

MECHANICAL ENGINEERING DEPARTMENT

M.Tech. MAINTENANCE ENGINEERING

**Course of Study & Scheme of Examination
2016-17**



**Maulana Azad National Institute of Technology
Bhopal**

M.TECH. IN MAINTENANCE ENGINEERING**First Semester**

Course Number	Subject	Scheme of Studies Periods per week			Credits
		L	T	P	
MTH511C	Statistics and Probability	2	2	-	3
MT512	Maintenance Management – Policies, Strategies & Options	3	-	-	3
MT513	Lubrication Management & Practice	3	-	-	3
	Elective - 1	3	-	-	3
	Elective - 2	3	-	-	3
	Open elective-1	3	-	-	3
MT514	Maintenance Engg Lab-I and Tribology Lab	-	-	2	2
MT515	Seminar 1 and mini project	-	2	-	2
Total credit					22

Second Semester

Course Number	Subject	Scheme of Studies Periods per week			Total Credits
		L	T	P	
MT521	Reliability, Availability & Maintainability Engineering	3	-	-	3
MT522	Failure Analysis & Prevention	3	-	-	3
MT523	TPM, CBM and RCM	3	-	-	3
	Elective - 3	3	-	-	3
	Elective - 4	3	-	-	3
	Open elective-2	3	-	-	3
MT524	Maintenance Engg Lab-II and Diagnostics Lab.	-	-	2	2
MT525	Seminar 2 and mini project	-	2	-	2
Total credit					22

List of department electives

MT531 Maintenance Audit
 MT532 Risk Analysis and Safety
 MT533 Concurrent Engineering
 MT534 Maintenance Awareness in design
 MT535 Maintenance of Agriculture and Earth Moving Machinery
 MT536 Bulk Solids and Handling
 MT537 Maintenance of Electrical Machines
 MT538 Maintenance of Power Plant Machinery
 MT539 Maintenance of Transport Machinery ;
 MT541 Mechatronics and NDT in Maintenance Engineering
 MT542 Maintenance of CNC Machines
 MT543 Restoration, Repairs and Retrofitting
 MT544 Machinery Vibration Monitoring Analysis
 MT545 Maintenance of Chemical Plant Machinery

List of open electives:

MT551 Theory of Tribology Elements

MT552 Maintenance Economics and Turn Around Management

MT 553 Computer aided maintenance management

MT 554 Maintenance of Power Plant Machinery

SYLLABUS

FIRST SEMESTER

MTH 511C STATISTICS AND PROBABILITY

Collection & Tabulatory data. 2 Measures of central Tendency, Mean, Median, Mode. Dispersion, range, Deviation, Coefficient of Dispersion, Moments. Probability: Additive law of probability, Compound events, Use of multinomial Expansion, theorem. Probability density function. Probability Distribution, Binomial, Poisson's and Normal weibill, experimental etc.

Sampling: Simple Sampling, Sampling distribution the sampling of variables, estimation, distribution, chi-square distribution. Interpolation: Newton's Forward and Back ward interpolation formula, central difference interpolation formulae, Interpolation with unequal intervals. Numerical Differentiation Numerical integration Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8 rule, weddlesrule. Solution of Algebraic and Transcendental Equations, Method of false position, Newton Rap son method, Bisection method.

References

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|--|---------------------|
| 1. Engineering Reliability Fundamental and Application | R. Rama Kumar |
| 2. Mechanical Survival | J.H. Bampas – Smith |
| 3. Mathematical Statistic | M. Ray |
| 4. Mathematical Statistic | Fruend |

MT 512 MAINTENANCE MANGAEMENT –Policies, Strategies & Options.

Introduction : Maintenance,Need of Maintenance Management, Maintenance Policies, Strategies and options in Maintenance management. Maintenance forms/actions and their inter relationships, Brief descriptions of various Maintenance actions. Maintenance Organisations: Prerequisites, factors determining effectiveness of a Maintenance organization, objectives of organization design, types of organization.

Maintenance Planning and Control: Establishing a Maintenance Plan-Preliminary considerations, Systematic method of Maintenance Plan and schedule planning and schedule of Plant shut downs

Maintenance practices on production machines- Lathe,Drilling,Milling,Welding,ShaperUse of computer in maintenance,Machine Reconditioning. Evaluation of Maintenance Management: Need for evaluation a to z objectives, criterion of evaluation. Spare Parts Management: Capacity utilization, cost reduction approach to spares, reliability and quality of spares, spare parts procurement, inventory control of spare parts.

References:

1. Maintenance Management
Policies, Strategies and Options:July 27–29 , 2000, Lecture notes MACT, Bhopal.
2. Maintenance & Spare Parts
Management. :P. Gopal Krishnan & A.K. Banerji
3. Hand Book of Reliability
Engineering & Management :W. Grant Ireson and Clyde F – McGraw Hill
4. Maintenance Planning & Control:Anthony Kelley – East West Press.

MT513 LUBRICATION MANAGEMENT & PRACTICES

Introduction: friction, wear and lubrication, Historical background, Purpose of lubrication, Lubrication regimes, Characteristics of lubricants - viscosity, viscosity index, oxidation stability, flash point and fire point, pour point and cloud point, carbon residue, ash content, iodine value, neutralization number, dielectric strength, Composition and classification of lubricants, Lubricating oils – oil refining, types, categories, grading, Grease - composition, function, characteristics, thickeners and additives, soap and its complexes, selection and its practices, solid lubricants, Functional additives – surface, performance enhancing, lubricant protective , Lubricants applications – tribological components and industrial machinery, Lubricants testing and test methods, Organisation and management of lubrication, lubricant storage and handling, Safety and health hazards, Environmental regulations.

References:

1. CRC Hand Book of Lubrication and Tribology Vol. I – Vol. III CRC Press Inc.
2. Maintenance Engineering Handbook L.R.Higgins,
3. Basic Lubrication Theory A Cameron

MT514 MAINTENANCE ENGINEERING LABORATORY

Experiments in Preventive maintenance and diagnostic engineering

MT515 SEMINAR 1 & MINI PROJECT

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

SECOND SEMESTER

MT521 RELIABILITY AVAILABILITY AND MAINTAINABILITY ENGINEERING

Introduction to Reliability Availability and Maintainability (RAM), Development of RAM Engineering, Reliability Availability and Maintainability utilization factors, down time consequences.

Reliability engineering fundamentals and applications, Historical perspectives, Definition of Reliability, Role of Reliability evaluation, Reliability assessment, relationship between different Reliability functions, typical Hazard functions, Mean time to failure, Cumulative Hazard function and average failure rate,

Application of Probability distribution function in Reliability evaluation combinational Aspects of Reliability, Markov models optimization of system Reliability, Heuristic Methods applied to optimal system Reliability. Maintainability :

Definition and application of Maintainability Engineering, Factors affecting Maintainability. Maintainability design criteria, operating and down time categories, Maintainability and its quantification, Mean time to activity restore an equipment, Mean Maintenance man hours, Mean time for corrective and Preventive Maintenance, Replacement Policies. Availability, types of Availability, approaches to increase equipment Availability.

References:

1. SERC School on RAM Engineering for Manufacturing servicing and Process Industries.
2. Reliability Engineering Fundamentals R. Ramakumar
3. Maintainability, Availability and Dimitri Kececelogu
4. Reliability Engineering Govil
5. Reliability Engineering Balguruswamy

MT522FAILURE ANALYSIS & PREVENTION

Introduction: Engineering aspects of failure & failure analysis

Defects: Types and characteristics, Effects of defects on service properties General Procedures for Failure Analysis Basic Failure Mechanisms: Distortion Failures, Overload Failures, Fatigue Failures, Wear Failures, Corrosion Failures, Elevated Temperature Failures, Fractures.

Failure Analysis Techniques and Preventive Measures: Non Destructive Testing Techniques and Metallographic Techniques.

Component Failures: Bearings, Chain and Belt Drives, Gears, Lifting Equipments, Mechanical Fasteners, Pressure Vessel, Seals, Shafts, Springs

Failure Modes and Effect Analysis: Failure Modes, Categories of Failure Modes, Failure Effects, Sources of Information about modes and effects, failure consequences, Case Studies on failure Analysis.

References

1. Metals Hand Book 9th Edition, Vol. 11, Failure Analysis and Prevention.
2. Failure of materials in Mechanical Design: Analysis, Prediction and Prevention Jacks A. Collins.
3. Metallurgy of Failure Analysis. A.K. Das.
4. CRC Hand book of lubrication Vol.I Application and maintenance. E.R.Boosy

MT523 TPM, CBM & RCM

Introduction: Definition concept of TPM, characteristics of TPM, Benefits of TPM, losses of TPM, implementing TPM. Philosophy of TPM. Indications of TPM.

TPM Development: Preparation phase, TPM introduction education, TPM Promotion organization, TPM policies and goods, TPM Master Plan TPM initiatives, Implementation phase; consolidation phase.

Measuring TPM effectiveness: Philosophy of setting goals Measuring TPM effectiveness Indicators topos, Plant effectiveness quelling and Energy saving Maintenance Measuring TPM Benefits.

Application of TPM in Process Industries Administrative & Support departments and other Industrial enterprises

Reliability Centred Maintenance (RCM): Introduction its place in Maintenance policies & Hierarchy aims of RCM, steps in RCM implementation, steps in RCM analysis, system selection, RCM effectiveness indicators. Maintenance informer and efficiency.

RCM tasks Proactive Maintenance, Preventive and Predictive tasks. Scheduled restoration and scheduled discard . The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams. Implementation of RCM. Condition Based Maintenance: Machine signatures, various techniques of signature analysis, temperature noise, vibration and wear particle analysis, on line and off line techniques.

References

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| 1. Seichi Nakajima TPM development | Productorly Press 1989. Programme |
| 2. Total Productive Maintenance | Vikas Bhaduri |
| 3. Industrial / Maintenance & Management | S.K.Shrivastava. |
| 4. Introduction to TPM – Total.
Maintenance | S Nakafiurea Productivity Productive |

MT524 MAINTENANCE ENGINEERING Lab-II & DIGONESTIC Lab

Experiments in Preventive maintenance and diagnostic engineering

MT525 SEMINAR 2 & MINI PROJECT

Students have to collect a International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

DEPARTMENT ELECTIVES

MT 531 MAINTENANCE AUDIT

A Methodology for auditing the industrial maintenance function. The purpose and procedures of such auditing. An outline with examples of a full audit, a snapshot audit and a fingerprint audit. Information gathering strategy. Information gathering techniques: models, questionnaires, survey forms. An outline of an aide-memoire based on the audit methodology Methods of interviewing. Analysis of data: the analysis procedure, identification of problem areas, developing improved organisations and systems. Reporting: the report structure, the audit section, the proposal section. A major part of the course will be devoted to the discussion and analysis of actual audit reports. This will include use of audit data to identify problems, their causes and solutions.

References

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| 1. GIP Quality Audit Manual | Milton A. Anderson |
| 2. ISO 14000 EMS Audit Hand book | Gregory P Johnson |

MT 532 RISK ANALYSES AND SAFETY

Risk management and analysis during operation. Risk analysis and management during system procurement and installation. Role of maintenance and inspection in risk management. Risk minimization through operation and maintenance feed back in design. Strategies for safety of equipment and personnel and emerging trends in design of power plants to reduce fire risk. Risk and hazards in chemical industries. Risk and safety assessment in defence equipment. Risk management in EHV transmission systems. Risk man & Risk management in steel cord conveyors.

References

1. Risk Analysis and Security Survey John F. Border
2. Fundamentals of Risk Analysis and Risk Management Vlasta Molar

MT533 CONCURRENT ENGINEERING

Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools.

Quality by design: Quality Function Deployment methodology, Taguchi methods of robust design, Design for manufacturability: Virtual manufacturing, , Introduction to Value Engineering, Value Engineering analysis and techniques, Design for assembly : Introduction to various DFA technologies.

Rapid Prototyping: Need and use of RP, various RP technologies, Design for Reliability: Reliability fundamentals and design for reliability principles, Design for Serviceability: Factors affecting serviceability, serviceability evaluation, Design for Maintainability and Economics.

References

1. Concurrent Engineering, shortening lead times, raising quality & lowering costs
John. R. Hartley, Susmu Okamoto.
2. Total quality development, a step by step guide to world class concurrent engineering
Don Clausing,
3. Concurrent engineering, what every engineer should know about series Thomas A. Salomone

MT 534 MAINTENANCE AWARENESS IN DESIGN

Design activity: design modules, what makes for good design, design levels. Systems engineering. M+R parameters that can be usefully used in design. Design reviews. Design evaluation. Creative design. Design detail. Design contractual agreements. Decision analysis. Ergonomic considerations. Industrial case studies.

References

1. Parking Structures Planning ,Design ,Construction, Maintenance and Repair
A.P.Chrest,Mary S. Smith
2. Asset Maintenance ManagementAguide to developing strategy and improving performance
A.Wilson

MT 535 MAINTENANCE OF AGRICULTURAL AND EARTH MOVING MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Fault diagnosis, rectification servicing and repairs of various components/systems of agricultural equipments and earth moving machinery, fault diagnosis and manuals.

Special problems associated with heavy earth moving equipments and their solutions. Planning and design.

References

- 1.Hand book of Maintenance: Lindley R. Higgins

MT 536 BULK SOLIDS AND HANDLING

Nature of Bulk Solids, Flow of bulk solids – gases/solid flow in pipelines, Mechanical Handling – Screw Conveying, Belt Conveying, Bucket Elevators, Vibratory Conveyors, Components of Pneumatic Conveying Systems – Feeding devices, Pipeline, Engaging and Disengaging, Devices, Pneumatic Conveying System Design, Operational Problems, -- Erosive wear, Product Degradation, Moisture.

References:

1. HandBook of Pneumatic Conveying Vol. 1 D.Mills,Mark G.Jones,V.Agarwal
2. A Practical Guide to Pneumatic Conveying Problems V.Agarwal

MT537 MAINTENANCE OF ELECTRICAL MACHINES

Principals and planning of maintenance, heating and ventilation of electrical machines, mechanical features of electric motors, lubrication system, possible faults, their causes and repairs in A.C. single phase induction motors and D.C. motors, transformers, installation and commissioning of transmission lines and distribution lines, under ground cables, switch gears, house installation maintenance, importance of earthing, its testing and maintenance, fire fighting equipments, batteries.

References

1. Parameter Estimation, Condition Monitoring and Diagonosis of Electrical Machines
P.Vas

MT538 MAINTENANCE OF POWER PLANT MACHINERY

Introduction to various systems of power plant e.g., boilers, fuel and ash handling equipments, steam turbine, condenser and feed heaters etc. Operation and maintenance of piping, plant, stokers, oil burners. Boiler tube corrosion and its prevention, maintenance of furnace and boiler accessories and mountings. Emergency actions, Boiler regulation/ inspection. Boiler operations and safety precautions.

Operation and maintenance of coal handling, oil handling and ash handling plants. Predictive and preventive maintenance of steam turbine and its components. Erosion of blades and its prevention.

Lubrication of bearings, valves etc. Steam path deposits, vibration monitoring, performance monitoring. Planned overhauls, general purpose steam turbine maintenance and repair, maintenance overview. Maintenance scheduling methods of detection of leaking and its prevention in the condensers, Condenser fault systems and its causes. On load and off load cleaning of condenser tubes, Maintenance scheduling of cooling water plants, cooling towers etc.

References

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| 1. Plant Service and Operation Handbook | A.L. Kohan |
| 2. Practical Machinery Management for | H.P. Bloch & F.K. Geitner |
| 3. Maintenance Engineering hand Book | Lindley & Higgins |
| 4. Steam turbine -Operation & Maintenance | Kearton |

MT539 MAINTENANCE OF TRANSPORT MACHINERY

Introduction and classification – Passenger vehicles, heavy load carriers, moderate capacity vehicles. Light motor vehicles.

Fault diagnosis, rectification, servicing and repair of various components/system of transport vehicles e.g. engine fuels system lubrication, transmission, supervision and electrical system, fault diagnosis charts and service manuals. Maintenance scheduling predictive and preventive maintenance, machinery health monitoring systems, spare parts, inventory and maintenance, Social problems connected with public transport system.

Reference

1. Journal of Institute of Rail Transport : Institute of Rail Transport (India)
2. Handbook of National Accounting Tackling Transport :H.TrischlerS.Zeilinger

MT541 MECHATRONICS AND NDT IN MAINTENANCE ENGINEERING

Introduction, Mechatronic systems, closed and open loop measurement systems, The Mechatronics approach, Sensors microprocessors and transducers, displacement, position and proximity pickups. Mechanical and Electrical activation systems.

Measurement Systems: Measurement errors, modelling measurement systems, system Reliability, signal conditioning & processing, Data acquisition and processing systems, Data presentation.

Applied Instrumentation : Measurement of mechanical and process parameters. Measurement of force, torque, temperature, pressure and flow. Measurement of displacement velocity and acceleration. Measurement of noise and vibration.

Non Destructive Testing: Visual inspection, crack detection techniques like magnetic crack detection, dye penetrant, radio graphy, oil analysis, wear particle analysis, strain gauge technology, ultra sonic crack detection, Thermography.

Machine Health Monitoring: Signature analysis and their significance, machine signatures, temperature, vibration, wear particle and noise monitoring, acceptable standards, online and offline techniques, performance trending, potential failure (Pf) curves.

References

1. Handbook of Condition Monitoring BKN Rao
2. Non-Destructive Examination K.G. Bowling
3. Non-Destructive Testing R. Halmshaw
4. Mechatronics W. Bolton
5. Mechanical Measurements T.G. Beckwith, , R.D. Marangoni and J.H. Lienhard

MT542 MAINTENANCE OF CNC MACHINES

Introduction to DNC,FMS,CNC systems, failure in CNC systems, causes diagnosis and remedies. Failure in hydraulic systems, monitoring strategies, fluid contaminant monitoring techniques, particle characterization, lubricant analysis, operational parameters.

Electropneumatic systems – advantages of electropneumatic systems, valve failure, diagnostic displays. Introduction to Robotics, Maintenance of Robots. Black – out Industries.

References

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| 1. Handbook of condition monitoring | BKN Rao |
| 2. Maintenance Engg. Handbook | Lindley R.Higgins |

MT 543 RESTORATION REPAIRS & RETROFITTING

Restoration: . Scheduled restoration and scheduled discard tasks. . Restoration techniques for industrial equipments: Gear transmissions, key fittings, splines fitting, coupling & clutches, lead screw & nut, belt ,chain & sprocket wheels, bush bearing ball & roller bearings their shank & housings. . Restoration of parts by welding metallisation, chromium plating,maintainability for given restoration time with weibull times to restore distribution, time to restore for given maintainability with a weibull time to restore distribution,steady state mean times to actively restore, repair and /or replace components in an equipment,equipment restoration time, efficiency & consistency.

Repair: Repair cycle, repair complexity, Assembly & dessembly of machine& omponents, repair of cracks, reclamation of worn & damaged parts, economics of reconditioning, reconditioning Vs replacements. Repair of Industrial equipments: Machine spindle, Hydraulic machines, tailstock, three jaw chucks, repair of cracks in C.I. Body , special features of the repair of cranes, hammers power press.

Retrofitting: Retrofitting, objectives, classification of retrofitting, scope of retrofitting, Cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features &selection for retrofitting.

References

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| 1. Industrial maintenance | H.P.Garg |
| 2. Maintenance engineering hand book | Lindley R Higgins |
| 3. Reliability centered maintenance | John moubray |
| 4. Maintainability, availability & operational readiness engineering | Dimitri Kececioglu |

MT 544 MACHINERY VIBRATION MONITORING ANALYSIS

Vibration of Rotating Machinery. Machine Faults And Frequency Range Of Symptoms. Localised and Distributed Faults. Impact Excited Resonance. Vibration Level Classification. ISO Standards. Peak and RMS Levels. Constant Percentage Bandwidth Spectra. Use of Phase. Cepstral Analysis. Envelope Detection. Time Domain Averaging. Rolling Element Bearings. Rotor Dynamics. Orbit Analysis. Static And Dynamic Balancing. Gearbox Vibration. Induction Motors. Reciprocating Engines and Compressors.

References:

- | | |
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| 1. Machinery Vibration –Measurement and Analysis | W. Victor |
| 2. Rotating Machinery Vibration | Maurice L.Adams |

MT 545 MAINTENANCE OF CHEMICAL PLANT MACHINERY

Maintenance scheduling, predictive and preventive maintenance, machine health monitoring systems, spare parts – inventory and maintenance.

Corrosion and corrosion problems in process equipments such as piping, pressure vessels, heat exchangers, process towers, chimneys, boilers etc. Corrosion and erosion control.

Maintenance problems associated with moving machinery such as blowers, pumps, gear drives, conveyors, electrical machines etc. And their rectification identification of special problems with different chemical plants and their solution.

Reference Books:

1. Fault Diagnosis in Complex Chemical Plants

J.C.Hoskins

OPEN ELECTIVES

MT551 THEORY OF TRIBOLOGY ELEMENTS

Introduction to Tribology: Theoretical Back ground , engineering surface, laws of friction, sliding & rolling, dry and lubricated friction, lubricated friction. Wear, its types, abrasive, adhesive, corrosive, erosive, fretting, fatigue & cavitation wear, practical examples, wear reduction measures, prevention of wear, Lubrication Principle : Principle of lubrication, lubrication regimes, boundary lubrication, Hydrodynamic and Hydrostatic lubrication, Elastohydrodynamic lubrication, types of lubricants, solid, liquid, semi solid and gaseous lubricants, lubricant additives.

Tribo Elements - I - Bearings : Bearings types, journal bearings, important parameters for better performance, special additives, rolling element bearings, their types and important parameters in their selection. Tribo Elements - II – Gears: Gears, gear types, gear drives, gear losses and reduction gears, selection of gear drives, gear lubrication and maintenance, gear failures. Chains for power transmission, types, service factors, maintenance and lubrication of chains.

Tribo Elements - III - Seals : Metallic and elastomeric seals, non contacting seals for rotating shafts, radial lip seals, mechanical face seals, selection of seal types for rotating shaft application. Seal failure, its analysis. Practical consideration in use of seals.

References

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|--|----------------------|
| 1. Basic Lubrication Theory | A Cameron |
| 2. Friction and Lubrication in Mechanical Design | A.A. Seireg |
| 3. CRC Hand book of lubrication – Vol. II | Ed. E.Richard Booser |
| 4. Hand Book of fluid sealing | Ed-R.V. Brink |

MT552 MAINTENANCE ECONOMICS AND TURN GROUND MANAGEMENT

Objective: To introduce the concepts of economic theory and behavior for preparing the strategic financial models for maintenance investment decisions. Fundamentals concepts of economics: Scope, definition, characteristics of economic, relationship to the functional areas of business, theory of firm, its constraints and limitations, nature and function of profit, basics of demand and supply equilibrium.

Demand Analysis: Demand theory, demand estimation, simple multiple regression analysis, demand forecasting- qualitative forecasts; survey techniques, opinion polls, quantitative forecasts; time – series analysis, smoothing techniques input-output forecasting. Production and

Cost Analysis: Production theory and estimation, production function, returns to scale, comparative advantage, cost theory and estimation, short-run and long run costs, plant size and economies of scale, learning curve, cost-volume profit analysis and operating leverages, cost estimation based on project cost, types of costs, inter-alia, design, installed capital, commissioning and decommission costs, operating costs maintenance and opportunity costs, life cycle costs, cost output analysis and maintenance cost history.

Product/project Life Cycle: Concepts of product/project life cycle capital assets, reliability and risk, life cycle costs and its economic consequences for strategic development. Project financing and capital structure, financial leverages, working capital and capitalization.

Turnaround: Characteristics of the maintenance work load, critical path analysis and its use for the planning of large shutdowns, procedure of managing shut downs; Initiation, validation of work scope, organizing preparatory work, contractor packages, shutdown plan, manpower plan. A typical shutdown operation-administrative and resource structures, site logistics plan and its preparation, cost profile, safety and quality plans, executing and controlling the shutdown, review procedures.

References

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| 1. Managerial Economics | Salvatore |
| 2. Applied Economics for Engineers and Managers | S.K. Jain |
| 3. Engineering Economics | Tarachan |
| 4. Industrial maintenance management | Srivastava |

MT 553 COMPUTER AIDED MAINTENANCE MANAGEMENT

Introduction Definition Basic components of CMMS, Uses of Computers in Maintenance CAMSS Justification reasons for lack of CMMS effectiveness

Basic Hardware Components General Software categories, fundamentals of C, CH, Network Software, Networking CAMSS Softwares, Flowchart Algorithms & Programming.

Approach towards Computerization, selection of computer system, Master files, Maintenance files, Maintenance Module, classification records, Preventive and repair planning module, codification for Break down, job sequencing files/records.

Developing softwares:- Planning & Scheduling equipment & facilities control, work central Maintenance of spare parts and inventory centre performance reporting and other tools and techniques of Industrial engineering used in Maintenance Management.

References

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| 1. Maintenance Engineering Hand book | Kindly IIndley and R Higgins |
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2. Engineering Maintenance Management	Benjamin W.Niebel
3. Industrial Maintenance Management	S.K. Shrivastava.
4. Maintenance Planing & Central	Anthony kelly

MT554 MAINTENANCE OF POWER PLANT MACHINERY

Introduction to various systems of power plant e.g., boilers, fuel and ash handling equipments, steam turbine, condenser and feed heaters etc. Operation and maintenance of piping, plant, stokers, oil burners. Boiler tube corrosion and its prevention, maintenance of furnace and boiler accessories and mountings. Emergency actions, Boiler regulation/ inspection. Boiler operations and safety precautions.

Operation and maintenance of coal handling, oil handling and ash handling plants. Predictive and preventive maintenance of steam turbine and its components. Erosion of blades and its prevention. Lubrication of bearings, valves etc. Steam path deposits, vibration monitoring, performance monitoring. Planned overhauls, general purpose steam turbine maintenance and repair, maintenance overview. Maintenance scheduling methods of detection of leaking and its prevention in the condensers, Condenser fault systems and its causes. On load and off load cleaning of condenser tubes, Maintenance scheduling of cooling water plants, cooling towers etc.

References 1. Plant Service and Operation Handbook A.L. Kohan 2. Practical Machinery Management for H.P. Bloch & F.K. Geitner 3. Maintenance Engineering hand Book Lindley & Higgins 4. Steam turbine -Operation & Maintenance Kearton.