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Assignment - 1

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Ques 1 What do you mean by maintenance Engineering?

Ans Maintenance Engineering is a specialized branch of engineering focused on optimizing the maintenance and reliability of equipment, machinery, and systems. It involves designing and implementing processes to ensure that assets operate efficiently, safely, and with minimal downtime. Maintenance engineering plays a crucial role in industries such as manufacturing, transportation, construction, energy and more.

Key Responsibilities in Maintenance Engineering:

① Preventive Maintenance: Developing

maintenance schedules to prevent equipment failure.

② Predictive Maintenance: Using data

and technology (e.g. Sensors) to predict potential failures.

③ Periodic Maintenance: Undertaking

after some time interval the maintenance or change is to be done, so that machine will work smoothly and efficiently.

④ Trouble shooting and Repairs:- Diagnosing and fixing issues to minimize down-time.

⑤ Reliability Engineering:- Improving the reliability and lifespan of equipment through design improvements and operational strategies.

⑥ Asset Management:- Ensuring efficient use of resources and minimizing costs over the lifecycle of equipment.

⑦ Safety and Compliance:- Ensuring equipment operates safely and complies with industry standards and regulations.

Goals of Maintenance Engineering:-

- ① Reduce unplanned downtime.
- ② Optimize operational efficiency.

③ Lower maintenance costs.

④ Prolong the life of assets.

⑤ Ensure workplace safety.

It's a field that combines technical expertise, problem-solving skills and knowledge of systems to improve overall productivity.

Ques Explain the maintenance function of Plant Maintenance Department.

Ans The plant maintenance department plays a critical role in ensuring the smooth functioning, reliability and safety of machinery, equipment, facilities with in an organization/organisation. It's functions are essential for maintaining operational efficiency and minimizing downtime. Below are the key functions of the plant maintenance department.

① Preventive Maintenance:- It involves

② planning and performing scheduled maintenance tasks to avoid unexpected breakdowns.

③ It includes regular inspections, lubrication

ations, adjustments, cleaning, and calibration of equipment.

② Corrective Maintenance: Identifying and repairing faults or breakdowns in machinery and equipment. It ensures minimal downtime, by promptly addressing issues.

③ Predictive Maintenance: Using advanced technologies such as sensors, IoT devices and software to predict potential equipment failures. It also aims to address issues before they occur based on data and performance trends.

④ Emergency Maintenance Handling: unplanned repairs in response to sudden equipment failures. It focuses on restoring functionality as quickly as possible.

⑤ Spare parts and Inventory Management: Managing the inventory of spare parts to ensure availability during

maintenance or repairs. It avoids delays due to the unavailability of critical components.

⑥ Energy Management: Monitoring and optimizing the energy consumption of machinery and systems. This helps in implementing energy saving measures to reduce costs and environmental impact.

⑦ Safety and Compliance: Ensuring all equipment meets safety standards and complies with regulations. Regularly inspecting facilities for hazards and implementing corrective actions.

⑧ Maintenance planning and Scheduling: Developing detailed maintenance plans, schedules and timelines for all equipment. Prioritizing tasks to balance operational needs with maintenance activities.

⑨ Training and Development: Training and developing staff on equipment maintenance.

handling, troubleshooting, and safety protocols. Training the team in skilled and up to date with latest technologies and techniques.

- (10) Documentation and Reporting: Maintaining detailed records of maintenance activities, equipment history and performance metrics. Generating reports to analyze maintenance efficiency and identify areas for improvement.

- (11) Cost Control: Optimizing maintenance expenses by minimizing downtime, extending equipment life and reducing repair costs. Balancing maintenance budgets with operational needs.

- (12) Significance of Plant Maintenance Department
- Increases equipment reliability and reduces production downtime.

- Enhances operational efficiency and productivity.

- (1) Ensures worker safety and compliance with regulations.

- (2) Contributes to cost saving through proactive maintenance strategies.

The plant Maintenance Department is vital for sustaining the long term operational health of organization's facilities and equipment.

Ques Define the aim of Maintenance Engineering?

Ans The aim of Maintenance Engineering is to ensure that machinery, equipment and systems operate efficiently, reliably and safely while minimizing downtime, reducing operational costs and extending the life of assets. Maintenance engineering focuses on optimizing maintenance strategies to balance productivity, cost effectiveness and asset longevity.

Key Objectives of Maintenance Engineering:

- ① Reliability: Ensure equipment performs consistently without unexpected failures.
- ② Availability: Maximize the operational availability of machinery and systems.
- ③ Cost Efficiency: Minimize maintenance costs through proactive and efficient maintenance practices.
- ④ Safety: Prevent accidents by maintaining equipment to meet safety standards.
- ⑤ Asset Longevity: Extend the lifespan of assets through proper care and timely upgrades.
- ⑥ Sustainability: Reduce energy consumption, waste, and environmental impact by maintaining equipment in optimal condition.
- ⑦ Productivity: Enhance operational performance by minimizing downtime and disruptions.

Conclusion

The ultimate goal of maintenance engineering is to achieve high operational efficiency with minimal interruptions and maximum cost-effectiveness.

Ques Explain main objectives of plant maintenance.

Ans The main objectives of plant maintenance are to ensure the efficient operation, reliability and safety of machinery, equipment and facilities while minimizing downtime and maintenance costs. Plant maintenance is essential for sustaining production quality, meeting operational goals and extending the lifespan of assets.

Key Objectives of Plant Maintenance:

- ① Ensure Equipment Reliability: Maintain machinery and systems in good working condition to prevent unexpected breakdowns. Enhance the reliability of equipment for consistent production performance.

② Minimize Downtime : Reduce unplanned

Steps through preventive and predictive maintenance strategies. Ensure quick repairs to minimize disruptions to operations.

③ Optimize Maintenance Cost : Balance

maintenance expenses by implementing cost-effective strategies. Avoid costly repairs or replacements by addressing small issues early.

④ Enhance Operational Efficiency :

Maintain equipment at peak performance to optimize productivity and reduce energy consumption. Avoid delays in production processes caused by equipment failures.

⑤ Ensure Safety and Compliance :

Keep all machinery and facilities in compliance with safety standards and regulations. Prevent workplace accidents and ensure the safety of employees and assets.

⑥ Prolong Equipment Life :-

Perform regular maintenance to extend the useful life of machinery and equipment.

⑦ Improve product quality :- Ensure

Equipment operates accurately and consistently to produce high quality products. Minimize defects caused by poorly maintained machinery.

⑧ Spare parts and Inventory Management :

Ensure the availability of critical spare parts to avoid delays in repairs. Optimize inventory levels to reduce storage costs.

⑨ Energy Efficiency : Reduce energy

wastage by maintaining equipment in optimal condition. Implement energy-saving practices to lower operational costs.

⑩ Data Driven Decisions : Maintain

records of maintenance activities and equipment performance. Use

data analysis to improve maintenance strategies and predict future needs.

Significance of Achieving these objectives:-

- (a) Maintains uninterrupted production.
- (b) Reduces overall operating costs.
- (c) Enhances employee safety and satisfaction.
- (d) Supports long term business growth and sustainability.

By focusing on these objectives, plant maintenance ensures that operation run smoothly and efficiently while safeguarding assets and resources.

Ques Discuss the main objectives Elaborate

Different types of plant Maintenance system and explain any two in detail. Also write their advantage, Dis-advantage and their application and example.

Ans Plant Maintenance system can be broadly classified in to the following types:-

- (1) Preventive Maintenance
- (2) Corrective Maintenance
- (3) Predictive Maintenance
- (4) Periodic Maintenance
- (5) Condition - Based Maintenance
- (6) Emergency Maintenance
- (7) Scheduled Maintenance

(1) Preventive Maintenance:-

Preventive maintenance involves performing scheduled inspections and routine maintenance tasks to prevent equipment failures. It is done at regular intervals regardless of the current condition of the equipment.

Advantages:-

- (a) Reduces the risk of unexpected breakdowns.
- (b) Prolongs the lifespan of machinery.
- (c) Minimizes downtime.
- (d) Improves operational efficiency.

Dis-advantages

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- (a) Higher initial cost due to frequent maintenance activities.
 - (b) Maintenance may be performed, unnecessarily on perfectly working equipment.
 - (c) Requires detailed scheduling and documentation.
- Applications:-
- Industries with critical continuous processes such as power plants and manufacturing.
- Example:- at that construction site, the maintenance is required continuously.
- Changing oil in a machine every 3 months regardless of its condition.

(2) Predictive Maintenance

Predictive Maintenance uses data and technology (e.g. Sensors, IoT, and software) to monitor the condition of equipment and predict failures before they occur. Maintenance is performed based on real-time equipment conditions.

Advantages

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- (a) Reduces unnecessary maintenance.
- (b) Lowers maintenance costs by addressing issues only when necessary.
- (c) Minimizes unplanned downtime.
- (d) Enhances the efficiency of equipment and resources.

Dis-advantages

- (a) High initial set up cost for sensors, software, and training.
- (b) Requires skilled personnel for interpretation.

- (c) Not feasible for small-scale operations.

Application

- (a) Industries with expensive or complex machinery such as aerospace, automotive and heavy engineering.

Example

Using vibration sensors on a rotating

machine to detect early signs of bearing failure.

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(1) Explain various types of Maintenance Cost.

Ans Maintenance costs are the expenses incurred to keep equipment, machinery, and facilities in good working condition. These cost can be broadly classified into various categories based on the type of maintenance activity and its impact on operations.

1. Preventive Maintenance Cost: Cost incurred for routine and scheduled maintenance to prevent unexpected equipment failures.
Examples: (a) Lubrication of moving parts. (b) Regular inspection and cleaning. (c) Calibration of instruments.

Advantages

Reduces the risk of breakdowns and

and extends equipment life.

Dis-Advantage
Can lead to over-maintenance if tasks are unnecessary.

(2) Predictive Maintenance Cost: Cost

associated with condition monitoring and using advanced tools to predict failures before they occur.
Examples

(a) Investment in sensors, IoT devices and monitoring software.

(b) Analyzing vibration, temperature and oil analysis data.

Advantages: Minimizes downtime and optimizes resource use.

Ris-advantages: High initial set-up and training cost.

(3) Corrective Maintenance Cost

Costs related to repairing or restoring equipment after a failure or malfunction is identified.

Examples:

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(a) Replacing worn out parts.

(b) Repairing electrical circuits.

Advantages: - Addresses issues directly and promptly.

Dis-Advantages: - Can be expensive and lead to production delays.

(4) Breakdown Maintenance Cost

Expenses incurred when equipment fails unexpectedly, leading to emergency repairs. Examples: (a) Replacing a failed motor. (b) Hiring external technicians for urgent repairs.

Advantages: - (a) Resolves critical issues quickly.

Dis-advantages: - High costs due to emergency repairs and production downtime.

(5) Emergency Maintenance Cost:

Cost incurred for unplanned maintenance needed to fix critical failures immediately.

Examples:

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(a) Hiring a crane for lifting heavy equipment during a failure.

(b) Purchasing spare parts urgently at higher prices.

Advantages: - prevents further damage to equipment.

Dis-Advantage: - Often very costly and disruptive to operations.

(6) Scheduled Maintenance Cost:

Costs associated with planned maintenance tasks performed at regular intervals.

Examples: (a) Annual Service Contracts. (b) Hiring maintenance staff for periodic inspections.

Advantages: - Predictable and manageable expenses.

Dis-Advantages: - Equipment must be temporarily taken offline for maintenance.

(7) Spare parts and inventory cost

Costs related to procuring and

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Storing spare parts needed for

maintenance. Examples: - (a) stocking

spare motors, gears, and consumables (b) Managing inventory storage space.

Advantages: Expenses quick repairs.

Dis-advantages: Tie-up capital & management.

(8) Labor cost: wages and benefits

paid to maintenance staff for performing maintenance tasks.

Example: (a) Salaries of maintenance engineers and technicians.

(b) Overtime payment for emergency repairs.

Advantages: Skilled labor ensures quality maintenance.

Dis-advantage: Can be expensive, especially during unplanned maintenance.

(9) Tools & Equipment cost. Expenses

incurred for purchasing and

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maintaining tools and equipment used in maintenance. Examples:

(a) Buying diagnostic tools, welding machines for cleaning equipment.

(b) Repairing maintenance tools.

Advantages: Essential for efficient maintenance.

Dis-advantages: High initial investment for specialized tools.

(10) Energy cost: Cost related to the energy consumption of equipment during maintenance tasks. Examples: -

(a) Power usage for running diagnostic equipment.

(b) Electricity required for lighting during maintenance work.

Advantages: Necessary for smooth maintenance operations.

Dis-advantages: Often overlooked but adds to overall maintenance expenses.

Conclusion

Maintenance costs are a combination of direct costs and indirect costs. Proper planning and implementation of an effective maintenance strategy can help optimize these costs, ensuring efficient operations and long-term savings.

Ques 2 Define :- (i) Service life of equipment.

- (ii) Economic life of equipment.
- (iii) Factor influencing service life of an equipment.
- (iv) Types of maintenance tool.

Ans 1) Types of Maintenance tool :- Maintenance tools are essential for performing various maintenance activities on machinery, equipment, and systems. These tools can be classified based on their functionality, purpose and the type of maintenance work they support. Below are the main types of maintenance tools :-

Hand Tools :- Basic tools operated manually for tasks like tightening, cutting or hammering.

Examples :- wrenches, screwdrivers, pliers,

Hammer, files and Saws. These are used for general repair assembly, and minor maintenance work.

Power Tools :- Electrically or battery operated tools used for

quicker and more efficient maintenance tasks. Examples :- Drills, grinders and impact wrenches. Power tools stand out due to their versatility in maintenance of heavy machinery or structures.

Diagnostic Tools :- Tools used to monitor, test and diagnose

equipment performance and identify faults. Examples :-

- (a) Multimeters
- (b) Thermometers and thermal cameras.
- (c) vibration analyzers and pressure gauges.

Measuring Tools :- Precision tools used for measuring dimension, angles, or

alignment during maintenance. Examples :- vernier calipers and micrometers, measuring tapes and spirit levels.

(5)

Cutting and welding tools

Tools used to lift or move heavy machinery and component.

Examples :- Hoists, jacks and cranes, slings and chain blocks

(6)

COMS Tools - COMS stands for

Computerized maintenance management system. Tools. Software tools used to schedule tasks and manage maintenance tasks. Examples:- SAP Plant Maintenance, IBM Maximo, or Elix COMS.

(7)

Safety Tools :- Tools and equipment used to ensure safety during maintenance tasks.

Examples :- Personal protective equipment such as gloves, goggles and helmets. Safety harnesses and fire extinguishers.

(8)

Hydraulic & pneumatic Tools - Tools

powered by hydraulic or compressed air systems to perform high force tasks. Examples:- hydraulic presses, air ratchets and pneumatic drills.

(9)

Specialized Tools: Tools designed

for specific maintenance tasks or industries. Examples :- (a) Valve spring

Compressors for engines (b) Torque wrenches for precision tightening.

Conclusion

Using the right tools for maintenance not only improves efficiency and accuracy but also ensures safety and reduces the risk of equipment damage.

(11)

Service life of Equipment:- The

service life of equipment refers to the total period during which a piece of material, machinery or asset remains operational and performs its intended functions effectively under normal operating conditions.

(111)

Factors affecting Service life:-

1) Design and Quality of machine equipment.

(2)

Operating Conditions

(3)

Frequency and intensity of use

(4) Maintenance

(5) Technological Obsolescence

(6) Material and Manufacturing Standard

(iv) Economic life of Equipment

The economic life of equipment refers to the period during which the equipment remains cost effective to operate. It is the time span where the total operating costs are lower than the costs of replacing the equipment with a new one. After this period, it becomes more economical to replace the equipment rather than continue using it.

Key Factors Influencing Economic life :-

(1) Initial cost

(2) Depreciation

(3) Maintenance and Repair Costs

(4) Operating Costs

(5) Productivity

(6) Technological Obsolescence

(7) Market value

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Ques) What is Industrial Noise?

Ans) Industrial noise is unwanted or excessive sound produced by industrial activities. It is a type of environmental noise that can come from factories, construction sites and other industrial sources.

Causes of Industrial Noise

(1) Machinery: Engines, presses, hammers and other machinery can create continuous noise.

(2) Transportation: Airports, ports, and other transportation hubs can create noise.

(3) Construction: Blasting, bulldozing and quarrying can create noise.

Effects of Industrial Noise

(1) Hearing Damage - Long exposure to industrial noise can cause

Permanent hearing damage.

(2) Fatigue: Industrial noise can lead to fatigue in employees.

(3) Health Threats: Industrial noise can be a threat to safety and health. Industrial noise can be controlled by following ways:

(1) Noise Indicators: Noise indicators can be used to analyze noise levels and determine regions with high noise levels.

(2) Industrial process silencers: Industrial process silencers can be used to reduce noise from compressors, vents, and other sources.

(3) Protective equipment: Workers can wear protective equipment like earplugs or hard hats to reduce the effects of noise pollution.

Q(2) Explain different personal protective equipments. (PPE).

Ans Personal protective Equipment (PPE) is issued for safeguarding workers from workplace hazards. It's an over-view:-

Types of PPE

- (1) Head protection - Hard hats, Safety helmets, and bump caps.
- (2) Eyes and Face protection:- Safety glasses, goggles, face shields and welding huddles.
- (3) Hearing protection: Earplugs, earmuffs, and hearing bands.
- (4) Respiratory protection: Masks, respirators and breathing apparatus.
- (5) Hand protection: Gloves, gauntlets, and sleeves.
- (6) Foot and leg protection - Safety shoes, boots, and leggings.
- (7) Body protection: Coveralls, aprons and vests.

- (8) Fall protection: Harnesses, lanyards, and safety nets.
- Importance of PPE

- (1) Hazard Assessment:- Identify workplace hazards and select PPE accordingly.
 - (2) PPE Standards: Ensure PPE meets industry standards and regulations.
 - (3) Proper Fit: Ensure PPE fits properly to prevent discomfort and effectiveness.
 - (4) Training: Provide training on PPE use, maintenance and limitations.
 - (5) Regular Inspection: Regularly inspect PPE for damage, wear and tear.
- Limitations of PPE
- (1) Not a Substitute: PPE is not a substitute for engineering controls.

or safe work practices.

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(2) Limited protection: PPE may not provide complete protection against all hazards.

(3) User Error: PPE may not be effective if not used correctly.

(4) Maintenance: PPE requires regular maintenance to ensure effectiveness.

Selection and Use of PPE

(1) Hazard Assessment: Identify workplace hazards and select PPE accordingly.

(2) PPE Standards: Ensure PPE meets industry standards and regulations.

(3) Proper Fit: Ensure PPE fits properly to prevent discomfort and effectiveness.

(4) Training: Provides training on PPE use, maintenance and limitations.

(5) Regular Inspection:

Regularly inspect PPE for damage, wear and tear.

Regulatory Framework:

(1) OSHA: Occupational Safety and Health Administration regulations in the United States.

(2) EU Directive: European Union Directive on PPE, such as the PPE Directive (89/686/EEC).

(3) ISO Standards: International Organization for Standardization (ISO) standards on PPE, such as ISO 13688.

Safety Practices:

(1) Develop PPE programme: Establish a

comprehensive PPE programme.

(2) Conduct Regular Training: Provide regular training on PPE use and maintenance.

(3) Monitor and Evaluate: Monitor and evaluate PPE effectiveness.

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4) Encourage Employee Participation :-

Encourage Employee Participation in PPE Selection and Use.

Ques. Explain Factories Act 1948. Explain about its features and why it is required.

Ans. The Factories Act, 1948 is a crucial labor law that balances industrial productivity with workers' rights and safety. It ensures fair treatment, human working conditions and better welfare facilities for factory workers contributing to a healthier and more efficient workforce.

Here are the key features of the Factory Act, 1948 :-

Health and Safety provisions :-

① Safety officers:- Appointment of safety officers to ensure compliance with safety regulations.

② Safety Committees:- Establishment of Safety Committees

to promote health and safety.

(3) Risk Assessment:- Identification and assessment of hazards in the factory.

(4) Safety Training:- Provision of safety training to workers.

(5) Personal Protective Equipment (PPE):- Provision of personal protective equipment to workers.

Welfare provisions :-

(1) Welfare officers:- Appointment of welfare officers to ensure compliance with welfare regulations.

(2) Canteens:- Provision of canteens for workers.

(3) Rest Rooms:- Provision of Rest Rooms for workers.

(4) First Aid:- Provision of first aid facilities.

(5) Creeches:- Provision of creeches for children of workers.

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Working Hours and Conditions

① Working Hours: Regulation of working hours, including maximum hours of work, rest intervals and overtime.

② Weekly Holidays: provision of weekly Holidays.

③ Leave: provision of leave, including annual leave, sick leave and casual leave.

④ Night-Shifts: Regulation of night shifts, including restrictions on employment of women and young persons.

Employment of women and young persons

① Restrictions on Employment: Restrictions of women and young persons in hazardous industries.

② Prohibition of Employment: prohibition of employment of children in factories.

③ Certificate of Fitness: Requirement of certificate of fitness

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for young persons

Registration and Licensing:

① Registration: Registration of factories by the State Government.

② Licensing: Licensing of factories by the State Government.

Inspections and Penalties

① Inspections: Regular inspections by inspectors to ensure compliance with the Act.

② Penalties: penalties for non-compliance and imprisonment.

Miscellaneous provisions

① Display of notices regarding factories rules, working hours and wages.

② Maintenance of records regarding workers, wages and working hours.

③ Procedure for Disputes and appeals regarding implementation of the Act.

Ques: Write short notes on objective of Industrial Safety?

Ans: Industrial Safety aims to protect workers, equipments and the environment from hazards in the workplace. The key objectives include:-

(1) Prevent Accidents and injuries:- Minimise workplace accidents, injuries and fatalities through proper safety measures.

(2) Ensure Employee Health and well-being:- protect workers from occupational diseases and unsafe conditions.

(3) Enhance productivity:- A safe workplace reduces downtime and improves efficiency.

(4) Comply with legal and Regulatory Requirements:- Follows industry safety standards and government regulations.

(5) Protect Equipment and property:- prevent damage to machinery, tools, and infrastructure.

(6) Reduce Financial losses:- Lower

costs associated with accidents, medical expenses, and compensation claims.

(7) Improve workplace morale:- A safe environment boosts employees' confidence and job satisfaction.

(8) Promote a Safety Culture:- Encourage a proactive approach to identifying and mitigating risks.

(9) Ensure Environmental protection:- prevent pollution, ~~hazard~~ hazardous spills and other environmental risks.

(10) Prepare for Emergencies:- Develop response plans for fire, chemical spills, and other industrial hazards.

Ques: What are different types of industrial accidents, their causes & control measures?

Ans: Industrial accidents can happen in various ways, depending on the process involved. Here are some common types of industrial accidents, their causes and control measures:-

(1) Fire and Explosion:- Due to Handling

flammable material & gas leaks, or electrical faults.

→ Improper storage or handling of volatile substances.

Control Measures:-

→ Install fire detection and suppression systems (sprinklers, alarms and extinguishers)

→ Regular maintenance of electrical systems and equipment.

→ Safe storage of flammable materials and gases.

→ Provide fire safety training to all employees.

② Chemical Spills and Toxic Exposure

Causes:-

→ Leaks or spills of hazardous chemicals during production & transportation or storage.

→ Poor handling of chemicals & inadequate safety gear.

Control Measures:-

→ Proper labeling and safe handling of chemicals.

→ Use personal protective equipment (PPE) such as gloves, goggles and boots.

→ Install ventilation and fume extraction systems.

→ Regularly inspect storage tanks, pipelines and containment areas.

→ Training employees in safe chemical handling and emergency response.

③ Machinery Accident Causes:-

→ Malfunctioning machinery & improper maintenance. Human error or inadequate training.

→ Lack of safety guards or failure to use personal protective equipment.

Control Measures:-

→ Perform regular maintenance and safety checks on machinery.

→ Use machine guarding to prevent accidental contact with moving parts.

→ provide training on safe equipment operation.

→ Implement lockout/tagout procedures to ensure equipment is properly shut down during maintenance.

→ Enforce the use of proper PPE.

④ Slips, Trips and Falls: Causes

→ Ensure proper house keeping and keep walkways clear of obstruction.

→ Install anti-slip flooring and adequate lighting.

→ Post warning signs in wet or slippery areas.

→ Provide proper footwear with anti-slip soles.

→ Conduct regular inspection of floors and walkways.

⑤ Electrical Accidents: Causes:

→ Faulty wiring exposed electrical components or malfunctioning equipment.

→ Inadequate grounding or failure to follow electrical safety standards.

Control Measures:

→ Perform regular inspections and maintenance of electrical systems.

→ Install circuit breakers & groundings system and electrical safety devices.

→ Use insulated tools and equipment.

→ Train employees on electrical safety protocols.

→ Adhere to local electrical codes and standards.

⑥ Confined Space Accidents: Causes:

→ Lack of proper ventilation, toxic atmosphere or insufficient safety measures.

→ Improper entry and exit procedures.

Leading to Suffocation or Entrapment.

Control Measures:-

- Ensure proper ventilation and atmospheric testing before entering confined spaces.
 - Use PPE (respirators, harnesses etc.)
 - Establish strict entry procedures and permit systems.
 - Provide confined space training and emergency response plans.
- (7) Falls from Height:- Causes:-
- Working on scaffolding, ladders or roofs without proper fall protection.
 - Unstable surfaces, poor weather conditions or lack of safety gear.
- Control Measures:-
- Use fall arrest systems such as harnesses, guardrails and safety nets.

- Provide training on working at height and fall prevention.

- Regularly inspect scaffolding, ladders and fall protection other elevated work areas.

- Ensure safe working conditions.

(8) Vehicle and Transport Accidents:- Causes:-

- Collision between vehicles, equipment or pedestrians with in the work places.
- Poor vehicle maintenance, inadequate signage or lack of proper traffic control.

Control Measures:-

- Implementing traffic management plans including clear pedestrian walkways.
- Conduct regular vehicle maintenance and inspections.
- Ensure all vehicles have proper safety equipment.

→ Provide drivers and pedestrian safety training.

① Ergonomic Injuries :- Causes :-

- Repetitive motion, awkward postures or lifting heavy objects improperly.
- Poor workstation design, leading to strain on the body.

Control Measures :-

- Design Ergonomic workstations and provide adjustable equipment.
- Encourage regular breaks and exercise to reduce strain.
- Train employees in proper lifting techniques and posture.
- Use mechanical aids for lifting and handling heavy objects.

Industrial accidents are a serious risk in any workplace, but many can be prevented with the right control measures.

Q. 2 Define the occupational health. Explain the importance of it & write down the names of occupational diseases.

Ans

Occupational Health is a vital aspect of ensuring the well-being and safety of workers in various industries. Here's a Comprehensive Overview :-

Occupational Health refers to the branch of medicine that deals with the prevention, diagnosis and treatment of work-related illness and injuries.

Importance

(1) Prevents work related illnesses :- Identifies and controls hazards to prevent illness.

(2) Reduces Injuries :- Implements safety measures to minimize injuries.

(3) Promotes Health and well being :- Encourages healthy behaviours and provides medical care.

(4) Enhances Productivity :- Healthy workers are more productive and efficient.

(4) Reduces Costs: Prevents costly medical treatments and lost productivity.

Occupational Health Hazards:

(1) Physical Hazards: - Noise, vibration, temperature extremes.

(2) Chemical Hazards: Toxic substances, gases and vapours.

(3) Biological Hazards: Infectious diseases, parasites, toxins, bacteria, etc.

(4) Psychological Hazards: Stress, anxiety, depression.

(5) Ergonomic Hazards: Repetitive strain injuries, musculoskeletal disorders.

Importance of Occupational Health:

(1) Ensures Employees well being:

- Reduces workplace injuries
- Prevents long term health conditions like respiratory diseases, hearing loss and musculoskeletal disorders.

→ Supports mental health by reducing stress and burnout.

(2) Increases Productivity:

→ Healthy employees are more engaged and efficient.

→ Reduced absenteeism and sick leave.

→ Fewer workplace accidents lead to less downtime.

(3) Reduces Healthcare and Compensation Costs:

→ Preventing injuries and illnesses lowers medical expenses.

→ Reduced workers compensation claims and insurance costs.

→ Decreases costs related to hiring and training replacement workers.

(4) Legal Compliance and Reputation:

→ Encourages a culture of safety and wellness.

→ Boosts Employee morale and job satisfaction.

→ Attracts and retains top talent.

Occupational Diseases are as follows:-

(a) Respiratory Diseases: Silicosis, Asbestosis
caused by inhaling dust particles like silica or asbestos.

→ Occupational asthma.

→ Chronic obstructive pulmonary disease.

(b) Skin Diseases: Contact dermatitis - irritation or allergic reactions due to chemicals or allergens.

→ Eczema - common among health-care workers and cleaners.

→ Skin Cancer - caused by prolonged exposure to UV radiation or hazardous chemicals.

(c) Hearing Disorders: Noise induced hearing loss - caused by long term exposure to loud noise in industries like

construction and manufacturing.

→ Tinnitus - Constant ringing in the ears due to excessive noise exposure.

→ Tendonitis: Inflammation of tendons from repetitive motions.

(d) Occupational Cancers:-

→ Lung Cancer: Linked to exposure to asbestos, silica or chemicals like benzene.

→ Bladder Cancer: Associated with cancer exposure to industrial chemicals.

→ Leukemia - caused by benzene exposure in industries like petroleum or rubber manufacturing.

(e) Infectious Disease: STB - Tuberculosis.

→ Hepatitis B and C - transmitted through needles and syringes in hospitals.

→ Covid 19 and other respiratory infections - spread

in Crowded workplaces.

①

Mental Health Disorders:

- work related stress and burnout - due to high workload and job insecurity.
- Depression and anxiety - common in high-pressure environments.
- post-traumatic stress disorder - seen in emergency responders and military personnel.

Prevention of Occupational Diseases:

- proper use of PPEs.
- Regular health screenings and medical check-ups.
- workplace safety regulations and hazard control measures.
- Ergonomic adjustments to prevent stress and injuries.
- Mental health support programmes for stress management.

Ques 2 Define the First Aid. Name seven items to be kept in a first aid box.

Ans:

First Aid is the immediate care or treatment given to a person suffering from an injury or sudden illness before professional medical help arrives. It aims to prevent the condition from worsening and promote recovery.

Seven Essential items in a First Aid Box :-

- ① Sterile Gauze and Bandages - For covering wounds and stopping bleeding.
- ② Antiseptic wipes or solution - To clean wounds and prevent infection.
- ③ Adhesive Bandages (Plasters) - For minor cuts, blisters or abrasions.
- ④ Disposable Gloves - To maintain hygiene and prevent infections.
- ⑤ Scissors and Tweezers - For cutting bandages and removing debris from wounds.

① Pain Relievers - To manage pain and reduce inflammation.

② CPR Face Shield - To safely perform resuscitation.

These basic supplies help provide immediate and effective first aid in emergencies.

Ques 8: Describe the major Responsibilities of Safety management in any industry.

Ans: Safety management plays a crucial role in protecting workers, preventing accidents and ensuring compliance with legal regulations. Here are the key responsibilities.

① Risk Assessment and Hazard Identification: → Identify potential hazards in the workplace (e.g., chemical, electrical, ergonomic risks).

② Conduct regular risk assessments to evaluate safety threats.

→ Implement control measures to reduce risks.

③ Compliance with Safety Regulations: → Ensure the industry follows local, national, and international safety laws.

→ Keep updated with Occupational Safety and Health Administration (OSHA) or relevant authorities guidelines.

→ Maintain records of safety procedures and incidents.

④ Implementation of Safety Policies and Procedures: → Develop and enforce safety rules and standard operating procedures (SOPs).

→ Ensure emergency response plans are in place (fire safety, evacuation drills).

→ Promote the use of Personal Protective Equipment (PPE).

⑤ Employee Training and Awareness: → Conduct regular safety training sessions for employees.

→ Conduct regular safety training sessions for employees.

→ Educate workers on emergency procedures, first aid and hazard management.

→ Encourage a culture of safety awareness in the workplace.

5 Incident Investigation and Reporting

→ Investigate workplace accidents, injuries and near misses.

→ Identify the root causes and take corrective actions.

→ Maintain proper documentation and report incidents to authorities if required.

6 Workplace Safety Audits and Inspections

→ Perform routine inspections of machinery, tools and work environments.

→ Ensure compliance with fire safety, electrical safety and structural safety standards.

→ Address any identified hazards promptly.

7 Promoting a Safety Culture

→ Encourage employees to report unsafe conditions without fear of retaliation.

→ Reward safe work practices and recognize safety-conscious employees.

→ Communicate regularly about safety improvements and updates.

→ By effectively managing these responsibilities, industries can create a safer workplace, reduce accidents and enhance productivity.

X

Q.1 What are the advantages of preventive maintenance & define it also.

Ans Preventive Maintenance: Preventive maintenance (PM) is a proactive approach to maintaining equipment, machinery, or systems by performing regular inspections, servicing and repairs to prevent unexpected failures or breakdowns.

It involves scheduled maintenance tasks such as lubrication, cleaning, adjustments, part replacements and performance checks to ensure optimal functionality and longevity. The goal of preventive maintenance is to reduce downtime, improve efficiency and extend the life-span of assets while minimizing costly repairs.

Advantages

- ① Reduced Downtime: Regular maintenance helps prevent unexpected breakdowns, keeping equipment operational.
- ② Cost Savings: Prevents major repairs and extends equipment lifespan reducing replacement and emergency repair costs.

③

Increased Efficiency: Well maintained machinery runs smoothly improving performance and energy efficiency.

④

Enhanced Safety: Reduces the risk of accidents caused by equipment failure.

⑤

Better planning: Scheduled maintenance allows for better resource allocation and inventory management.

⑥

Improved productivity: Reliable equipment ensures uninterrupted operations leading to higher productivity.

⑦

Compliance with Regulations: Helps meet safety and industry standards, avoiding legal issues and penalties.

⑧

Higher Asset Value: Proper maintenance increases resale value and asset reliability.

By implementing a preventive maintenance program, businesses can achieve long-term operational and financial benefits.

Q.2 Explain Repair Cycle in brief and also explain it.

Ans A Repair cycle refers to the sequence of steps involved in maintaining, diagnosing, repairing and restoring equipment or machinery to optimal working condition. It typically follows three stages:-

- (1) Inspection & Detection:- Identifying wear, damage or potential failures through routine checks.
- (2) Diagnosis & Assessment:- Analysing the problem to determine the root cause and extent of the damage.
- (3) Planning & Scheduling:- Organising the necessary resources (parts, tools, and personnel) for the repair.
- (4) Repair & Replacement:- Fixing or replacing faulty components to restore functionality.
- (5) Testing and Verification:- Running tests to ensure the repair was successful and the equipment functions properly.

(6) Reintegration:- Returning the equipment to regular operation.

(7) Preventive Maintenance:- Implementing measures to avoid future failures and extend equipment life.

Repair cycle can be categorized in to different types based on the nature of maintenance and repair strategies:- Time maintenance categories include:-

(1) (PM) - Preventive maintenance:- Regularly scheduled maintenance inspections and servicing to prevent failures before they occur.

(2) Corrective maintenance (CM): Repairs carried out after detecting a fault or failure to restore functionality.

(3) Predictive maintenance: (PdM): Uses data and condition-monitoring tools to predict failures and schedule maintenance accordingly.

(4) Emergency or Breakdown maintenance:- Unplanned repairs performed immediately after an unexpected

failure.

(5) Condition based Maintenance (CBM):

Maintenance performed only when performance data showed indicates deterioration.

(6) Overhaul Maintenance: A comprehensive restoration process where equipment is completely disassembled, repaired and reassembled to extend its life span.

Each category helps ensure efficient equipment management, reducing downtime and extending operational life.

Q.3 Explain periodic and preventive Maintenance of pump.

Pumps are critical components in many industrial and domestic applications. To ensure their efficiency and longevity, both periodic maintenance and preventive maintenance are essential.

Periodic Maintenance of Pump:-

Periodic maintenance involves scheduled inspections, servicing, and major repairs

at fixed time intervals. It helps maintain the pump's performance and prevents unexpected failures.

Key Tasks in Periodic Maintenance:

- (1) Daily checks
 - * Inspect for leaks, abnormal noise or vibrations.
 - * Check oil levels and temperature.
- (2) Weekly Maintenance
 - * Inspect and clean filters or strainers.
 - * Check motor alignment and belt tension.
- (3) Monthly Maintenance
 - * Lubricate bearings and moving parts.
 - * Tighten loose bolts and fittings.
- (4) Quarterly Maintenance
 - * Inspect the impeller for wear or clogging.
 - * Test the pressure and flow rate.
- (5) Annual Maintenance
 - * Conduct a full system check, including electrical components.

* Replace worn out seals, gaskets or bearings if necessary.

Preventive Maintenance of Pump

Preventive maintenance is a proactive approach where regular inspections and servicing are done to prevent failures before they occur. It reduces downtime and increases the pump's lifespan.

Key Tasks in Preventive Maintenance

① Visual Inspection:

* Check for leaks, corrosion and physical damage.

* Ensure pipes and connections are secure.

② Lubrication:

* Regularly lubricate bearings, motor, and seals to prevent friction and overheating.

③ Alignment Checks:

* Ensure pump and motor alignment to avoid vibration and wear.

④ Seal and Gasket Inspection

* Replace worn out seals to prevent leaks.

⑤ Impeller Maintenance:

* Clean and inspect the impeller for damage or debris accumulation.

⑥ Vibration and Noise Analysis:

* Monitor vibrations and unusual sounds to detect early signs of mechanical failure.

⑦ Motor and Electrical System Inspection:

* Check motor winding resistance and insulation.

* Ensure power supply and electrical connections are stable.

Benefits of Periodic and Preventive Maintenance

① Reduces unplanned breakdowns.

② Extend Pump life.

③ Improves efficiency and performance of pump.

④ Reduces overall repair costs.

5) Ensure Safety and compliance with industry standards.

By implementing both periodic and preventive maintenance, pump system can operate reliably with minimal disruptions.

Ques 4 State the Complete Overhauling.

Ans Overhauling is the process of thoroughly inspecting, repairing, and restoring equipment, machinery, or components to their original or optimal working condition. It involves complete disassembly, cleaning, replacement of worn-out parts, reassembly and testing to ensure proper functionality.

Types of Overhauling

1) Minor Overhauling: Involves partial disassembly, cleaning, and replacement of basic components like seals, bearings and gaskets.

2) Major Overhaul (Complete Overhaul): A full teardown, inspection, repair, or replacement of major parts followed by reassembly and testing.

* General Steps in Overhauling:

1) Disassembly: Breaking down the machine or component systematically.

2) Cleaning: Removing dirt, oil and debris from all parts.

3) Inspection: Checking components for defects, wear, damage, or

4) Replacement / Repair: Fixing or replacing defective parts.

5) Reassembly - putting the machine back together correctly.

6) Testing - Running performance tests to ensure proper function.

Overhauling helps extend equipment and machine life, improve efficiency and prevent unexpected failures.

Ques 5 Differentiate preventive maintenance x breakdown maintenance.

Basis of difference	Preventive maintenance	Breakdown maintenance	Basis of difference	Preventive maintenance	Breakdown maintenance
<u>Frequency</u> on:	Regular, planned maintenance to prevent equipment failure	Maintenance performed only after a failure occurs.	(7) Reaction Time	Prepares for maintenance in advance avoiding emergency situations	Requires quick actions often leading to rushed and expensive fixes.
(2) Maintenance Scheduling	Performed at regular intervals (daily, weekly, monthly) etc.	Only performed when equipment / machine fails.	(8) Production loss	Minimal production loss due to scheduled maintenance	High production loss due to unexpected downtime.
(3) Equipment Condition	Keeps equipment in good working condition	Equipment deteriorates over time until failure occurs.	(9) Emergency spare parts requirement	Spare parts are pre-stocked based on the maintenance schedule.	Spare parts may not always be available, leading to delays.
(4) Inspection frequency	Regularly scheduled inspections help detect minor issues early	No inspection issues are identified only when failure happens.	(10) Effect on workflow	Organized and planned work distribution.	Causes stress and inefficiency due to emergency response.
(5) Planning Requirement	Requires proper planning, scheduling and resources allocation.	No prior planning maintenance is done on an emergency basis.	(11) Effect on Reliability	Increases equipment reliability and reduces failure chances	Decreases reliability since failures are unpredictable.
(6) Cost of Repair	Lower because problems are fixed before major damage.	Higher due to extending repairs or full replacement.	(12) Safety concerns	Reduces the risk of accidents and hazards.	Higher risk of accidents due to unexpected failures.

12. Examples

Routine oil

Fixing a Conveyor belt only after

Changes, lubrication, belt replacement, motor inspection

after it burns out

14. Failure prevention

Prevents breakdowns and ensures continuous operation

15. wear and tear management

Reduces wear and tear by keeping equipment in optimal condition

16. Response Time

Maintenance is planned and scheduled efficiently

Que 6

Before replacing any defective part what are the facts that need to be kept in mind

Ans Before replacing any defective part several important factors must be considered to ensure a successful and efficient repair. These include:-

(1) Identifying the Cause of Failure:-

* Determine the root cause of the defect e.g. wear and tear misalignment, overheating improper lubrication

* Ensure that the same issue doesn't recur after replacement

(2) Checking the manufacturer's specifications:-
* Verify the part number, size (material and compatibility with the existing system)

* Ensure the replacement part meets OEM (Original Equipment Manufacturer) standards

(3) Availability of Spare parts

* Check if the required part is in stock or if it needs to be ordered

* If unavailable find an alternative that matches specifications

(4) Compatibility with the system:-

- * Ensure the new part fits the existing set up without modifications.

- * Check electrical and mechanical compatibility.

(5) Tools and Equipment Required for Replacement:-

- * Gather necessary tools like wrenches, screwdrivers, calibration instrument, lubricants and safety gear.

- * Ensure all required tools are in good condition.

(6) Safety Precaution: * Disconnect power, pressure or fluid sources before replacing the part.

- * wear protective gear like gloves, goggles and safety shoes.

(7) Environmental Conditions:-

- * Perform the replacement in a clean, dry and safe environment to prevent contamination or further damage.

- * Ensure the working area is well lit and ventilated.

(8) Testing and Calibration after Replacement :- * After installation test the machine to ensure proper functioning.

- * Perform calibration or alignment adjustments if required.

(9) Cost Consideration :-

- * Compare the repair cost versus replacement cost.

- * Ensure the new part offers better durability and efficiency.

(10) Maintenance Records and Documentation:-

- * Update maintenance logs to track part replacements and future servicing.

- * Document details like replacement date, part number, technician name and observations.

~~Important~~ ~~Notes~~

Primary Functions of Maintenance Department

Date: / /
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- ① Equipment Maintenance
- ② Repair of Faults
- ③ Preventive Maintenance
- ④ Break down Maintenance
- ⑤ Maintenance Planning & Scheduling
- ⑥ Safety Assurance

Secondary Functions

- ① Inventory control of spare parts
- ② Training of maintenance staff
- ③ Energy conservation
- ④ Equipment Installation & Commissioning
- ⑤ Technical Documentation
- ⑥ Modification & Upgradation

Stages of Repair Cycle

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- ① Fault Detection ✓
- ② Diagnosis ✓
- ③ Planning ✓
- ④ Repair ✓
- ⑤ Testing ✓
- ⑥ Documentation ✓
- ⑦ Return to Service ✓

Reconditioning & Refurbishing

Occupational Health & Injuries
various deep diseases
Defective Fault tracing. List out - of
reasons for fault tracing
Corrosion? How to prevent
wear?