Machine Systems - interfaces.
- Unit 2 – Anatomy, Posture and Body Mechanics** [7]
Muscle Functioning, Spine, Musculoskeletal problems in Sitting and Standing.
- Unit 3 - Anthropometric Principles** [7]
Anthropometric Data - sample, equipment, analysis. Applications of Anthropometry in Design. Workstation design for standing and seated posture.
- Unit 4 – Upper Body at Work** [7]
Injuries due to upper body at work, Neck problems, shoulder, elbow and wrist, Design of manual handling tasks.
- Unit 5 – Physiology, Workload and Work Capacity** [7]
Energy for action, cardiovascular system, Physical work capacity, Factors affecting work capacity, fitness for work. Vision - Measurement of light, Lighting design consideration, visual fatigue. Sound and Noise - Measurement, Industrial Noise control, Thermal conditions - Measurement, effect on human being.
- Unit 6 – Legal Aspects** [7]
Legal and Safety Aspects.
- Practical:** One assignment based on each of the topics mentioned above.

Text Books:

1. M. S. Sanders and Ernest J. McCormick, *Human Factors Engineering and Design*, McGraw-Hill Inc.
2. E. Grad jean, *Fitting Task to the Man* Taylor and Francis.
3. The Factories Act, 1948.

Reference Books:

1. ILO, *Introduction to Work study*.
2. Curie R. M. & Faraday, *Work study* Pitman for the British Institute of Management
3. R. S. Bridger, *Introduction to Ergonomics*, Taylor and Francis
4. Nordin, Anderson, Pope, *Musculoskeletal Disorders at Workplace: Principles and Practice* - ISBN-13:978-0-323-02622-2, Mobsy Inc.
5. ILO, *Encyclopedia of Occupational Health and Safety*.
6. Waldemar Karwowski, William Steven Marras, *Occupational ergonomics: design and management of work systems*, CRC Press,

411110 (A): Logistics and Warehousing Management (Elective V)

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theory: 03	In-Sem: 30 Marks End-Sem: 70 Marks

UNIT 1 – Introduction [7]

Logistics. Producer - Consumer system. Logistics communication, costs & role of modern technology in logistics management

UNIT 2 - Marketing and product distribution [7]

Inter dependence and interaction. Multilevel system and sensitivity analysis

UNIT 3 - Logistic information system [7]

Nature, purpose and scope of information system, Customer order cycle and order processing neutral networks bar-coding.

UNIT 4 – Transportation [7]

Time and place utility, transportation -logistic -marketing interface different modes of transportation - merits demerits and costs

UNIT 5 – Warehousing [7]

Nature purpose and scope of warehousing. Own warehouse, third party warehouses. Economics of warehousing. Inventory management; Material handling storage and packaging issues

UNIT 6 – Logistics Support [7]

Organizing for effective logistic support -strategies supply chain management in the context of globalization

Practical: One assignment based on each of the topics mentioned above.

Text Books:

- 1) Douglas Lambert, James Stock Ellram; *Fundamentals of Logistics Management*, Mc Graw Hill Publication
- 2) Ronald H., Balfour, *Basic Business Logistics*, Prentice Hall of India
- 3) Benjamin & Blamhord, *Logistics Engineering and Management*, Prentice Hall of India

411110 (A) : Material Forming (Elective V)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

UNIT I - Fundamentals of Material Forming

[7]

Engineering stress-strain and true stress-strain, Strain hardening, work done in tensile test, temperature rise in plastic deformation compression test, Concept of flow stress determination, Effect of temperature, strain rate, Mohr's circle for three dimensional state of stress Theory of plasticity- Yield criteria of Von Mises criteria and Tresca criteria. Classification of material forming process. Concept of workability, formability and forming diagram.

UNIT II - Forging Processes

[7]

Comparison of forging with other manufacturing processes. Classification of forging processes-open die and closed die forging Forging equipment- Hammers and presses, construction working capacities and selection of equipment. Basic forging operations such as drawing, fullering, edging, blocking etc. Determination of forging load considering friction, Other forging techniques- Liquid metal forging, Isothermal forging, Rotary swaging, Orbital forging Lubrications in forging. Forgability tests, Forging defects and remedies.

UNIT III - Wire and Tube Drawing

[7]

Introduction rod and wire drawing machines - construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Variables in wire drawing, Maximum reduction in wire in one pass, forces required in drawing. Multiple drawing, work hardening, lubrication in wire drawing. Tube drawing: Methods, force calculation, stock preparation. Lubrication in tube drawing

UNIT IV - Rolling of Metals

[7]

Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening, Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Lubrication in rolling

UNIT V – Extrusion

[7]

Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock penetration. Extrusion ratio Force equipment (with and without friction), metal flow in extrusion, defects. Role of friction and lubricants. Manufacture of seam-less tubes.

UNIT VI - Miscellaneous Forming processes

[7]

High velocity forming- principles, comparison of high velocity and conventional Forming processes. Explosive forming, Magnetic pulse forming, Electro hydraulic forming, Stretch forming, coining embossing, curling, spinning, flow forming advantages, limitations and application of the process.

Practical: To be based upon each of the units above.

TEXT BOOKS:

1. Rao P. N., "Manufacturing Technology", Tata McGrawHill Publishing Company Ltd.
2. Groover Micel P., "Fundamentals of Manufacturing", John Wiley & Sons.
3. Banabick Dorel, "Advanced Methods in Material Forming", Springer, Verlag, Berlin, Heidenberg
4. Date P. P., "Introduction to Manufacturing Technology, Principles and Practices", Jayco Publishers, Mumbai

Reference Books:

1. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill
2. William F. Hosford, Robert M. Caddell - Metal forming: mechanics and metallurgy, Cambridge University Press (2007) - Hardback - 312 pages - ISBN 0521881218
3. ASM Metal handbook Volume IV Forming.
4. G. W. Rowe, *Principles of Industrial Metal Working Processes*, Edward Arnold

411110 (A) : Human Resource Management (Elective V)

Teaching Scheme

Lectures: 03 hours / week

Credit Scheme

Theory: 03

Examination Scheme

In-Sem: 30 Marks

End-Sem: 70 Marks

UNIT I - Fundamentals of HR Management

[7]

Importance of HRM to an organization. Changes in technology, work-force diversity, and skill requirements affect human resource management. Identify the four external influences affecting human resource management. Characterize how government legislation, Labor unions, and management practices affect HRM. Describe the goals, components and major activities within HRM.

UNIT II – Job Design and HR Planning

[7]

Job design: definition, approaches, job design options; Job analysis: definition, process, benefits of job analysis

HR planning: introduction, objectives of HRP, linkage of HRP to other plans, definition and need for HRP, benefits of HRP, factors affecting HRP, process, problems and limitations of HRP

UNIT III - Recruiting & Selection

[7]

Define what is meant by the term recruiting. Identify the principal sources involved in recruiting employees. Describe the selection process. Discuss the problems associated with job interviews and means of correcting them. Discuss the use of various types of interview questions

UNIT IV - Benefits & Rewards

[7]

Explain various classifications for rewards. Define goal of compensation administration. Discuss job evaluation and approaches. Describe competency and team-based compensation programs. Discuss why employers offer benefits to their employees. Contrast Social Security unemployment compensation and worker's compensation benefits. Identify and describe insurance options

UNIT V - Evaluating Performance

[7]

Identify purposes of performance management systems and who is served by them. Describe the two categories of difficulties in Performance Management Systems. Explain the steps in the appraisal process. Describe the absolute and relative methods of appraising employees. Discuss how management by objectives (MBO) can be used as an appraisal method. Identify ways to make performance management systems more effective

UNIT VI - Ethics in HRM & Labor Relations

[7]

Define "ethics" and "code of ethics". Describe what determines whether or not a code of ethics will be effective in an organization. Discuss HRM's role in ensuring that ethics exist in an organization and are adhered to. Describe the guidelines for making ethical choices. Define what is meant by the term unions. Discuss the effect of Wagner and Taft-Hartley Acts on labor management relations. Describe the components of the collective-bargaining process

Practical: To be based upon each of the units above

TEXT BOOKS:

1. DeCenzo, David A. and Robbins, Stephen P., "Fundamentals of Human Resource Management", John Wiley and Sons, Inc. New York (ISBN 978-0-470-00794-5)

2. Raymond Noe, Raymond Andrew Noe, John Hollenbeck, Barry Gerhart, Patrick M. Wright, *"Humna Resource Management"*, McGraw-Hill Irwin

REFERENCE BOOKS:

1. K. Ashwathappa, *"Human Resource & Personnel Management"*, Tata McGraw Hill
2. Fisher Cynthia, Schoenfeldt Lyle F., Shaw James B., *"Human Resource Management"*, Houghton Mifflin Co.
3. Dessler Gary, *"Human Resource Management"*, Person Publications

411111 (A) : Industrial Laws (Elective VI)

Teaching Scheme

Lectures: 03 hours / week

Credit Scheme

Theory: 03

Examination Scheme

In-Sem: 30 Marks

End-Sem: 70 Marks

UNIT I - The Industrial Disputes Act, 1947

[7]

Extent. Works Committee, Conciliation Officers, Board of Conciliation, Court of Inquiry, Labour Courts, Tribunals, National Tribunal. Procedure, power and duties of the authorities. Strikes and lockouts, layoffs and retrenchment, closure. Unfair labour practices, Penalties.

UNIT II - The Trade Union Act 1926

[7]

Formation of Trade Unions, Collective bargaining capacity.

UNIT III - The Industrial Employment [Standing Orders] Act, 1946 (20 of 1946):

[7]

Draft Standing Orders, conditions for certification of Standing Orders, Appeals, Register of Standing Orders. Temporary application of model standing orders.

UNIT IV - The Factories Act, 1948

[7]

Health, Safety, Provisions relating to Hazardous Processes, Welfare, Working Hours of Adults, Employment of young persons, Annual Leave with wages.

The Employees' Provident Fund & Miscellaneous Provisions Act, 1952 (10 of 1952).

Employee's Provident Fund Schemes, Central Board, Employee's Pension Scheme, Employee's Deposit Linked Insurance Scheme, Contributions.

UNIT V - The Sale of Goods Act, 1930 (3 of 1930)

[7]

Contract of Sale, Formalities of Contract, Subject Matter of Contract, the Price, Conditions and Warranties. Transfer of Property as between seller and buyer, Transfer of title.

UNIT VI - The Monopolies and Restrictive Trade Practices Act, 1969 (54 of 1969) & The Competition Act, 2002 [7]

Monopolies and Restrictive Trade Practices Commission, Unfair and Restrictive trade practices. The Competition Commission,

Text Books:

1. Pramod Verma, *Management of Industrial Relations*, Oxford and IBH Publishing Co., Mumbai.
2. C. Jagamohandas and Co., Mumbai - publications of Acts with short notes.
3. Taxman, Commercial Laws.
4. Taxman, Labour Laws.

Reference Books: Bare Acts and Bare Acts with Cases for each of these.

411111 (A) : World Class Manufacturing (Elective VI)

Teaching Scheme

Lectures: 03 hours / week

Credit Scheme

Theory: 03

Examination Scheme

In-Sem: 30 Marks

End-Sem: 70 Marks

Unit 1 - Industrial Decline and Ascendancy

[7]

Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade - American decade - Global decade

Unit 2 - Building strength through customer - Focused principles

[7]

Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing

Unit 3 - Value and Valuation

[7]

Product Costing - Motivation to improve - Value of the enterprises

Quality

The Organization : Bulwark of stability and effectiveness - Employee stability - Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability

Unit 4 - Strategic Linkages

[7]

Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence

Unit 5 – Impediments

[7]

Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines - Whole Plant

Unit 6 - Remaking Human Resource Management

[7]

Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous improvement

Text Books

1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs - *Operations Management for Competitive Advantage*, McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, *Making Common Sense Common Practice: Models for Manufacturing Excellence*, Elsevier Multiworth
3. Narayanan V. K., *Managing Technology & Innovation for Competitive Advantage*, Pearson Education Inc.
4. Korgaonkar M. G., *Just In Time Manufacturing*, MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, *World Class Manufacturing*, MacMillan Publishers

411111 (A) : Machine Tool Technology (Elective VI)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Unit I – Drives [7]

Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box. Stepless drives, Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking,

Unit II - Design of Machine Tool Structures [7]

Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables.

Unit III - Design of Guide-ways and Power Screws [7]

Functions and types of guideways, design criteria and calculation for slideways, design of hydrodynamic, hydrostatic and aerostatic slideways, Stick-Slip motion in slideways. Design of power screws: Distribution of load and rigidity analysis.

Unit IV - Design of Spindles and Spindle Supports [7]

Design of spindle and spindle support using deflection and rigidity analysis, analysis of anti-friction bearings, preloading of antifriction bearing.

Unit V - Dynamics of machine tools [7]

Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools. Control Systems: Mechanical and Electrical, Adaptive Control System, relays, push button control, electrical brakes, drum control.

Unit VI - Advances in Machine Tool Design [7]

Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices.

Text Books:

1. N. K. Mehta, *Machine Tool Design*, Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya A., Sen S. G., *Principles of Machine Tool*, New Central Book Agency, Kolkata, ISBN 81-7381-1555.
3. D. K Pal, S. K. Basu, *Design of Machine Tool*, Oxford & IBH Publishing Company, New Delhi, ISBN 81-204- 0968.
4. N. S. Acherkan, *Machine Tool*, Vol. I, II, III and IV, MIR Publications.
5. F. Koenigsberger, *Design Principles of Metal Cutting Machine Tools*, The Macmillan Company New York 1964.

Reference Books:

1. Joshi P. H., *Machine Tools Handbook – Design & Operation*, Tata McGraw Hill Publishing Company Ltd., New Delhi
2. Date P. P., *Introduction to Manufacturing Technology, Principles and Practices*, Jayco Publishers, Mumbai

411111 (A) : Development of Professional Skills (Elective VI)

Teaching Scheme
Lectures: 03 hours / week

Credit Scheme
Theory: 03

Examination Scheme
In-Sem: 30 Marks
End-Sem: 70 Marks

Unit I – Introduction

[7]

Status of youth employment - Global, Asian and Indian scenario, employment by organized and unorganized sectors in India, challenges and opportunities in turning job seekers into job creators, An entrepreneurship as an alternative.

Unit II - Types of Organizations and Current issues

[7]

The Government policy environment, problems in current youth environment, problems in India, Education gaps, role of stakeholders in entrepreneurship - Government, NGOs, financial institutions, corporate sector, industrial parks, educational and training institutes, Overview on rules and regulations for different types of business units.

Unit III –Entrepreneur

[7]

Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of entrepreneur, Entrepreneur - an emerging class, Concept of Entrepreneurship-Evolution of Entrepreneurship; Development of Entrepreneurship; The entrepreneurial Culture; Stages in entrepreneurial process.

UNIT IV – Creativity and Innovation

[7]

Creativity and Innovation: Creativity, Exercises on Creativity, Source of New Idea, Ideas into Opportunities. Creative problem solving: Heuristics, Brainstorming, Syntectics, Value Analysis, Innovation and Entrepreneurship: Profits and Innovation, Globalization, Modules of Innovation, Sources and Transfer of Innovation, Why Innovate, What Innovation, How to Innovate, Who Innovates.

UNIT V – Intellectual Property Rights

[7]

Origins of Intellectual Property Law, Trade Secrets Trademark, Rights of Publicity & Moral Rights Copyright, Patent International Protection and the Future of Intellectual Property Law. The competing rationales for protection of rights in Copyright Trademarks Patents designs Introduction to the leading international instruments concerning intellectual property rights: the Berne convention, Universal Copyright Convention, the Paris Union, the World Intellectual Property Rights Organization (WIPO) and the UNESCO; TRIPS; WIPO.

UNIT VI – Copyrights and Trademarks

[7]

Meaning of Copyright Copyright in literary, dramatic and musical works ,Copyright in Musical and Works and cinematograph films , Ownership of Copyright, Assignment of Copyright, Author's special rights, Infringement of copyright, Fair use Provisions, Remedies.

Intellectual Property in Trademarks: The rationale of protection of trade marks as (a) an aspect of commercial and (b) of consumer rights, definition, conception of Trade Marks, Registration; Distinction Between Trade Mark and Property Mark, Geographical Indicators.

TEXT BOOKS:

1. Phansalkar S. J., *"Making Growth Happen – Learning from First Generation Entrepreneurs"*, Response Books, division of Sage Publications India Private Limited, New Delhi
2. Kanungo Rabindra N, *"Entrepreneurship & Innovation Models for Development"*, Sage Publications India Private Limited, New Delhi

3. Dr. Mathew J. Manimala, Entrepreneurship theory at crossroads, Biztantra,
4. Vasant Desai, Entrepreneurial Development and Management, Himalaya Publishing House,
5. Maddhurima Lall, Shikha Sahai, Entrepreneurship, Excel Books
6. Kurakto, Entrepreneurship-Principles and practices, Thomson publication
7. P. Narayanan: Patent Law, Eastern Law House.2. Roy Chowdhary, S.K. & Other, Law of Trademark, Copyrights, Patents and Designs.
8. Dr. G.B. Reddy, Intellectual Property Rights and the Law, Gogia Law Agency.
9. John Holyoak and Paul Torremans, Intellectual Property Law.
10. B.L. Wadhera, Intellectual Property Law, Universal Publishers.

REFERENCE BOOKS:

1. Juneja J. S., *Small and Medium Enterprise: Challenges and Opportunities*, Vanity Books International, New Delhi
2. *Harvard Business Review on The Innovative Enterprise*, Harvard Business School Publishing Corporation

411108 (B) : Reliability Engineering Lab

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 01

Examination Scheme

Practical: 50 Marks

TW: 25 Marks

During the practical students should be asked to solve real life 8 cases on the topics. On each of the following topics at least one assignment should be there.

1. Introduction to Reliability
2. System safety analysis
3. Reliability in design and Life Cycle costing
4. System reliability and redundancy
5. Loads, capacity, maintainability and availability
6. Reliability testing and Failure Interactions

411109 (B): Energy Management Lab

Teaching Scheme

Lectures: 02 hours / week

Credit Scheme

Pr/Or: 01

Examination Scheme

Oral: 50 Marks

TW: 25 Marks

During the practical students should be asked to solve real life 8 cases on the topics. On each of the following topics at least one assignment should be there.

1. Basics of Energy Management
2. Physical Aspects of Energy
3. Legal Provisions
4. Demand Side Management
5. Energy Audit and Energy Saving
6. Energy Audit
7. Legal Provisions relating to Conservation of Energy

411112: Project Stage 2

Teaching Scheme

Lectures: 06 hours / week

Credit Scheme

Pr/Or: 06

Examination Scheme

Term work: 100 Marks

PR: 50 Marks

As per submitted project phase II plan to complete it within the time schedule, the term work shall consist of:

1. Fabrication of models, machines, prototypes based on new ideas, robots and machine based on hi-tech systems and automation, experimental set-up, fabrication of testing equipment, renovation of machines, etc. Above work shall be taken up individually or in groups.

OR

Extensive analysis of some problems done with the help of a computer individually or in a group not exceeding two students.

2. A detailed report on the work done shall include project specification, design procedure, drawings, process sheets, assembly procedure and test results etc. Project may be of the following types:

- i. Manufacturing / Fabrication of a prototype machine' including selection, concept, design, material, manufacturing the components, assembly of components, testing and performance evaluation.
- ii. Improvement of existing machine / equipment / process.
- iii. Design and fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, inspection gauges, measuring instruments for machine tools.
- iv. Computer aided design, analysis of components such as stress analysis.
- v. Problems related to Productivity improvements/Value Engineering/Material Handling Systems
- vi. Energy Audit of an organization, Industrial evaluation of machine devices.
- vii. Design of a test rig for performance evaluation of machine devices.
- viii. Product design and development.
- ix. Analysis, evaluation and experimental verification of any engineering problem encountered.
- x. Quality systems and management. Total Quality Management.
- xi. Quality improvements, In-process Inspection, Online gauging.
- xii. Low cost automation, Computer Aided Automation in Manufacturing.
- xiii. Time and Motion study, Job evaluation and Merit rating
- xiv. Ergonomics and safety aspects under industrial environment
- xv. Management Information System.
- xvi. Market Analysis in conjunction with Production Planning and Control.

OR

Computer based design / analysis or modeling / simulation of product(s), mechanism(s) or system (s) and its validation or comparison with available benchmarks / results. When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Two copies of Final Project Report shall be submitted to the college. The students shall present their Final Project Phase-II report. Before the examiners. The oral examination, shall be based on the term work submitted and jointly conducted by an internal and external examiner from industry, at the end of second semester.

Format of the project report should be as follows:

- 1 Paper: The Project report should be typed/printed on white paper of A-4 size.

- 2 Typing: The typing shall be with one and half spacing and on one side of the paper.
- 3 Binding: The Industrial Implant Report should be submitted with front and back cover in black Hard bound, with golden embossing.
- 4 Margins: Left -1.25", Right -1". Top and Bottom 1"
- 5 Sequence of Pages:
 - 5.1 Title page
 - 5.2 Certificate form Institute
 - 5.3 Completion Certificate form Industry, if sponsored.
 - 5.4 Acknowledgement
 - 5.5 Abstract
 - 5.6 Index
 - 5.7 Nomenclature and Symbols
 - 5.8 Actual Content
 - 5.9 Conclusion
 - 5.10 References.
6. Front cover: The front cover shall have the following details in block capitals
 - i. Title at the top.
 - ii. Name of the candidate in the center, and
 - iii. Name of the Institute, Name of Industry, if sponsored and the year of submission on separate lines, at the bottom.
7. Blank sheets: No blank sheets be left anywhere in the report.
8. Project Completion Certificate:

411113 : Audit Course 8: Leadership Excellence

Unit I: Team working and collaborations:

Understanding team and team dynamics, leading teams, analysing teams and team performance, collaborative team. Characteristics of Successful Team, Stages in team Development, Team Structure, Team leadership, Assessing effective team, Cross functional Collaboration: Introduction, definition cross functional team work, Why use cross functional teams, Desired outcomes and team types, Towards a model of cross functional team type

Unit II: Meeting and Email Etiquettes:

Managing a Meeting: Meeting agenda, Meeting logistics, Minute taking, protocols during the meeting; Duties of the chairperson, Ground rules for conducting meeting; *Effective Meeting Strategies:* Preparing for the meeting, Conducting the meeting, Evaluating the meeting, Rules for meetings, Codes of Conduct while attending Meetings, Tips for good meeting etiquette;

Business Card Etiquette: Carrying business cards, exchanging business cards, Receiving and storing business cards;

E-Mail Etiquette: Significance of Netiquette, Enforcement of email etiquettes in the organization, E-mail: Way of professional communication, Basic Email Etiquettes: Proper Grammar, Spelling, Punctuation, Styling and Formatting, Body of Email, Response, Privacy; Contents of email, Best practices of writing emails, Controlling contents of email

Unit III: Time Management

Time Management strategies: Daily planning, Prioritization of Tasks, Use of Time Management Tools, Determination of productive Times, Remove Distractions, Use of a Timer, Splitting Large Projects into Pieces, Delegation of Work;

Time management tools: Time tracking software, To-Do-list, project management software, communication tools (skype, slack, zoom), Apps helpful in creating good habits, Managing interruptions, managing procrastination;

Time management skills: Prioritizing, Delegation, Decision-making, Goal setting, Multitasking, Problem solving, Strategic thinking, Scheduling.

Reference Books:

1. Michael Egan (2004) Email Etiquette, New Line Publishing, ISBN: 9781844811182
2. Marc Mancini (2003) Time Management, McGraw Hill, ISBN: 978-0071406109
3. Alison Hardingham (1998) Working in Teams, CIPD Publishing, ISBN: 9780852927670