

COURSE SCHEME  
EXAMINATION SCHEME  
ABSORPTION SCHEME  
&  
SYLLABUS

Of

First, Second, Third & Fourth Semester  
Choice Base Credit System (CBCS)

Of

Master of Technology (M.Tech)

In

Industrial Engineering

*Of*

RASHTRASANT TUKDOJI MAHARAJ  
NAGPUR UNIVERSITY, NAGPUR

**Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur**  
**Faculty of Engineering & Technology**  
**Course and Examination Scheme of Master of Technology**  
**Choice Base Credit System (CBCS)**  
**First Semester M.Tech (Industrial Engineering)**

Subject Code	Subject	Teaching Scheme		Marks				
		Hours per week		No. of Credits	Internal	Uni.Exam	Total	Passing
		L	P					
PGIE101T	Operations Research	4		4	30	70	100	50
PGIE102T	Personal Management & Industrial Relations	4		4	30	70	100	50
PGIE103T	Planning and Controlling of Manufacturing System	4		4	30	70	100	50
PGIE104T	<b>Elective - I</b>	4		4	30	70	100	50
PGOPEN105T	<b>Elective -II (Open)</b>	4		4	30	70	100	50
PGIE106P	Operation Research		2	1	50	50	100	50
PGIE107P	Computer Aided Facilities Planning		2	1	50	50	100	50
	Total	20	4				700	
		24		22				

- Elective - I:** 1) Marketing Management  
2) Flexible Manufacturing System & Robotics  
3) Inventory and Supply Chain Management  
4) Statics and Quality Control

- Elective -II (Open) :**  
1) Entrepreneurship Development  
2) Computer Aided Facilities Planning

**Choice Base Credit System (CBCS)**  
**Second Semester M.Tech (Industrial Engineering)**

Subject Code	Subject	Teaching Scheme		Marks				
		Hours per week		No. of Credits	Internal	Uni.Exam	Total	Passing
		L	P					
PGIE201T	Automation in Production	4		4	30	70	100	50
PGIE202T	Work Study and Ergonomics	4		4	30	70	100	50
PGIE203T	Manufacturing Economics and Analysis	4		4	30	70	100	50
PGIE204T	<b>Elective -III</b>	4		4	30	70	100	50
PGFD205T	Foundation Course	4		4	30	70	100	50
PGIE206P	Automation in Production		2	1	50	50	100	50
PGIE207P	Work Study and Ergonomics		2	1	50	50	100	50
	Total	20	4				700	
		24		22				

**Elective -III** : 1) Materials Management  
2) Mechatronics  
3) Value Engineering  
4) Project Evaluation and Management  
5) Maintenance Engineering

**Foundation Course:** 1) Research Methodology

**Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur**  
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**Choice Base Credit System (CBCS)**  
**Third Semester M.Tech (Industrial Engineering)**

Subject Code	Subject	Teaching Scheme		Marks				
		Hours per week		No. of Credits	Internal	Uni.Exam	Total	Passing
		L	P					
PGOPEN301T	<b>Elective IV (Open)</b>	4		4	30	70	100	50
PGFD302T	Foundation Course II	4		4	30	70	100	50
PGIE303P	Project Seminar		3*	8	200		200	100
	Total	8	3				400	
		11		16				

\*Contact Hours per Week per Project

**Elective -IV (Open)** : 1) Product Design & Intellectual Property Rights  
2) Reliability Engineering  
3) Communication Skills

**Foundation Course II** : 1) Project Planning & Management

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**Choice Base Credit System (CBCS)**  
**Fourth Semester M.Tech (Industrial Engineering)**

Subject Code	Subject	Teaching Scheme	Marks
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		Hours per week		No. of Credits	Internal	Uni.Exam	Total	Passing
		L	P					
PGIE401P	Project		6*	16		400	400	200
	Total						400	
		6		16				

\*Contact Hours Per Week Per Project

**RashtrasantukadojiMaharaj Nagpur University, Nagpur**  
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**Course and Examination Scheme of Master of Technology**  
**Choice Base Credit System (CBCS)**

**ABSORPTION SCHEME**

**First Semester M.Tech (Industrial Engineering)**

<b>As per Non -Credit Based Scheme (Non-CBS)</b>		
Subject Code	Subject	Theory/Practical
I/In 01	Operation Research	Theory
I/In 04	Personal management and industrial relations	Theory
I/In 05	Planning and controlling of manufacturing system	Theory
I/In 03	Statics and Quality control	Theory
I/In 02	Computers and database management	Theory
I/In 06	Operation Research	Practical
I/In 01	Computers and database management	Practical

<b>As per Choice Base Credit System (CBCS)</b>		
Subject Code	Subject	Theory/Practical
PGIE101T	Operations Research	Theory
PGIE102T	Personal Management & Industrial Relations	Theory
PGIE103T	Planning and Controlling of Manufacturing System	Theory
PGIE104T	<b>Elective - I</b>	Theory
PGOPEN105T	<b>Elective -II (Open)</b>	Theory
PGIE106P	Operation Research	Practical
PGIE107P	Computer Aided Facilities Planning	Practical

- Elective - I:** 1)Marketing Management  
2) Flexible Manufacturing System &Robotics  
3) Inventory and Supply Chain Management  
4) Statics and Quality Control

- Elective -II (Open) :**  
1)Entrepreneurship Development  
2) Computer Aided Facilities Planning

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**Choice Base Credit System (CBCS)**

**ABSORPTION SCHEME**

**Second Semester M.Tech (Industrial Engineering)**

<b>As per Non -Credit Based Scheme (Non-CBS)</b>		
Subject Code	Subject	Theory/Practical
II/In 01	Automation in Production	Theory
II/In 02	Methods Engineering and Ergonomics	Theory
II/In 03	Manufacturing Economics and Analysis	Theory
II/In 04	Project Evaluation and Management	Theory
II/In 05	Maintenance Engineering	Theory
II/In 06	Automation in Production	Practical
II/In 07	Methods Engineering and ergonomics	Practical

<b>As per Choice Base Credit System (CBCS)</b>		
Subject Code	Subject	Theory/Practical
PGIE201T	Automation in Production	Theory
PGIE202T	Work Study and Ergonomics	Theory
PGIE203T	Manufacturing Economics and Analysis	Theory
PGIE204T	<b>Elective -III</b>	Theory
PGFD205T	Foundation Course	Theory
PGIE206P	Automation in Production	Practical
PGIE207P	Work Study and Ergonomics	Practical

**Elective -III** : 1) Materials Management  
2) Mechatronics  
3) Value Engineering  
4) Project Evaluation and Management  
5) Maintenance Engineering

**Foundation Course:** 1) Research Methodology

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**ABSORPTION SCHEME**

**Third Semester M.Tech (Industrial Engineering)**

<b>As per Non -Credit Based Scheme (Non-CBS)</b>		
Subject Code	Subject	Theory/Practical
III/In 01	Elective I	Theory
III/In 02	Elective II	Theory
III/In 03	Project phase I	Practical

<b>As per Choice Base Credit System (CBCS)</b>		
Subject Code	Subject	Theory/Practical
PGOPEN301T	<b>Elective IV (Open)</b>	Theory
PGFD302T	Foundation Course II	Theory
PGIE303P	Project Seminar	Practical

**Elective -IV (Open)** : 1)Product Design & Intellectual Property Rights  
2) Reliability Engineering  
3)Communication Skills

**Foundation Course II** : 1) Project Planning & Management



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**ABSORPTION SCHEME**

**Fourth Semester M.Tech (Industrial Engineering)**

<b>As per Non -Credit Based Scheme (Non-CBS)</b>		
Subject Code	Subject	Theory/Practical
IV/In 01	Project phase II	Practical

<b>As per Choice Base Credit System (CBCS)</b>		
Subject Code	Subject	Theory/Practical
PGIE401P	Project	Practical

**Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur**  
**Faculty of Engineering & Technology**

**First Semester M.Tech (Industrial Engineering)(CBCS)**  
**Syllabus of Semester I**

**Course Code: PGIE101T**

**Course: Operations Research      L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. Formulate given situation to get better visualization of objectives and constraints.
2. Represent any project through a network and understand its critical activities.
3. Model any real-world problem into a simulation model

**Syllabus:**

**Introduction**

Introduction to O.R, Optimization Techniques, Model Formulation, Assignment, Transportation models,

General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models, Deterministic and Probabilistic Models. Competitive Models, Waiting Line Models, Single and Multi-channel Problems, Sequencing Models, Flow in Networks, Elementary Graph Theory, Shortest Route Problems. Investment Models, Game Theory, Simulation, Project Networks.

**Reference Books:**

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

**Course Code: PGIE102T**

**Course: Personal Management & Industrial Relations**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To understand the scope & Objective of personnel Management.
2. To get knowledge about personnel planning, recruitment training etc.
3. To aware about employee health, security ,welfare related issues.
4. To understand Industrial disputes their nature, Causes and settlement.
5. To know about role and functions of Trade unions and related labor legislations.

**Syllabus :**

Human behavior of an individual as a member of a small group and as a member of an organization . Influence of culture; organizational, social, national and international on individual.

Analysis of dynamic behavior of organization by simulation, structure of organization and flow of men, money, material, information capital, equipment and order, system models to evolve effective policies for management.

Scope and objective of personnel management, personnel planning, labor market, recruitment, training and placement, Job evaluation, Merit rating, wage incentives, employee health, security and welfare, morale, and motivation, industrial disputes, voluntary and compulsory settlement, trade unionism, labour legislations, performance appraisal and evaluation.

**Reference Books :**

1. Human Resources Management: K. Aswathappa, Tata McGraw Hill.
2. Dynamics of Industrial Relations: C. B. Mamoria, Himalaya Publication.
3. Personnel Management: Edwin Flippo, Tata McGrawHill.
4. Fundamentals of Human Resource Management: David A. Decenzo & Stephen PRobbins, Wiley-India.

**Course Code: PGIE103T**

**Course: Planning and Controlling of Manufacturing System**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To make students understand the different manufacturing systems.
2. To know about material handling equipments along with the problems and uses .
3. To make students understand the use of various demand forecasting tools, production Planning techniques.

**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.

**Demand forecasting:**

Tools and techniques. Production planning and control, Capacity planning: tools and techniques, Aggregate production planning, MRP, ERR Process planning and LOB techniques.

**Scheduling of Production:**

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. Theory and problems in Production and Operation Management: S. Chary, McGrawHill
2. Production and Operation Management: E. Buffa, RichardD. Irwin.
3. Industrial Engineering and Production Management: MartandTTelsang, S. ChandA Co.,
4. Production and Operation Management: Pannerselvam, Prentice Hall of India

**Course Code: PGIE104T**

**Course: ELECTIVE-I (Marketing Management)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes :**

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

**Syllabus :**

**Modern Marketing Concept :**

Definition of marketing management, basic marketing system model, e-commerce and Internet marketing.

Marketing Environment: Marketing opportunity concept, economic, social, political and cultural environment, 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.

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, 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: Philips Kotler



**Course Code: PGIE104T**

**Course: ELECTIVE-I (Flexible Manufacturing System & Robotics)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To understand concept of FMS
2. To Know the component of FMS, AGV
3. To Understand Kinematics & Dynamics involved in Robotics.
4. To know application of Robotics.

**Syllabus:**

**Flexible Manufacturing System**

Introduction to Flexible Manufacturing system, Manufacturing Integration Model, Flexible Manufacturing Strategy, Manufacturing Cells, Group Technology & Cellular Manufacturing, Components of Flexible Manufacturing, Pallets and Fixtures, Machining Centers, Inspection Equipment, Material Handling Stations, Storage System, In-process Storage system, Manually Operated Stations, Allied Operation Centers, AGV.

**Robotics**

Robotics Configuration, Introduction to Kinematics & Dynamics, Drives, Control, Sensors and Grippers, Robotic Work cells, Applications of Robotics in handling, Welding, Painting, Assembly, Machining and other areas, Selection of Robots.

**Text Books:**

1. Robotics Technology & Flexible Automation: S. R. Deb (Tata McGrawHill)
2. Automation, Production System, and CIM: M. P. Groover (Pearson Education)
3. Computer Control of Manufacturing System: Yoram Koren (McGrawHill)

**Course Code: PGIE104T**

**Course: ELECTIVE-I (Inventory and Supply Chain Management)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To understand concept of Inventory Control
2. To Know the concept of Supply Chain Management (SCM)

**Syllabus:**

Introduction to Inventory Control Models, Introduction to Supply Chain Management (SCM): Concept of Logistics Management, Concept of supply management and SCM, Core competency, Value chain, Elements of supply chain efficiency, Flow in supply chains, Key issues in supply chain management, Sourcing and Procurement: Outsourcing benefit, Importance of suppliers, Evaluating a potential supplier, Supply contracts, Competitive bidding and Negotiation, E-procurement Introduction to Inventory Management: Selective Control Techniques, MUSIC-3D systems, Various costs. Deterministic Models, Quantity Discounts - all units, incremental price; Sensitivity, Make-or-buy decisions.

Independent Demand Systems (Probabilistic Models): Q- system, P- system, Mathematical Modeling under known stock out costs and service levels, Bullwhip effect, Information and supply chain trade-offs.

Decision making and application: Decision making in SC – Applications of SCM – warehouse management system – product data management – E –Commerce – Reverse logistics – Cases in Paper industry – Furniture industry.

**REFERENCES**

1. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. Second Edition, Pearson Education (Singapore) Pte. Ltd, 2004.
2. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Second Edition, Tata McGraw-Hill Edition, 2003.
3. Doebler, D.W. and Burt, D.N., Purchasing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.



**Course Code: PGIE104T**

**Course: ELECTIVE-I (Statics and Quality Control)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To Develop conceptual understanding of Quality of Product and Process and its Management.
3. To Develop Control charts for process control.
4. To know sampling plans for acceptance of materials.
5. To Understand concepts such as six sigma, Lean Production and JIT

**Syllabus:**

Introduction to Statistical Methods and Quality, Meaning of Quality, Brief History of Quality Control and Improvement, Statistical Methods of Quality Control and Improvement, Other Aspects of Quality Control and Improvement.

Basic Methods of Statistical Process Control and Capability Analysis

Methods and Philosophy of Statistical Process Control Introduction, Chance and Assignable Causes of Quality, Statistical Basis of the Control Chart, QC tools, New seven QC tools, Pareto analysis, Implementing SPC, An Application of SPC, Control Charts for Variables, Control Charts for  $\bar{x}$  and R, Applications of Variables Control Charts. Control Charts for Attributes,

Acceptance Sampling Lot-by-Lot Acceptance Sampling for Attributes, Acceptance Sampling Problem, Single-Sampling Plans for Attributes, Double, Multiple, and Sequential Sampling,

Six Sigma/Lean Six Sigma, DMAIC, Application of Six Sigma tools to minimize production variability, Taguchi Loss Function, Lean Production and Quality, The Birth of Lean Production, The Lean Production System, Stability, Just-In-Time

**Reference Books:**

1. Statistical Quality Control: E. L. Grant, Richard S. Leavenworth, Tata McGraw Hill.
2. Quality Planning and Analysis: Juran, Tata McGraw-Hill.
3. The Assurance Sciences: S. Halpern, Prentice Hall India Ltd. New Delhi,
4. Managerial Statistics: Winston and Zappen Duxbury, Thompson Learning Inc.

**Course Code: PGOPEN105T**

**Course: ELECTIVE –II (OPEN)**

**Course Code: PGIE106P**

**Course: Operation Research L: 0 Hrs. T: 0Hrs. P: 2Hrs Per week Total Credits: 2**

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**Experiments**

Practical's based on theory syllabus.



**Course Code: PGIE107P**

**Course: Computer Aided Facilities Planning**

**L: 0 Hrs. T: 0Hrs. P: 2Hrs Per week Total Credits: 2**

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### **Experiments**

#### **List of experiments:**

1. Design and construction of shop floor facilities like:
  - a. Floor space,
  - b. Wall width and height
  - c. Windows
  - d. Columns and beams for given specifications in a layout.
2. Constructing mezzanine floor and inserting cabinets on the mezzanine floor
3. Building the stairs in a layout
4. Assigning different machines, workbenches and other similar facilities in a layout
5. Design of a conveyor
6. Design of workstation along with aisles
7. Conducting simple pick and place motion by the operator at a workbench
8. Creating an assembly line using single and parallel processors along with source and drain stations
9. Design of required no. of buffers in an existing production or assembly line
10. Practical's based on ELECTIVE –II (OPEN) (Computer Aided Facilities Planning) theory syllabus.

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**Second Semester M.Tech (Industrial Engineering)(CBCS)**  
**Syllabus of Semester II**

**Course Code: PGIE201T**

**Course: Automation in Production L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

- 1) Students will be able to evaluate & compare investment projects.
- 2) Students will be able to analyze & evaluate the performance of automated production time based on production times, production rate and efficiency of live.
- 3) Students will be able to design part delivery system and evaluate the performance of automated assembly times.
- 4) Students should be able to evaluate and select a suitable CNC/machining centers for manufacturing a particular component.

**Syllabus:**

**Automation**

Principles, basic concepts, economy, efficiency, productivity and performance of machine tools, main trends in automation, automatic devices and design, automatic and semi-automatic machines, programme controlled machines, special purpose machines, unit type and transfer machines, automation in assembly, gauging and size control.

**Numerical Control (N.C.):**

Management implication, advantages and applications, N.C systems and controls, information processing and storage. Part programming languages, manual programming, machine axis system, machining centers, computer aided N.C. and adaptive control. Selection of components for NC manufacturing, tools for NC.

**Reference Books:**

1. Automation in Production: Groover M.R, Tata McGraw Hill.
2. Numerical Control of Machine Tool: Yoram Koren and Behuri J., Khanna Publication.
3. NC and CAM: Kundra and Rao, Tata McGraw.

**Course Code: PGIE202T**

**Course: Work Study and Ergonomics L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

Engineering approach to methods analysis and improvement, Data collection and recording techniques; critical examination and development, creative thinking

**Syllabus:**

Productivity Management: Concept of Productivity, Factors affecting Productivity, Total Productivity model, Short term and Long term Productivity Planning Models, Productivity improvement Techniques: Technology based, Material based, Employee based, Product and time base P.I. Techniques,

Work Study: Definition, objectives and areas of application  
of work study in industries, Historical review, Human aspects of work-study, Role of work-study in productivity improvement. Interrelation between method study and work measurement, Work Measurement: Systems of performance rating, Introduction to MOST, Work Sampling.

Introduction to Ergonomics: Ergonomics as a multi-disciplinary field, components, importance of ergonomics in equipments and work design, concept of man-machine; Types and characteristics, Anthropometry and Work place design.

Wage Incentives and Job Evaluation

**Reference book:**

1. Sumanth D.J. , Productivity Management, TMH
2. I.L.O, Introduction of Work Study, ILO
3. Maynand H.B., Industrial Engineering Hand Book.
4. Jhamb L.C. Workstudy and Ergonomics.

**Course Code: PGIE203T**

**Course: Manufacturing Economics and Analysis**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To make students understand the concept of Time Value of Money.
2. To make students understand the various costs and their application in manufacturing scenarios.
3. To make students understand Capital budgeting, and evaluation of various financial ratios.
4. To make students understand Financial Accounting, its principle, interpretations various types of financial statements and their use.

**Syllabus:**

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

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.

**Reference 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. Engineering Economy: De; Garmo PE., MacMillan Publication
5. Cost Accounting: Jawaharlal, Tata McGraw Hill



6. Advanced Accounts Volume II: M.C. Shukla, TS. Grewal, S. C. Gupta, S. Chand and company
7. Cost Accounting, Principles & Practice: Jain Narang, PHI

**Course Code: PGIE204T**

**Course: Elective III (Material Management)      L: 4Hrs. T: 0Hrs. Per week Total**

**Credits: 4**

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**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, KANAN 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. Selection & Use of Engineering Materials: Crane, FA.A & Charles, IA. London Butterworth, 1984
2. Material management & Inventory Control: Tersine
3. Applied Materials Management: S. Chatterjee

**Course Code: PGIE204T**

**Course: Elective III (Mechatronics)L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. Describe the basic building blocks of Mechatronics systems (e.g hardware, software, communication, interfacing, sensing, control and actuation)
2. Sketch such a technical solution and select component types.
3. Identify critical problems/design issues and suggest feasible methods and tools to solve.
4. Be able to summarize and on smaller problems apply a development model for mechatronic product development.
5. Model, simulate and synthesize (but not realize) smaller mechatronic systems and products.

**Introduction**

Introduction of Mechatronics Technology and approach towards Mechatronics designing, Study of sensors and transducers, measurement of various parameters like displacement, position, proximity, velocity, force temperature, light, etc., Selection criteria for sensors, signal conditioning elements and their needs, data indicators and recorders for a Mechatronics systems, Actuation system including pneumatic/hydraulic, electrical and mechanical actuation. System modeling for mechanical, electrical, fluid, thermal and the combination to find transfer function. Checking system stability by using tools like MATLAB and SIMULINK, close loop controllers, Digital logic including combination of logic and sequential logic, Study of microprocessor and programmable logic controllers (PLC), Fault detection technique in Mechatronics systems.

**Text Books:**

1. Mechatronics: HMTLtd. New Delhi- Tata McGraw Hill 12001.
2. Mechatronics: W.Bolton, Longman Second Edition. 1999
- 3 Introduction to Mechatronics and Measurement Systems:MichelHuston,DavidAlciatore McGraw Hill 1998

**Course Code: PGIE204T**

**Course: Elective III (Value Engineering) L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. Students will be able to apply cost reduction techniques.
2. Will be able to evaluate various alternatives.
3. Will be able to prioritize functions of products.
4. Will be able to identify under value products.
5. Will be able to improve value of product.

**Syllabus :**

An overview of value engineering (VE) - Definition, Concepts and approaches of value analysis and engineering – evaluation of VE. Evaluation of function, Problem setting system, problem solving system, setting and solving management-decision – type and services problem, evaluation of value.Results accelerators.

Basic steps in using the systems Value analysis - Understanding the decision environment, Effect of value analysis on other work in the business. VE Team, Co-ordinate, designer, different services, definitions, construction management contracts, value engineering case studies.

Effective organization for value work, Fast diagram, Matrix method and other approaches in value engineering, Evaluation of value alternatives.

**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. New York, John Wiley & Sons, 1973
3. An Introduction to Value Engineering: L. D. Miles

**Course Code: PGIE204T**

**Course: Elective III (Project Evaluation and Management)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. Students will be able to proper project charter.
2. Students will be able to plan & Schedule the Project activity.
3. Students will develop the ability to understand to use of human resources.
4. Students will be able evaluate Project performance.
5. Students will be able to prepare project audit report.

**Syllabus :**

Philosophy and Concepts: What Is Project Management? Project and System Definition. Concepts of Project Management, Project Management Life Cycle, Establishing the Project: Scope, Time, Cost and Performance Goals, Organizing Human Resources and Contracting, Organizing systems and Procedures for Project implementation, Project Direction, Coordination and Control, Project Evaluation, Benefits of Project evaluation, Limitations of Project evaluation, Methods of Project evaluation. Project Management Performance. Management

Information System, Project Management Tools.Managing Risks in Projects; Project Execution and Control; Project Evaluation, Communication, Implementation, and Closeout.

**Reference Books :**

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

**Course Code: PGIE204T**

**Course: ELECTIVE III(Maintenance Engineering)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To understand basic models of maintenance systems, including various aspects of breakdown & prevention of breakdown in respect of the maintenance and their controls.
2. To understand spares management, costing and budgeting of equipment maintenance resources  
planning for flaming for maintenance facilities and their implications in real scenario.
3. Cost and resources management for maintenance.

**Syllabus:**

Need for maintenance, Maintenance definition, Maintenance objectives, Challenges of Maintenance management, Scope of maintenance Department, Maintenance costs. General Objectives, Functions. Organization and administration of Maintenance Systems; Requirements, Concepts and Structure of Suitable Organization for Maintenance system, Failure analysis: Classification and Selectivity of Failure, Statistical and Reliability Concepts and Models for Failure Analysis, Maintenance system models,

Decision Models for Maintenance Planning; Operation and Control, Optimum Level of Maintenance/Replacement, Aspects of Break Down and Preventive Types, Group and Individual Type, Obsolete Facility, Deteriorating and Completely Failing Facilities, Replacement Vs. Reconditioning, Economics of Maintenance, Space Planning and Control; Static Spares, Insurance Spares With and without Salvage Value, Low Moving Spares, Man power Planning - Crew Size. Allocation etc.

Standby Machines:Economical and Operational Aspects: Scheduling and Planning of Activities, Monitoring and updating, Recourses Allocation. Assigning Priorities. Cost Management for Maintenance: Cost Estimates-Recording, Summarizing and Distributing Cost Data, Maintenance Budget. Work Measurement for Maintenance, Maintenance Control Indices, .Maintenance Service Contracts, Preventive Maintenance, Management Guidelines, Procedure, General Management of Lubrication Systems, Organizing Preventive Maintenance Programme Using Vibration Signature of Analysis, Management of Records for Maintenance, Computerization of Maintenance Activities, Major Plant Shut-Down Procedures.

#### **Reference Books:**

1. Maintenance Engineering Hand Book: LIHiggins, L C. Morrow, McGrawHill.
2. Management of Industrial Maintenance: A. Kelly and M. J. Harris, Newness-Butterworths.
3. Reliability, Availability and Maintainability: J. W. Foster, D. T. Phillips and IR. Rogers.
4. The Complete handbook of Maintenance Management: J. E. Heiltzelman, Prentice Hall of India.
5. Maintainability and Maintenance, Management Instrument Society of America: J. D. Patton.

**Course Code: PGIE205T**

**Course: Foundation Courses**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Code: PGIE206P**

**Course: Automation in Production**

**L: 0 Hrs. T: 0Hrs. P: 2HrsPer week**

**Total Credits: 1**

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**Practical's based on theory syllabus.**



**Course Code: PGIE207P**

**Course: Work Study and Ergonomics**

**L: 0 Hrs. T: 0Hrs. P: 2 Hrs. Per week**

**Total Credits: 1**

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**Practical's based on theory syllabus.**

**Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur**  
**Faculty of Engineering & Technology**

**Third Semester M.Tech (Industrial Engineering)(CBCS)**  
**Syllabus of Semester III**

**Course Code: PGOPEN301T**

**Course: Product Design & Intellectual Property Rights**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To Know basic product design concept
2. To know about IPR. Copyright and Trademark
3. To know about Patent procedures

**Syllabus:**

**Product Development**

Definition and objective, Role of designer in product development, Manufacturing and economic aspects of product development, Product promotions, product developments.

**Visual Design , Form & Color**

Basic elements and concept of visual design-line color, balance proportion, size and shape, mass, unity and variety, special relationships and composition in two and three dimensions.

Elementary forms their characteristics and significance in design. Form transition, Form in relation to ergonomics, material and manufacturing process, color as an element of design, color clarification dynamics, interrelation of colors, colors and traditions; Psychological use of color form and material.

**Product Graphics and Product Detailing**

Meaning and objectives of product graphics, Basic principles of graphic design, Visual communication aspects of product graphics, Graphics of displays and control panels, Standard fastening and joining details in different materials; Temporary and permanent joints: Detailing for plastic products, Detailing for fabricated products in sheet metal.

**Intellectual Properties Right**

Definition and Objective, issues involved with IPR. Patent, copyright and Trademark, difference between them. Patent Search, European databases, American Databases. Accessing free and paid sights, International patent classification, Procedure for filing patent. Legal issues involved.

**References:**

1. Mayall W.H., "Industrial Design for Engineers" London Liifee Books Ltd. 1967
2. Dale Huchingson R "New Horizons for Human Factors in Design" McGraw Hill Company
3. Mayall W. H, " Principles in Design"
4. Svensson, "Engineering Design"
5. Patent sights - USPTOV.GOV , Espacenet.com

**Course Code: PGOPEN301T**

**Course: Reliability Engineering**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Outcomes:**

1. To Know basic concept of Reliability Engineering
2. To know about Quality Management

**Syllabus:**

Reliability Engineering Concepts - Bathtub Hazard Rate Concept and Reliability Basic Formulas, Reliability Evaluation of Standard Configurations, Reliability Analysis Methods

Quality Engineering Concepts - Quality Goals, Quality Assurance System Elements, Total Quality Management, Quality Analysis Methods, Quality Costs and Indices

Robot Reliability - Medical Equipment Reliability - Power System Reliability – Computer and Internet Reliability

Software Quality - Quality in Health Care –Quality Control in Health Care – Quality Control in the Textile Industry – Quality Control in the Food Industry

**Text Books:**

1. Dhillon, B.S, Applied Reliability and Quality- Fundamentals, Methods and Procedures Series: Springer Series in Reliability Engineering, 2007

**Reference Books**

1. Hoang Pham, Recent Advances In Reliability And Quality In Design, Springer Series In Reliability Engineering, 2008
2. Bentley John P, Introduction To Reliability And Quality Engineering, Addison – Wesley, 1999

**Course Code: PGOPEN301T**

**Course: Communication Skills**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**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 to basic communication skills, Group behavior and group dynamics, Process of communication, Barriers to communication, Overcoming the barriers in communication, Effective verbal communication, Public speaking, Oral presentation, Group discussion, Facing the personal interview, Practice sessions, Non-verbal communication, Effective written communication, Reports Business letters Exercises, Effective use of the English Language, Elements of Style, Pronunciation-practice in the language laboratory, Implication for performance and satisfaction.

**Text Books:**

1. Communication for Professional Engineers: Bill Scott, Thomas TelfordLtd., 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

**Course Code: PGFD302T**

**Course: Foundation Course II (Project Planning & Management)**

**L: 4Hrs. T: 0Hrs. Per week Total Credits: 4**

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**Course Code: PGIE303P**

**Course: Project Seminar**

**L: 0 Hrs. T: 0 Hrs. P:3\* Hrs Per week      Total Credits: 8**

(\*Contact Hours per Week per Project)

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Seminar will be evaluated based on:

- Literature Review of emerging work in chosen area. Emphasis will be on modeling and other Industrial Engineering tools and techniques
  
- At least one case study review that demonstrates student ability to related theory to application
  
- Project/ Paper Write-up
  
- Presentation

**Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur**  
**Faculty of Engineering & Technology**

**Fourth Semester M.Tech (Industrial Engineering)(CBCS)**  
**Syllabus of Semester IV**

**Course Code: PGIE401P**

**Course: Project**

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

**Total Credits: 16**

(\*Contact Hours per Week per Project)

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**Final Project work will be evaluated based on:**

- Project problem definition
- Scope – In Scope, Out of Scope
- Assumptions
- Project Plan
- Project Preparatory Work and Data Gathering
- Literature Survey
- IE Concepts and Methodology used
- Recommendations
- Implementation Methodology
- Results
- Original Contribution of the project
- Project Report Depth and Quality
- Project Presentation