



SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME & SYLLABI 2021 – 2022

M. Tech. (Industrial Engineering)



Published By

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Principal

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ISO 9001 : 2015 CERTIFIED ORGANISATION



About The Department :

Shri Ramdeobaba College of Engineering & Management has the distinction of offering first inter disciplinarily post graduate programme in Industrial Engineering in the year 2004.

This Post Graduate programme has the available expertise of its core faculty supported by faculty of other departments and expert faculty from other engineering colleges. Faculty specialises in Operations Research, Quality Management, Human factors Engineering, Simulation and Modelling. Most of the faculty members are doctorates and deeply involved in the research work. The programme is functioning with the state of the art laboratories and close association with industries around.

All the Post Graduate Projects are based on live problems offered by the industry.

Vision of the Department :

To be a leader in imparting knowledge of creating efficient and effective systems for manufacturing and service organizations.

Mission of the Department :

- To nourish a learning environment conducive to foster innovations in Industrial Engineering.
- Improvement in Industrial productivity by devising systems and quality standards.
- Sintering the engineering knowledge by research support. Absorption of such knowledge in teaching and learning process and its reapplication to quasi-similar situations.

Programme Educational Objectives :

- PEO1.** Programme will prepare students to work in any engineering organization and undertake research work with integrity.
- PEO2.** Programme will ensure development of problem solving ability through the use of industrial engineering tools and software.
- PEO3.** Programme will encourage development of independent thinking & also the ability to work in teams through live projects undertaken in industry professionally.

Programme Outcome :

1. Students will be able to acquire the knowledge of Industrial Engineering with an ability to analyze and synthesize existing and new knowledge for its enhancement.
2. Students will be able to make creative advances for conducting research. They will be able to critically analyze engineering problems and apply their independent judgement for synthesizing information.
3. Students will be able to provide a feasible optimal solution for engineering problems considering public health, safety, culture, society and environment.



4. Students will be able to contribute individually and in group to the development of scientific knowledge by using appropriate research methodology.
5. Students will be able to learn and apply appropriate techniques, resources, and modern engineering and IT tools, including simulation and modeling, to complex engineering activities.
6. Students will possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research.
7. Students will acquire the knowledge of managing projects efficiently in multi disciplinary environments with due consideration to economical factors, as a leader and as a member.
8. Students will be able to comprehend and write effective reports and design documentation, will have the ability to effectively communicate with the engineering community regarding complex engineering activities.
9. Students are capable to recognize the need for, and have the preparation and ability to engage in life- long learning independently, with a high level of commitment.
10. Students will acquire enough maturity to behave in the most responsible manner towards society, acquire decision making ability with due consideration to ethics, professional code of conduct & integrity.
11. Independently improve on the decisions taken and take corrective actions.





Scheme of examination of master of technology (industrial engineering)
semester pattern

I Semester M. Tech. (Industrial Engineering)

Sr. No.	Course Code	Course Name	L	P	Credits	Maximum Marks			Exam Duration (Hrs)	Category
						Internal Assessment	End Semester Exam	Total		
1	INT551	Operations Research	4	0	4	40	60	100	3	PC
2	INT552	Statistics & Quality Control	4	0	4	40	60	100	3	PC
3	INT553	Planning and Control of Manufacturing Systems	4	0	4	40	60	100	3	PC
4	INP554	Lab Practicel	0	4	2	25	25	50	-	PC
5	INT555	Program Elective-I	4	0	4	40	60	100	3	PE
6	MET556	Research Methodology	3	0	3	40	60	100	3	FC
		Total	19	4	21	225	325	550	-	-

Program Elective-1

Sr no	Course Code	Course Name
1	INT 555-1	Automation In Production
2	INT 555-2	Financial Management
3	INT 555-3	Marketing Management
4	INT 555-4	Human Capital Management



II Semester M. Tech. (Industrial Engineering)

Sr. No.	Course Code	Course Name	L	P	Credits	Maximum Marks				Category
						Internal Assessment	End Semester Exam	Total	Exam Duration (Hrs)	
1	INT 556	Supply Chain Management	4	0	4	40	60	100	3	PC
2	INT 557	Human Factors Engineering	4	0	4	40	60	100	3	PC
3	INT 558	Maintenance Engg.	4	0	4	40	60	100	3	PC
4	INP559	Lab Practice -II	0	4	2	25	25	50	-	PC
5	INT 560	Program Elective -II	4	0	4	40	60	100	3	PE
6	INT 561	Advanced Computation Techniques	3	0	3	40	60	100	3	FC
7	INT 599	Open Elective	3	0	3	40	60	100	3	OE
		Total	22	4	24	265	385	650	-	-

Program Elective-II

Sr no	Course Code	Course Name
1	INT 560-1	Materials Management
2	INT 560-2	Reliability Engineering
3	INT 560-3	Project Management

Open Electives

Sr no	Course Code	Course Name
1	INT 599-1	Quality Management
2	INT 599-2	Optimization Techniques
3	INT 599-3	Fundamentals of financial Management



III Semester M. Tech. (Industrial Engineering)

Sr. No.	Subject Code	Subject Name	L	P	Credits	Maximum Marks				Category
						Internal Assessment	End Semester Exam	Total	Exam Duration (Hrs)	
1	INT651/ MET651	Group Elective -I	4	0	4	40	60	100	3	GE
2	INT652/ MET652	Group Elective -II	4	0	4	40	60	100	3	GE
3	INP653	Project Phase -I		3	6	100	100	200	-	-
		Total	8	3	14	180	220	400	-	-

GIM is group head of Industrial and Mechanical Engineering PG Program

Group Elective-I

Sr no	Course Code	Course Name
1	INT651-1	Total Quality Management
2	INT651-2	Value Engineering
3	INT651-3	System Design Engineering
4	INT651-4	Productivity Improvement Techniques
5	MET852-1	Embedded Systems Design
6	MET852-2	Machine Vision
7	MET852-3	Industry 4.0

Group Elective-II

Sr no	Course Code	Course Name
1	INT652-1	Computer and Database Management Systems
2	INT652-2	Manufacturing Economic and Analysis
3	INT652-3	Business Communications
4	MET853-1	Automation in supply chain
5	MET853-2	MEMS and Microsystems
6	MET853-3	Wireless Sensor Network for Robotics



IV Semester M. Tech (Industrial Engineering)

Sr. No.	Course Code	Course Name	L	P	Credits	Maximum Marks				Category
						Internal Assessment	End Semester Exam	Total	Exam Duration (Hrs)	
1	INP654	Project Phase-II		6	12	200	200	400	-	-
		Total		6	12	200	200	400	-	-

Summary of the Credits

Sr no	Semester	Credits
1	I	21
2	II	24
3	III	14
4	IV	12
	Total	71

Summary of the Marks

Sr. no.	Semester	Internal Assessment	End Semester Exam	Total Marks
1	I	225	325	550
2	II	265	385	650
3	III	180	220	400
4	IV	200	200	400
	Total	870	1130	2000



**Syllabus for Semester I, M.Tech
Department of Industrial Engineering**

Course Code : INT551

Course : Operations Research

L:4Hrs,T:0Hr, P: 0 Hrs, Per Week

Total Credits : 04

Course Outcomes :

1. Formulate Situation concerned as on LPP and solve it by simplex method. They will also be able to carry out sensitivity analysis on various constituents of LPP.
2. Apply LPP concepts to some applications like transportation problem, assignment problem, and game. They will also get the concept of optimal sequencing of operations.
3. Determine specifications for effective design of queuing system.
4. Simulate, queuing, inventory management systems.
5. Determine optimal solution using dynamic programming approach.
6. Analyze flow networks, activity networks through the perspectives.

Syllabus :

Introduction

Introduction to O.R, Optimization Techniques, Model Formulation, Assignment, Transportation models, General Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models, Deterministic and Probabilistic Models. Waiting Line Models, Single channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Shortest Route Problems, Game Theory Simulation, Project Networks.

Reference Books :

1. Operations Research: Hitler Liebermann, McGraw Hill Pub.
2. Operations Research: Pannerselvam, Prentice Hall of India
3. Principles of Operations Research: Harvey M Wagner, Prentice Hall of India





Syllabus for Semester I, M.Tech Department of Industrial Engineering

Course Code: INT552
L:4Hrs, P: 0 Hrs, Per Week

Course : Statistics & Quality Control
Total Credits : 04

Course Outcomes

Students shall be able to :

1. Develop understanding of Quality concepts and its Management
2. Develop Control charts for process control and analysis.
3. Analyse of sampling plans for acceptance control.
4. Understand the current trends of Quality control and improvement.

Syllabus

Introduction to Statistical Quality Control; Modeling Process Quality, Chance and assignable causes variation, Types of Distribution; Methods and Philosophy of Statistical Process Control, Statistical Basis of the Control Chart, QC tools, New seven QC tools, Control Charts for Variables, Control Charts for Attributes, Process Capability analysis, Process Capability Ratios, Acceptance Sampling, Single, Double, Multiple, and Sequential Sampling Plans, Standard Sampling schemes, Six Sigma/Lean. Six Sigma, DMAIC, Application of Six Sigma tools to minimize production variability, Taguchi Loss Function, The Lean Production System, Just - In-Time.

Text Books

1. Statistical Quality Control : E.L. Grant, Richard S. Leavenworth, Tata Mc Graw Hill.
2. Quality Planning and Analysis : Juran, Tata Mc-Graw Hill.

Reference Books

1. The Assurance Sciences : S. Halpern, Prentice Hall India Ltd. New Delhi,
2. Managerial statistics : Wiston and Zappen Duxbury, Thompson Learning Inc.





Syllabus for Semester I, M.Tech
Department of Industrial Engineering

Course Code : INT553

Course : Planning and Control of Manufacturing Systems

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

1. Students shall be able to understand different manufacturing systems and facility planning.
2. Students shall be able to understand aggregate planning.
3. Students shall be able to understand sequencing and scheduling in manufacturing systems.
4. Students shall be able to understand planning and control of group technology & cellular manufacturing.

Syllabus

Types of manufacturing systems and their associated planning and control problems, material handling and Material flow characteristics in manufacturing systems. Tools and techniques of facility planning and layout techniques. Production planning and control, Demand Forecasting, Capacity planning: tools and techniques, Aggregate production planning, MRP, ERP.

Sequencing Decisions in Single Machine and Flow Shops, Job-Shop Scheduling, Scheduling in parallel Machines and Networks, simulation and priority rules. Problems of planning and control of group technology, cellular manufacturing, CIMS and FMS.

Reference Books

1. S. Chary, "Theory and problems in Production and Operation Management" Tata McGraw-Hill
2. E. Buffa and R. K. Sarin, "Modern Production and Operation Management", Wiley India.
3. Martand Telsang, "Industrial Engineering and Production Management", S. Chand & Co.,
4. R. Pannerselvam, "Production and Operation Management", Prentice Hall of India.





**Syllabus for Semester I, M.Tech
Department of Industrial Engineering**

**Course Code: INP554
L: 0Hrs. T: 0Hrs. P: 4 Hrs. Per week**

**Course : Lab Practice-1
Total Credits : 02**

Practical based on the theory of Operations Research and Statistical Quality Control.





Syllabus for Semester I, M.Tech
Department of Industrial Engineering

Course Code: INT555-1

Course : Automation in Production

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes :

1. Students should be able to evaluate & compare investment proposals for Automation Projects.
2. Students should be able to analyze & evaluate the performance of automated production lines based on production time, production rate and efficiency of line.
3. Students should be able to design part delivery system & evaluate the performance of automated assembly lines.
4. Students should be able to evaluate and select a suitable CNC / Machining Centers for manufacturing a particular component.
5. Students should be able to use different codes & commands for preparing a CNC part programme and its execution.

Course Syllabus :

Concept of automation, mechanization and automation, Principles and strategies of automation, Production economics. Flow lines, transfer mechanisms, analysis of transfer lines. Assembly lines, part delivery systems, analysis of assembly lines. Sensors, Actuators and other Control System Components.

Development of CNC Technology-Principles and classification of CNC machines, types of control, CNC controllers, information processing and storage. Part programming languages, manual programming, machine axis system, adaptive control. Selection of components for NC manufacturing, automatic tool changers.

Reference Books :

1. Automation in Production: Groover M.R, Tata McGraw Hill.
2. Numerical Control of Machine Tool: Yoram Koren and Ben-Uri J., Khanna Publication.
3. NC and CAM: Kundra and Rao, Tata McGraw Hill-.
4. CAD/CAM: M. R Groover, Zimmers Jr., Tata McGraw Hill.
5. Computer Automated Manufacturing: Power J. Jr., Tata McGraw Hill.





Syllabus for Semester I, M.Tech Department of Industrial Engineering

Course Code: INT555-2
L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Course : Financial Management
Total Credits : 04

Course Outcomes

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

1. Knowledge of Basics of Financial Management Concepts
2. Ability to appreciate the preferred capital and its cost.
3. Understanding of EBIT-EPS analysis, evaluation of various financing plans and important leverages
4. Understanding the concept of dividends and various dividend evaluation models
5. Understanding the operating cycle and other aspects of working capital management.
6. Ability to appreciate the importance of Capital Budgeting techniques like IRR, NPV and PI.

Course Syllabus

Unit - I Introduction to Financial Management, Concept of Business Finance, Finance Function, Scope, Organization, Responsibilities of Finance Executive, Goal and Objectives of Financial Management, Functional Area, Source of Financing - Long Term Sources, Shares, Debentures, Term Loans, Lease, Hire- Purchase, Retained Earnings, Public Deposits, Bonds, Short Term Sources, Bank Finance, Commercial Paper and Trade Credit, Bills discounting,

Unit - II Cost of Capital, concept, meaning, principal and Importance. Cost of different source of finance, weighted average cost of capital and factors affecting cost of capital.

Unit - III Capital Structure, meaning, concept of optimal capital structure, computation of leverages, Capital Gearing and Leveraging, EBIT-EPS Analysis.

Unit - IV Financing and Dividend Policies Decision - concept, determinant and factors affecting relevance and irrelevance concept. Dividend valuation models - Gordon, Walter & Modigliani - Miller models and stability of dividends.

Unit - V Working Capital Management, Concept of Working Capital, Significance, Types, Adequacy of working capital Factors affecting working capital needs, financing approaches of working capital, Methods of forecasting working capital requirement.

Unit - VI Time value of Money, Investment Decision-Capital Budgeting - Nature and Significance, Techniques of Capital Budgeting, Payback Method, Accounting Rate of Return, Internal Rate of Return, DCF, Net Present Value and Profitability Index.



Textbook

1. Financial Management by R.P. Rustogi : Fourth Revised Edition; Taxman's Publication

Reference Books

1. Financial Management by Khan and Jain, Tata McGraw Hill Publication
2. Financial Management by P.C.Tulsian, S Chand Publications.
3. Financial Management by R.P.Rustogi; Galgotia Publications
4. Financial Management by Ravi Kishore; Taxmann Publications





**Syllabus for Semester I, M.Tech
Department of Industrial Engineering**

Course Code : INT555-3

Course : Marketing Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

1. Students will be able to understand concept of Marketing and model the marketing system.
2. Will be able to formulate form “P” of marketing and understand buyer behavior.
3. Methods of market forecast and demand potential estimate.
4. Will be able to understand market activities such as MIS, Market Research.

Syllabus

Changing business orientation, integrated marketing, customer satisfaction, definition of marketing management, basic marketing system model, e-commerce and Internet marketing. Marketing Environment: Marketing opportunity concept, economic, social, political and cultural environment, Duryer behavior and the four P's of marketing mix, brand preference. Measurement and Forecasting of Demand: Concept of Market Forecast and Market potential methods of estimating current demand, Chain ratio, Index of buying pinrer method, estimation of future demand, Survey of buyer intentions, Statistical analysis. Organizing for Marketing: Break up of marketing activities, organization for integrated marketing, Market information systems (MIS), internal accounting and intelligence systems, marketing research and decision making. Marketing Strategies : Product market matching, Product management, Product life cycles, innovations, Promotion strategies in advertising, personal selling, sales promotion and publicity. Price decisions: Reasons, Objectives and Methods; Price setting, Buyers reaction, demand elasticity of price, distribution trade off analysis, physical distribution methods, concept of level of service and Cost of services, overall marketing mix. Market Segmentation and marketing Control: Concept of segmentation, methods of segmentation, control of management over marketing subsystems, efficiency control, short and long controls.

Text Books

1. Modern Marketing: A Manual of Marketing, Salesmanship and advertising : Bombay, Himalaya Publishing House, 1990
2. Marketing Management Strategies and Progress: Guiltima J.P.& Paul, G. W. Singapore; McGraw Hill, 1985
3. Marketing Management: Philip Kotler.





Syllabus for Semester I, M.Tech
Department of Industrial Engineering

Course Code : INT555-4
L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Course : Human Capital Management
Total Credits : 04

Course Outcomes

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

1. Understand the roles and responsibilities of HR department in Industries
2. Have the knowledge to understand job analysis and design jobs.
3. Understand job evaluation and how to estimate HR requirements.
4. Be able to conduct recruitment and selection process
5. Be able to understand training methods and the concept of performance appraisal
6. Know to current trends in HRM

Syllabus

Introduction to HRM, Nature Scope Objectives, Functions and Importance of HRM. Evolution of the concept of HRM, HRM in India, Role of HR manager, HRM in India, HR practices in Industry. Job Analysis Design; Job Analysis Meaning; Uses, Methods and Process for collecting data for job analysis, Job Specification; Factors affecting techniques of Job Design, Techniques of Job Design. Job Evaluation and Human Resource Planning, Objective of Job Evaluation, Advantages and Limitations of Job Evaluation, Human Resource Planning, Concept and Need of Human Resource Planning. Process of Human Resource Planning. Recruitment and Selection, Factors affecting recruitment and selection, Sources of Recruitment, Selection Process, Methods of Interview, Tests, Induction Program, Problems of Induction. Training and Development. Performance Management, Objectives and Importance of Training, Process of Training and Development, Classification of Training methods/ techniques, Reasons for training, Performance Appraisal, Introduction to Performance appraisal, errors during appraisal. Employee Remuneration, Trends in HRM, Introduction to Compensation, Introduction to Strategic HRM, Balance Scorecard, Organization Citizenship behavior, HR audit, Competency mapping, Employee Engagement,

Text Books

1. Human Resource Management; Text & Cases ; K Ashwathappa Mcgraw Hill Publication.

Reference Books

1. Human Resource Management ; Ninth Edition ; L. R. Wayne, Mondy, Robert M. Noe, Pearson Education.
2. A Textbook of Human Resource Management; C.B.Mamoria, S.V.Ganarkar, Himalaya Publishing House
3. Human Resource Management. R. Jyothi; Oxford University Press.





Syllabus for Semester I, M.Tech Department of Industrial Engineering

Course Code: MET 556

Course : Research Methodology

L:3Hrs, P:0Hrs, Per Week

Total Credits : 03

Course Objective

1. Understand and apply the concept of research methodology to solve the real world problems.

Course Outcomes

1. Understand the concept of research, classify the literature and formulate the research problem.
2. Demonstrate the method of data collection and modeling.
3. Study and demonstrate the optimization of model.
4. Study and use of the computers in research publications.

Syllabus

Unit - I

Meaning and objective of research, types of research, research approaches, significance of research, research methods versus methodology, importance of knowing how research is done, research process, criteria of good research. Literature review and formulating a research problem.

Unit - II

Methods of data collection, data analysis, sampling and use of modeling techniques. Types of variables, collection of primary data, Analysis of variance, mathematical model, experimental data modeling based on industrial case studies.

Unit - III

Optimization of model / process / product, modeling and optimization based on industrial problem.

Unit - IV

Role of computers in research. Use of statistical analysis, software and report writing. Formats of report writing formats of publications in research journals. Industry based case studies presentation.

Text Books

1. Research Methodology : Methods and Techniques, Kothari C. K. (2004), 2/e, New Age International, New Delhi.
2. Research Methodology : A Step by Step Guide for Beginners, 2nd ed : Ranjit Kumar; Person.
3. Design and Analysis of Experiments, Montgomery, Douglas C. (2007), (Wiley India) 5th ed.



Reference Books

1. Design and Analysis of Experiments : Angela Dean and Deniel Voss, Springer-Verlag New York.
2. Theories of Engineering Experimentation, 1st ed. : H. Schenck Jr., Mc-Graw Hill.
3. Simulation Modeling and Analysis, 2nd ed. : Law, A. M., W. D. Kelton, 1991 McGraw Hill.
4. Applied Statistics and Probability for Engineers; Montgomery, Douglas C. and Runger, George C (2007), 3/e (Wiley India)





Syllabus for Semester II, M.Tech Department of Industrial Engineering

Course Code: INT556

Course : Supply Chain Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

By end of this course the students should be able to:

1. Student shall be able to understand the importance of Supply Chain Management (SCM).
2. Student shall be able to understand the forecasting and role of distribution network in SCM
3. Student shall be able to understand inventory management in SCM
4. Student shall be able to understand the supplier selection in SCM

Syllabus

The Objective, Importance of Supply Chain, Decision Phases in a Supply Chain, Drivers of Supply Chain Performance, The Role of Distribution in the Supply Chain, Factors Influencing Distribution Network Design, Options for a Distribution Network, The Role of Network Design in the Supply Chain, Framework and Factors Influencing Network Design Decision, Models for Facility Location and Capacity Allocation, Warehouse functions, Warehousing planning and cost reduction, The Role of Forecasting in a Supply Chain, Characteristics of Forecasts, Forecasting Methods, Lean supply chain management.

The Role of Cycle Inventory in a Supply Chain, Economies of Scale of Exploit Fixed Costs; Quantity Discounts, Managing Multi Echelon Cycle Inventory, The Role of Safety Inventory in a Supply Chain, The Role of Transportation in a Supply Chain, Modes of Transportation and their Performance Characteristics, Transportation Infrastructure, The Role of Sourcing in a Supply Chain; In - House or Out source, Third and Fourth - Party Logistics Providers, Supplier Scoring and Assessment, Supplier Selection. Make V/S buy.

Reference Books

1. Sunil Chopra & Peter Meindl , "Supply Chain Management: Strategy, Planning and Operations", Person Prentice Hall
2. Janat Shah, " Supply Chain Management, : Text and Cases", Person Education
3. Paul Myerson, " Lean Supply Chain and Logistics Management", Mc Graw Hill

Text Book

1. Supply chain management, Strategy & Analysis, Chopra, Meindl & Kolra, Prarson Education, Asia.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code: INT557

Course : Human Factors Engineering

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

By end of this course the students should be able to :

1. Describe an expanded view of ergonomics
2. Students will be able to identify ergonomically related injuries that occur in workplace.
3. Students will be able to find and assure that the workplace fits the worker
4. Students will be able to put ergonomic assessments and solutions to practical use in the workplace.

Syllabus

The nature of Ergonomics: Scope, applications. Productivity Correlation, Human machine System. Principles of Ergonomics, Process and application of Ergonomics. Anthropometry: Structural and functional dimensions, collection of anthropometric principles in application of anthropometric data. Design of workplace, seat design. Information input and processing: Concept of information, human information processing model, memory, Design of displays, Design of controls, hand tools and devices, MSD- Carpel tunnel syndrome Work Physiology: Metabolism & heat regulation, Muscle Structure, energy cost of work load, physical work capacity, whole body fatigue, stresses and work load Environmental Factors: Heat exchange process. Methods of heat exchange, environmental factors influencing heat exchange. Zone of heat exchange, Noise level measurement. Physiological effects of noise, effect of noise on performance & communication, noise reduction & exposure limit, illumination, effect of light on performance, Glare.

Text Books

1. Human factors Engg. & Design - Mark S. Sanders. Ernest J. Me McCormick : McGraw Hill International Editors
2. Ergonomics: Man in his working Environment -Murrell, K. Chapman and Hall London.
3. Human Factors Design Handbook -Wooden Vs. McGraw Hill New York.





Syllabus for Semester II, M.Tech Department of Industrial Engineering

Course Code : INT558

Course : Maintenance Engineering

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

Students should be able to:

1. Understand reliability concept and related models.
2. Design the features of maintenance system along with different Strategies.
3. Execute of planning, scheduling and cost management of maintenance activities.
4. Evaluate performance and measurement of maintenance.

Syllabus

Definitions of Reliability, failure data analysis, failure rate, failure density, MTBF, MTTF, Hazard models, Bath tub Curve, maintainability and availability, system reliability.

General Objectives, functions, organization and administration of maintenance system, maintenance and repair jobs, defect/failure list generation and failure analysis, maintenance strategies, condition monitoring, maintenance planning and scheduling, maintenance effectiveness, performance evaluation / indices, maintenance budgeting, costing & control, spare parts planning, recent trends in maintenance, Terotechnology.

Text Books

1. Maintenance Engineering – Er Sushilkumar Srivastava, S chand.
- 2) Reliability Engineering- L. S. Srinath affiliated East- west Press Private Limited
- 3) Maintenance planning and control – Antony Kelly

Reference Books

1. Reliability and Maintainability Engineering – Charles E. Ebeling, Tata McGraw Hill
- 2) Reliability, availability and maintainability : J.W. Foster, D.T. Philips and IR. Rogers., M/A Press.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code: INP559

Course : Lab Practice-II

L: 0Hrs. T: 0Hrs. P: 4 Hrs. Per week

Total Credits : 02

Practicals based on the theory of Ergonomics and Computers and Database Management..



**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code : INT560-1

Course : Materials Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

1. Students will understand the objective and scope of material management.
2. Students will be able to understand the concept various cost involved in inventory control.
3. Students will be able to understand various purchase and production based inventory control models.
4. Students will be able to understand the vendor rating system, MRP, JIT, KANBAN etc.
5. Students will be able to understand various algorithms in inventory control.

Syllabus

Role of materials management techniques in material productivity improvement, Cost reduction and value improvement, Purchase management, Incoming material control, Acceptance sampling and Inspection, Vendor rating system, Inventory management, Various inventory control models, Material requirement planning systems, Discrete lot size techniques, Wangar and Whitin algorithm, Silver and metal algorithm, Algorithms for multi product lot sizing with constraint inventory management of perishable commodities, Design of inventory distribution systems, Inventory management in KANBAN and JIT.

Text Books

1. Materials Management by A.K.Chitale, R.C. Gupta, PHI Publication
2. Materials Management & Material handling : S.C. Sharma, Khanna Publications
3. Materials, Management An integrated approach, P.Gopal Krishnan and Mr. Sudarsan, PHI

Reference Book

1. Introduction to Mat Management, Stephen Chapman, Pearson India.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code : INT560-2

Course : Reliability Engineering

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

Students will be able to :

1. Understand the importance of Reliability & its application.
2. Develop understanding of systems reliability and models.
3. Develop understanding of failure analysis, availability and maintainability concept.
4. Develop understanding of Failure / Repair Distribution and Parameter Estimation.

Syllabus

Basic Reliability Models, Reliability Function, Mean time to Failure, Hazard rate Function, Bath Tub Curve, Conditional reliability.

Constant Failure Rate Model: Exponential Reliability Function, Failure Modes, applications, the two parameter Exponential Distribution, Poisson process, Redundancy and the CFR Model. Time Dependant Failure Models, The Weibull Distribution, The Normal Distribution, System reliability.

Markov Analysis, Load-Sharing System, Standby Systems, and Degraded Systems.

Reliability specification and system Measurements, Reliability allocation, Failure analysis, System safety and Fault free analysis, Maintainability, Availability. Data Collection and Empirical Methods, Static Life Estimation.

Identifying Failure and Repair Distribution, Parameter Estimation, Relevant applications.

Reference Books

1. An Introduction to Reliability and Maintainability Engineering : Charles E. Ebeling Tata McGraw-Hill publishing Company Limited
2. Reliability Based Design : S. S. Rao, McGraw Hill
3. Reliability Engineering : E. Balagurusamy, Tata McGraw Hill Publishing Co. Ltd.
4. Reliability Engineering : L.S. Srinath, East West Press.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code : INT560-3

Course : Project Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

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

1. Understand project & project life cycle
2. Demonstrate the ability to understand and use human resources and contracts project team
3. Evaluate the project performance
4. To plan project audit process and use of project management tools.

Syllabus

Introduction and concepts of project management life cycle, Establishing project scope time cost and performance goals, organizing human resources and contracting, organizing systems and procedures for project implementation, project direction, coordination, control and evaluation. Benefits of project evaluation, limitations of project evaluation, limitations and methods of project evaluation, Project Management Performance, Management Information System, Project Management Tools.

Reference Books

1. Project Management : David Cleveland. Lewis Ireland, Tata McGrawHill.
2. Project Management : S. Chaudhary Tata McGraw Hill.
3. Guide to Project Management : Harold Kenzer Tata McGrawHill
4. Project Management : Jack Gido, James Clements; Cengage Learning.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code : INT561

Course : Advanced Computation Technique

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 03

Course Outcomes

At the end of this course the student should be able to

1. Study advanced Algorithm to solve the problems in Industrial Engineering
2. Apply advanced techniques like Artificial Neural Network, ant colony algorithm, particle swarm algorithm, Simulated Annealing method and response surface methodology-RSM.
3. Develop solutions to real time industrial engineering problems.

Syllabus

Introduction to statistical and soft computing techniques :

Genetic algorithm mechanism, Appraisal of GA performance, Procedures and operations in GA search, Computer Implementation and applications, Neural Networks, Introduction to Multilayer Networks, Fuzzy Optimization, TLBO, JAYA, Multi criterion, Developing expert systems using Fuzzy logic, Simulated Annealing, PSM, Ant Colony Optimization & Particle Swarm Algorithm. Apply advanced techniques to solve the Industrial Problems.

Text Books

1. Genetic Algorithms in Optimization and Machine Learning : D.E Goldberg, Addison Wesley Reading, MA, USA 1989.
2. Understanding Neural Networks & Fuzzy Logic: Basic Concepts and Application: Stamatios.V. Kartalopoulos, Prentice Hall of India New Delhi, 2002.
3. Multiobjective Optimisation using Evolutionary Algorithm : K. Deb Chichester 2002

Reference Book

1. Neural Networks, Fuzzy Logic and Genetic Algorithm; A synthesis and Applications :S. Rajashekharan, G.A Vijayalakshmi Pai, Prentice Hall of India, New Delhi 2003
2. An Introduction to Data Development Analysis, A Tool For Performance Management: SAGE Publications New Delhi 2003.





**Syllabus for Semester II, M.Tech
Department of Industrial Engineering**

Course Code : INT599-1

Course : Quality Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

Student shall be able to

1. To develop understanding of Quality concepts.
2. To apply QC tools and modern quality management tools.
3. To implement TQM concepts in manufacturing & Service sector.

Syllabus

Evolution of product and service quality, TQM Frameworks, Contributions of Deming, Juran and Crosby, Customer focus, Costs of quality. Leadership, Strategic quality planning, Employee involvement, Quality circles, PDCA cycle, 5S, Kaizen.

The seven traditional tools of quality and new QC tools, Control Charts, Process Capability, Concepts of Six Sigma, Quality function Deployment (QFD), Taguchi quality loss function.

ISO 9000 Quality System, Documentation, Quality Auditing, ISO 14000, TQM Implementation in manufacturing and service sectors.

Text Books

1. Dhale H. Besterfield, et al., " Total quality Management", Third Edition, Person Education Asia, Indian Reprint, 2006.
2. Poornima M. Charantimath. " Total Quality Management" - Pearson Publication.

Reference

1. James R. Evans and William M. Lindsay, " The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi, L. and Ananad Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd. 2006.
3. Janakiraman. B. and Gopal. R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. R.P. Mohanty and R.R. Lakhe, "TQM in the Service Sector" - Jaico Publishing House 2002.





Syllabus for Semester II, M.Tech
Department of Industrial Engineering

Course Code : INT599-2

Course : Optimization Techniques

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 3

Course Outcomes

Students shall be able to

1. Use classical technique to get optimal solution for NLP
2. Solve nonlinear optimization problem using digital technique or geometric programming.
3. Use evolutionary algorithm for solving optimization problems.

Syllabus

Classical Optimization Techniques : Single and multi variable Optimization, Langrangean function, Kuhn–Tucker Conditions. Nonlinear Programming I : One-Dimensional Minimization Methods: Unimodal Function, Dichotomous Search, Fibonacci Method, Golden Section Method, Quadratic Interpolation Methods, Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods .Nonlinear Programming II : Unconstrained Optimization Techniques: Univariate Method, Pattern Search, Method, Simplex Method, Steepest Descent (Cauchy) Method, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Quasi-Newton Methods, Davidon-Fletcher-Powell Method. Geometric Programming : Posynomial, Primal-Dual Relationship and Sufficiency Conditions, Degree of difficulty, orthogonality and normality conditions, 0 and 1 degree difficult problem. Modern Methods of Optimization : Genetic, Simulated Annealing. Particle Swarm Optimization, Ant Colony Optimization.

Text book :

1. "Engineering Optimization Theory and Practice", Fourth Edition, Singiresu S. Rao, JOHN WILEY & SONS, INC.

Reference Books

1. Optimization theory and Methods: Non linear Programming - Wenyu Sun, Ya-Xiang Yuan, Springer
2. Linear & Non linear Programming - David G. Luenberger, Yinyu Ye, Springer
3. Non linear Programming - Anthony V. Fiacco, Garth P. McCormick, SIAM





Syllabus for Semester II, M.Tech
Department of Industrial Engineering

Course Code : INT599-3

Course : Fundamentals of Financial Management

L: 3Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 3

Course Outcomes

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

1. Posses the Knowledge of Basics of Financial Management Concepts
2. Appreciate the preferred capital and its cost.
3. Understand the EBIT-EPS analysis , evaluation of various financing plans and important leverages
4. Understand the concept of dividends and various dividend evaluation models
5. Understand the operating cycle and other aspects of working capital management.
6. Appreciate the importance of Capital Budgeting techniques like IRR, NPV and PI.

Syllabus

Unit - I : Introduction to Financial Management, Concept of Business Finance, Finance Function, Scope, Organization, Responsibilities of Finance Executive, Goal and Objectives of Financial Management, Functional Area, Source of Financing – LONG TERM SOURCES - Shares, Debentures, Term Loans, Lease, Hire-Purchase, Retained Earnings, Public Deposits, Bonds, SHORT TERM SOURCES - Bank Finance, Commercial Paper and Trade Credit Bills discounting.

Unit - II : Cost of Capital, concept, meaning, principle and Importance. Cost of different sources of finance, weighted average cost of capital and factors affecting cost of capital.

Unit III : Capital Structure, meaning, concept of optimal capital structure, computation of leverages, Capital Gearing and Leveraging, EBIT-EPS Analysis.

Unit IV : Financing and Dividend Policies Decision-concept, determinant and factors affecting relevance and irrelevance concept. Dividend valuation models - Gordon, Walter and Modigliani- Miller models and stability of dividends.

Unit V : Working Capital Management, Concept of Working Capital Significance, Types, Adequacy of working capital, Factors affecting working capital, needs, financing approaches of working capital, Methods of forecasting working capital requirement.

Unit VI : Time Value of Money, Investment Decision-Capital Budgeting - Nature and Significance. Techniques of Capital Budgeting, Payback Method, Accounting Rate of Return, Internal Rate of Return, DCF, Net Present Value and Profitability Index.

Textbook

1. Financial Management by R.P. Rustogi : Fourth Revised Edition; Taxmann's Publication

Reference Books

1. Financial Management by Khan and Jain, Tata McGraw Hill Publication
2. Financial Management by P.C.Tulsian, S Chand Publications.
3. Financial Management by R.P.Rustogi; Galgotia Publications
4. Financial Management by Ravi Kishore; Taxmann Publications





Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INT651-1

Course : Total Quality Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

1. To develop understanding of Quality concepts.
2. To apply QC tools and modern quality management tools.
3. To implement TQM concepts in manufacturing & service sector.

Syllabus

Evolution of product and service quality TQM Framework Contributions of Deming, Juran and Crosby, Customer focus, Costs of quality.

Leadership, Strategic quality planning, Employee involvement, Quality circles, PDCA cycle, 5S, Kaizen.

The seven traditional tools of quality and new QC tools, Control Charts, Process Capability, Concepts of Six Sigma, Quality Function Deployment (QFD), Taguchi quality loss function.

ISO 9000 Quality System, Documentation, Quality Auditing, ISO 14000, TQM Implementation in manufacturing and service sectors.

Text Books

1. Dale H. Besterfield, et at., "Total Quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.
2. Poornima M. Charantimath "Total Quality Management" Person Publication.

References

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal. R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. R.P. Mohanty and R. R. Lakhe, "TQM in the Service Sector" - Jaico Publishing House 2002.





Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INT651-2

Course : Value Engineering

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

Students will be able to

1. Apply cost reduction techniques.
2. To evaluate various alternatives.
3. To prioritize functions of products.
4. To identify under value products.
5. To improve value of product.

Syllabus

Value engineering and its application in product design, Identification of major function and removal of poor value functions in a product, Types of value Effects of functions and cost on value, Life cycle of product and value engineering, Steps in value engineering, Methodology in value engineering, Fast diagram, Matrix method and other approaches in value engineering, Evaluation of value alternatives, Case studies in value engineering.

Text Books

1. Value engineering in Manufacturing: American Society of Tool & Manufacturing Engineers, New Jersey, Prentice Hall incorporated, 1967.
2. Cost Engineering Analysis: Park, W.R. NewYork, John Wiley & Sons, 1973
3. An Introduction to Value Engineering: L. D. Miles





Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INT651-3

Course : System Design Engineering

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

1. Students will develop understanding of system Concepts, Component, properties.
2. Will be familiarized with process of design of system.
3. Will be able to understand the concept of system reliability, maintainability,

Syllabus

Types of information :Operational, tactical, strategic and statutory, need of information systems, management structure, requirements of information at different levels of management, functional allocation of management, requirements of information for various functions, qualities of information. Requirements determination: Requirements specifications, feasibility analysis, final specifications, hardware and software study, system design, system implementation, system evaluation, system modification. Role of systems analyst: attributes of a systems analyst, tools used in system analysis. Strategies: methods, documenting study, system requirements. Specification from narratives of requirements to classification of requirements as strategic, tactical, operational and statutory. Deciding project goals: examining alternative solutions, cost benefit analysis, quantifications of costs and benefits, payback period, system proposal preparation for management, parts and documentation of a proposal, tools for prototype creation.

Data flow diagrams: Case study for use of DFD, good conventions, leveling of DFDs, leveling rules, logical and physical DFDs, software tools to create DFDs. Procedure specifications in structured English: Examples and cases, decision tables for complex logical specifications, specification oriented design vs procedure oriented design. Entity relationship model: E-R diagrams, relationships cardinality and participation, normalizing relations, various normal forms and their need, some examples of relational data base design.

Text Books

1. Systems Engineering and Analysis (5th Edition): (Prentice Hall International Series in Industrial & Systems Engineering) by Benjamin S. Blanchard and Wolter J. Fabrycky (2010)
2. Systems Engineering Principles and Practice : (Wiley Series in Systems Engineering and Management) by Alexander Kossiakoff, William N. Sweet, Sam Seymour and Steven M. Biemer(2011)
3. System Engineering Management: (Wiley Series in Systems Engineering and Management) by Benjamins. Blanchard(Jul28,2008)





Syllabus for Semester III, M.Tech (Elective - I)
Department of Industrial Engineering

Course Code : INT651-4

Course : Productivity Improvement Techniques

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

Students shall be able to

1. Systematic investigation of existing methods of performing work.
2. Execute select perform of appropriate recording technique for analysis of given activity.
3. Analysis and development of plant and workplace.
4. Do estimation of time standard using work measurement techniques.

Basics of Work Study, motion and time study, Taylors use of time study and motion study, general problem solving procedure, Method Study, Recording Techniques for plant and workplace layout, critical evaluation phase and improvement, Quantitative Techniques for man machine relationship, Micro motion Study, work measurement techniques, estimation of time standards, Plant Layout, Quantitative Analysis of Layouts, Productivity, Recent trends in productivity improvement.

Text Books

1. International Labour organization, "Introduction to work-study", Universal Publishing Company, ISBN 81-850270
2. Barnes Ralph M., "Motion & Time study : Design and Measurement of work", Wiley Text Books, 2001.
3. Facility layout and location : An Analytical Approach Richard Francis, Leon F. Mc Ginnis, Jr. John A. White.

Reference Book

1. Maynard H. B. " Industrial Engineering Handbook", 3rd edition, Mc Graw Hill Book Company. ISBN 0-07-041084-4.





Syllabus for Semester III, M.Tech (Elective - I)

Department of Industrial Engineering

Course Code : MET852-1

Course : Embedded Systems Design

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Objective

This course will introduce the conceptual understanding of Embedded System and its components.

Course outcome

The students will be able to

CO1 : Summarize the concept of embedded system, microcontroller, different components of microcontroller and their interactions.

CO2 : Understand the architecture and organization of 8085 microprocessor **CO3**: Explain the architecture and organization of microcontroller

CO4 : Construct the software and hardware component to interface the peripherals with microcontroller **CO5**: Design real world application using microcontroller and explain the concepts of Embedded Operating System

Unit - I

Introduction to Embedded Systems and microcomputers : Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded system Models, Embedded System development cycle, Challenges for Embedded system Design, Evolution of computing systems and applications. Basic Computer architecture: Von Neumann and Harvard Architecture, RISC and CISC architecture. Basics on Computer organizations. Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics.

Unit - II

Microprocessor : 8085 Microprocessor and its Internal Architecture, Pin Configuration and their functions, Mode of Operation, Introduction to I/O and Memory, Timing Diagrams, Introduction to Interrupts. Microprocessor Programming: Introduction to assembly language, Instruction format, Assembly language programming format, Addressing mode, Instruction Sets. Introduction to DMA.

Unit - III

Microcontroller : Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, Programming model, Addressing modes, Instruction sets, programming for Microcontroller, I/O programming using C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller4.



Unit- IV

Microcontroller Interfacing : Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor.

Unit- V

Introduction to Software: Embedded C, Embedded OS, Real Time Operating System (RTOS), Linux.

Text Book

1. Embedded Systems: Raj Kamal, TATA McGRAW Hill Publications
2. Microprocessor: Architecture, Programming & applications with 8085; Ramesh S.Gaonkar;Penramth International, 5 Edition.
3. ArduinoCookbookby Michael Margolis, O'Reilly Media, Inc., 1st edition
4. An embedded software primer: David E Simon, Pearson education Asia, 2000 5.

Reference Book

1. Introduction to Embedded Systems: Shibu K V, McGRAW Hill Publications.
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C; Muhammad AliMazidi, 2nd Edition, Pearson
3. The 8051 Microcontroller and Embedded Systems Using Assembly and C; Muhammad AliMazidi, 2nd Edition, Pearson
4. Beginning C for Arduino By Jack Purdum (ebook)Arduino for Beginners: Essential Skills Every
5. Maker Needs, John Baichtal, Pearson Education, Inc., 1st edition
6. Micro C/OS II The Real Time Kernel: Jean J. Labrosse, CMPBooks,(2/E) 2002
7. Embedded LinuxPrimer: christopherHallinan, Pearson (1/E) 2007





Syllabus for Semester III, M.Tech (Elective - I)

Department of Industrial Engineering

Course Code : MET852-2

Course : Machine Vision

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week

Total Credits : 4

Objective

To introduce students the fundamentals of image formation, the major ideas, methods, and techniques of computer vision and pattern recognition.

Course Outcome

CO1: To give an overview of the various image processing techniques used in machine vision

CO2: To give knowledge on motion tracking and its techniques

CO3 : To introduce vision system to assist in Simultaneous Localization and Mapping for mobile robots

Unit - I : Image capture and digitization : Image transforms; digital Fourier transform, fast Fourier transform, other transforms, convolution, correlation; image enhancement; spatial methods, frequency domain methods; image restoration.

Unit - II : Geometric transformation : Image compression; error free and lossy compression; edge detection; hough transform, region based segmentation; image feature/region representation and descriptors; morphological operators.

Unit - III : Features based matching : Baye's classification; Low level vision: Introduction to stereopsis, shape from shading, optical flow; Rule based picture segmentation. Development and evaluation of image algorithms.

Unit - IV : Image Filtering and EDGE Detection : Histogram Modification, Linear Systems, Linear Filters, Median Filter, Gaussian Smoothing.

Gradient, Steps in Edge Detection, Roberts Operator, Sobel Operator, Prewitt Operator, Comparison, Second Derivative Operators, Laplacian of Gaussian, Image Approximation, Gaussian Edge Detection, Canny Edge Detector, Subpixel Location Estimation, Edge Detector Performance, Sequential Methods, Line Detection

Unit - V : Object Detection : System Components, Complexity of Object Recognition, Object Representation, Observer-Centered Representations, Object-Centered Representations, Feature Detection, Recognition Strategies, Verification.

Text Books / References:

1. Milan Sanka, Vaclav Halavac, Roger Boyle "Image Processing, analysis and machine vision" Vikas Publishing.
2. Kenneth & Castleman "Digital Image Processing (PHI)
3. Conzalez RC & P Wint "Digital Image Processing" Addison Wesley
4. Chanda & Mazumdar " Digital Image Processing & Analysis" (PHI)
5. Anil K. Jain, "Digital Image Processing", Prentice Hall, 1989



Syllabus for Semester III, M.Tech (Elective - I)

Department of Industrial Engineering

Course Code : MET852-3

Course : Industry 4.0

L: 4 Hrs. T: 0 Hrs. P: 0 Hrs. Per week

Total Credits : 4

Objectives

This course is designed to offer learners an introduction to Industry 4.0 (or the Industrial Internet), its applications in the business world. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

Course Outcomes

The students will able to

1. Understand the drivers and enablers of Industry 4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world
4. Appreciate the power of Cloud Computing in a networked economy
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

Unit - I : Introduction to Industry 4.0 : 1.1 The Various Industrial Revolutions, 1.2 Digitalisation and the Networked Economy, 1.3 Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, 1.4 The Journey so far: Developments in USA, Europe, China and other countries, 1.5 Comparison of Industry 4.0 Factory and Today's Factory, 1.6 Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

Unit - II : Road to Industry 4.0 : 2.1 Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, 2.2 Smart Manufacturing, 2.3 Smart Devices and Products, 2.4 Smart Logistics, 2.5 Smart Cities, 2.6 Predictive Analytics

Unit - III : Related Disciplines, System, Technologies for enabling Industry 4.0 : 3.1 Cyber physical Systems, 3.2 Robotic Automation and Collaborative Robots, 3.3 Support System for Industry 4.0, 3.4 Mobile Computing, 3.5 Related Disciplines, 3.6 Cyber Security

Unit - IV : Role of data, information, knowledge and collaboration in future organizations : 4.1 Resource-based view of a firm, 4.2 Data as a new resource for organizations, 4.3 Harnessing and sharing knowledge in organizations, 4.4 Cloud Computing Basics, 4.5 Cloud Computing and Industry 4.0

Unit - V : Other Applications and Case Studies : 5.1 Industry 4.0 laboratories, 5.2 IIoT case studies, 5.3 Case studies from HKPolyU students. Business issues in Industry 4.0: Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world

Text books

1. Industry 4.0: The Industrial Internet of Things by Alasdair Gilchrist
2. The Fourth Industrial Revolution by Klaus Schwab
3. Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0 by Ibrahim Garbie



Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INT652-1

Course : Computers and Database Management

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits: 4

Course Outcomes

1. Understand the concepts of Database, RDBMS and software applications in industrial engineering.
2. By the completion of the course the student should be able to
 - a. Apply the concepts of Database, DBMS and software applications in industrial engineering.
 - b. Design databases using RDBMS Tools.
3. To realize the importance of information for decision making in the organizing.
4. Develop Databases and computer programs for the solution of engineering Problems

Syllabus

Information concepts, System concepts, Examples of Information systems, Concept of General System Theory and their applications to Information Systems. Definition of data, information and knowledge . Introduction to Transaction processing systems, management information system, Decision Support Systems etc. Electronic Commerce and its impact on Business Strategy. ERP

Introduction to databases and relational database management systems. Design and development of databases, What is a DBMS, File versus Database, uses of DBMS, Different Data models, Levels of Abstraction, introduction to Data Independence and Concurrency Control. Structure of a DBMS.

The Entity-Relationship Model : Entity, Entity Set, Relationship, Constraints, attributes, data flow diagrams and ER diagrams, Normalizing relations; Data input methods; Structured Systems Analysis and Design.

Introduction to SQL, DDL Commands, DML Commands, DCL Commands, Function Of SQL Plus , Select Statement with all options, Creating, Dropping and Altering Tables, Types of Keys, Relational Algebra, Projection, Selection, Union, Intersection, Set-Difference, Joins, Division,

Management of database users and security. Introduction to front-end and its connectivity with the database. Safety of data, evaluation of database system to avoid fraud.

Reference Books :

1. An Introduction to Database Systems: C. J. Date, Addison-Wesley, 2000
2. Management Information System: Gordon B. Davis and M.H. Olson, Tata McGrawHill.
3. Database system concept: Henry Korth and S. Sudarshan, Tata McGraw Hill. Database Management Systems, 3rd Edition
4. by Raghu Ramakrishnan, Johannes Gehrke Tata McGrawHill
5. Complete reference Oracle 10g: Oracle Press.





Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INT652-2

Course : Manufacturing Economic Analysis

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

Manufacturing Economic Analysis The course intends to enable students to understand and apply

1. The concept of time value of money and cash flow diagrams.
2. Economic analyses techniques in the decision making process to justify or select alternatives / projects on an economic basis, depreciation methods, replacement analysis, and after - tax analysis.
3. Principles of financial accounting, interpretation and analysis of financial statement.
4. BEP/CVP analysis, marginal and absorption costing.

Syllabus

The principal and use of economic analysis in the engineering practices, Time Value of Money :

Nominal and effective interest rates, discrete and continuous compounding. Role of engineering economy in the decision making process, Discounted cash flow analysis, evaluation of investment alternatives, evaluation of alternatives with equal and unequal lives, the effects of income tax on economic studies, Replacement analysis.

Capital budgeting :

Rate of return computation & Cost of Capital; Payback period; Present worth, Annual Worth and capitalized cost evaluation; Benefit/Cost ratio evaluation.

Financial accounting & Costing :

Accounting Principles, Financial Statements, Interpretation and use of accounting information. Cost Accounting, Cost control, Analysis of cost, fixed, variable and semi variable cost, Break-even analysis, CVP Analysis, Marginal and absorption costing, Depreciation: Concepts and Computational Models. Theory of Firm as an owner and as a Producer-Economics of scale-Market Models-Production Function

Text Books

1. Engineering Economy: Theusen H. G. and others Prentice Hall of India
2. Engineering Economy: William G. Sullivan, Prentice Hall
3. Engineering Economy: Leland Blank and Anthony Tarquin, McGraw Hill
4. Cost Accounting: Jawaharlal, Tata McGraw Hill
5. Advanced Accounts Volume II: M.C. Shukla, TS. Grewal, S. C. Gupta, S. Chand and company

Reference Book

1. Engineering Economy Decormo P.E. Macmillon Publication.
2. Cost accounting Principals & Practice Jain, Narong PHI.





**Syllabus for Semester III, M.Tech
Department of Industrial Engineering**

Course Code : INT652-3

Course : Business Communications

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 4

Course Outcomes

1. To make students realize the importance of communication.
2. To prepare for making effective communication.
3. To prepare for group discussion & Personnel Interview.
4. To be able to write Business letters, Report etc.

Syllabus

Introduction, importance of communication, process of communication, types of communication, Interpersonal and intrapersonal communication, basic communication skills, barriers to communication, overcoming the barriers in communication, Effective verbal communication, public speaking, oral presentation, non-verbal communication, telephonic conversation. Group behavior and group dynamics, group discussion, types of interviews, facing the personal interview, meetings, video conferencing Effective written communication, reports, memos, business letters. Communication through emails.

Text Books

1. Communication for Professional Engineers: Bill Scott, Thomas Telford Ltd., 1984
2. Technical Writing: John M. Lannon, Little Brown and Co. 1985
3. The element of Style: 3d edition., Willianl Strunk Jr., Macmillan Publishing Co. 1979





Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : INP653

Course : Project Phase-I

L: 0Hrs. T: 0Hrs. P: 3 Hrs. Per week

Total Credits : 6

Project Phase

Seminar/research work based on some topic related to Industrial Engineering



Syllabus for Semester III, M.Tech

Department of Industrial Engineering

Course Code : MET853-1

Course : Automation in Supply Chain

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Objective

To provide an insight on the fundamentals of Automated supply chain networks, tools and techniques.

Course Outcome

The student would understand the framework and scope of Automated supply chain networks and functions.

Contains

Supply Chain Network Design, Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

Logistics in Supply Chain, Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

Supply Chain and Information Technology, The role IT in supply chain- The supply chain IT framework Customer Relationship Management -Internal supply chain management – supplier relationship management– future of IT in supply chain -E-Business in supply chain.

Warehouse Automation India, Automated storage & Retrieval, Cloud-Based Supply Chain Mgmt, Warehouse Robotics, Automated Guided Vehicles, Autonomous Mobile Robots, Aerial Drones, Automated Storage and Retrieval Systems

Text Books

1. Sunil Chopra, Peter Meindl and Kalra, Supply Chain Management, Strategy, Planning, and operation, Pearson Education, 2010.
2. Warehouse Management: Automation and Organisation of Warehouse and Order Picking Systems, By Michael Hompel, Thorsten Schmidt · 2006, Springer

References Books

1. David J. Bloomberg, Stephen Lemay and Joe B. Hanna, Logistics, PHI 2002.
2. James B. Ayers, Handbook of Supply chain management, St. Lucie press, 2000.
3. Jeremy F. Shapiro, Modeling the supply chain, Thomson Duxbury, 2002.
4. Srinivasan G.S, Quantitative models in Operations and Supply Chain Management, PHI, 2010.



Syllabus for Semester III, M.Tech
Department of Industrial Engineering

Course Code : MET853-2

Course : MEMS and Microsystems

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course Outcomes

Upon the completion of this course, students will demonstrate the ability to

1. Apply the principles behind the operation of MEMS devices
2. Choose a micromachining technique for a specific MEMS fabrication process
3. Design and fabricate MEMS devices or a Microsystems
4. Understand recent advancements in the field of MEMS and devices.

UNIT - I : Micro-fabrication and Micromachining : Scaling laws, Materials for microstructures, Clean room practices, Success Stories: Ink-Jet printer heads, LED Projector, Accelerometer, Lithography techniques

UNIT - II : Bulk Micromachining: Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA), Design problems and case studies

UNIT - III: Surface Micromachining : Sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Silicon Dioxide, Silicon Nitride, Piezoelectric materials, Surface Micro machined Systems: Success Stories, Micro motors, Gear trains, Mechanisms

UNIT - IV : Micro-sensors : Classification of physical sensors, Integrated, Smart sensors, Sensor Principles and Examples: Thermal sensors, Mechanical Sensors, Sensors for robotic applications

UNIT - V : Micro-actuators : Electromagnetic and Thermal micro-actuation, Mechanical design of micro- actuators, Micro-actuator examples, micro-valves, micro-pumps, micro-motors-Micro-actuator systems

UNIT - VI : Application Areas : All-mechanical miniature devices, 3-D actuators and sensors, Navigation solution for Robotics, Need for MEMS components in robotics, biomedical and defense applications.

Text Books

1. Micro and Smart Systems, Ananthasuresh, G. K., Vinoy, K. J. Gopala Krishnan, S., Bhat, K. N., Aatre, V. K., Wiley-India, New Delhi, 2010. 1st Edition
2. RF MEMS and Their Applications: Vijay. Varadan, K. J. Vinoy, K. A. Jose, Wiley, 2002, 1st Edition.

Reference Books

1. Microsensors, MEMS and Smart Devices, Julian W. Gardner, Vinay K. Varadan, Osama O. Awadelkarim, Wiley, 2001, 1st Edition



Syllabus for Semester III, M.Tech

Department of Industrial Engineering

Course Code : MET853-3

Course : Wireless Sensor Networks for Robotics

L: 4Hrs. T: 0Hrs. P: 0 Hrs. Per week

Total Credits : 04

Course objective

To know the basic knowledge about wireless sensor networks and its implementation.

Course Outcomes

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

1. Understand the WSN node architecture and network architecture
2. Identify wireless sensor network platforms
3. Demonstrate knowledge of MAC routing protocols developed for WSN
4. To design and Develop wireless sensor node
5. Understand and explain mobile data-centric networking principles

UNIT - I

Overview : Introduction, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.

Architectures : Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture, Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT - II

Networking : Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts, S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing and Major Routing Protocols.

UNIT - III

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT - IV

Sensor Network Platforms And Tools : Sensor Node Hardware – Berkeley Motes, Deployment, Programming Challenges, Node-level software platforms, Embedded Operating System, Node level Simulators, State-centric programming.



References

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", TMH, 2004.
3. Elsevier B.W. Anderson, "The Analysis and Design of Pneumatic Systems", Wiley, 1995.
4. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks-Technology, Protocols, And Applications", John Wiley, 2007.
5. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
6. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers, 2007.
7. Robert Faludi, "Building Wireless Sensor Networks", O'reily Publications. John Pippenger & Tyler Hicks, "Industrial Hydraulics", 3rd edition McGraw Hill, 2010.





**Syllabus for Semester IV, M.Tech
Department of Industrial Engineering**

Course Code : INP654

Course : Project Phase - II

L: 0Hrs. T: 0Hrs. P: 6 Hrs. Per week

Total Credits : 12

Project Phase II

Seminar/research work based on some topic related to Industrial Engineering

NOTES

