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Apr. 25

SET 1

Pages: 2

Scoring Indicators

COURSE NAME : MATERIAL HANDLING

COURSE CODE : 5023 B

QID : 2109240178

| Q No | Scoring Indicators | Split score | Sub Total | Total score |
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| | **PART A** | | | **9** |
| I. 1 | 1.Storage and handling equipment<br>2.Bulk material handling equipment<br>3.Engineered systems<br>4.Industrial trucks | 1/2X2 | 1 | |
| I. 2 | A Unit Load is a method of assembling various goods into a single, well secured, and manageable load, typically for handling and transportation purposes. | 1 | 1 | |
| I. 3 | Load handling attachments – forged hooks, triangular eye hooks, crane grab, and vacuum lifter. | 1/2X2 | 1 | |
| I. 4 | Monorail conveyors are a type of overhead conveyor system designed to transport materials or products along a single track or rail. They are particularly useful in cross handling and logistics for moving items efficiently through various stages of a process. | 1 | 1 | |
| I. 5 | Chain conveyors use chains to move goods along a track. They are suitable for heavy-duty applications and can operate in harsh environments. | 1 | 1 | |
| I. 6 | An escalator is made up of a set of interlocking steps, powered by an electric motor, the entire mechanism to connect the floors. | 1 | 1 | |
| I. 7 | Ware housing and distribution<br>Manufacturing<br>Mining<br>Construction | Any two (1/2x2) | 1 | |
| I. 8 | Hoists are mechanical devices used to lift heavy loads. They rely on a lever mechanism to create mechanical advantage, allowing users to lift weights with minimal effort | 1 | 1 | |
| I. 9 | Cable cranes- are specialized lifting systems that use cables and pulleys to move heavy loads. They are often used in construction, mining, and other industries where heavy materials need to be transported over distances or difficult terrain. | 1 | 1 | |

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| | **PART B** | | | 24 |
| II. 1 | A. Horizontal flow line.<br>B. Vertical flow lines<br>C. Unidirectional or Retractional flow<br>D. Vertical or inclined flow | 3 | 3 | |
| II. 2 | Stacking is one way to make maximum use of storage space. The different methods of stacking:Block Stacking, Brick Stacking, Pin wheel Stacking and Irregular Stacking<br>Block stacking is a warehousing method in which goods are stacked directly on the floor.<br>Brick stacking<br>Pinwheel stacking<br>Irregular stacking | 3 | 3 | |
| II. 3 | Hemp ropes are ropes made from fibers derived from the hemp plant, specifically the Cannabis sativa plant species.<br>Hemp fibers are naturally strong, making hemp ropes robust and able to withstand heavy loads and wear.<br>They are particularly resistant to stretching and deterioration from exposure. | 3 | 3 | |
| II. 4 | An electric lifting magnet, often referred to simply as a magnet crane grab, is a type of lifting device used in material handling and industrial applications. Unlike traditional mechanical grabs, electric lifting magnets use the principle of electromagnetism to lift and transport ferrous (metallic) materials. | 3 | 3 | |
| II. 5 | A conveyor belt works by using two motorized pulleys that loop over a long stretch of thick, durable material. When motors in the pulleys operate at the same speed and spin in the same direction, the belt moves between the two. If objects are particularly heavy or bulky or if the conveyor belt is carrying them for a long distance or duration, rollers may be placed on the sides of the conveyor belt for support.<br>Components of a Belt Conveyor: Belt: A continuous loop of material, typically rubber or fabric that carries the load.<br>Pulley: A cylindrical component that drives the belt. There are usually two types: Drive Pulley: Powered by a motor to move the belt. Idler Pulley: Supports and guides the belt as it returns to the drive pulley.<br>Motor: Provides power to the drive pulley. Frame: The structural support that holds all the conveyor components together.<br>Rollers: Positioned along the length of the conveyor to support the belt and reduce friction. | 3 | 3 | |
| II. 6 | Pneumatic conveyors are systems used to transport bulk materials through pipes or tubes using air or other gases as the conveying medium. They are commonly used in industries for moving powders, granules, and small particles. | 3 | 3 | |
| II. 7 | A trailer is an unpowered vehicle towed by a powered vehicle. It is commonly used for the transport of goods and materials. | 3 | 3 | |

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| | Industrial trailers and commercial trailers are pulled behind a powered vehicle to carry goods, livestock, or equipment. They are used to move cargo from factories to warehouses, warehouses to distributors, and distributors to retailers. | | | |
| II. 8 | Lever operated hoist<br>Differential hoists<br>Worm geared and spur geared hoists<br>Helical gear hoist | 3 | 3 | |
| II.9 | Rotary crane<br>Bridge crane<br>Cable crane<br>Floating crane<br>Jib crane<br>Derrick crane<br>Overhead crane<br>Gantry crane | 3 | 3 | |
| II.10 | Industrial lifts are mechanical devices used to raise and lower heavy loads in factories, warehouses, and other industrial settings. Their construction is designed to handle heavy weights and ensure safety and efficiency. | 3 | 3 | |

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| | **PART C** | | | 42 |
| III | Factors affecting choice of material handling equipment<br>Choosing the right material handling equipment is crucial for optimizing efficiency, safety, and cost in various operations. Here are some key factors that typically affect this choice.<br>• Nature of the Material:–<br>Type: The physical form (bulk, packages, pallets, etc.) and properties (fragile, hazardous, etc.) of the material.<br>Size and Weight: Heavier or larger items may require more robust equipment.<br>Temperature: Extreme temperatures might necessitate specialized equipment.<br>• Volume and Frequency:–<br>Throughput: The quantity of material to be moved and the frequency of movement can influence equipment selection.<br>Handling Cycles: High-frequency operations might require more automated solutions.<br>• Space Constraints:–<br>Layout: The available space and the layout of the facility affect the size and type of equipment that can be used.–<br>Aisle Width: Narrow aisles might limit the choice of equipment to more compact options.<br>• Operational Efficiency:<br>Speed: Some tasks may require faster equipment to maintain productivity<br>Integration: Equipment should integrate seamlessly with other systems in place, such as inventory management systems.<br>• Cost:–<br>Initial Investment: The upfront cost of the equipment and installation.<br>Operational Costs: Maintenance, energy consumption, and training costs.<br>• Safety:–<br>Compliance: Equipment must meet safety regulations and standards.<br>Ergonomics: Ensuring that equipment is designed to reduce the risk of injury for operators.<br>• Maintenance and Reliability:–<br>Durability: The reliability of the equipment and the ease of maintenance can impact long term operational efficiency.–<br>Support: Availability of spare parts and service support.<br>• Environmental Conditions:–<br>Exposure: Equipment should be suitable for the environmental conditions, such as dust, moisture, or chemical exposure.<br>• Operator Skills:–<br>Training: The level of expertise required to operate the equipment and the availability of trained personnel. | 7 | 7 | 7 |
| IV. | Four general types of maintenance philosophies can be identified, namely | 7 | 7 | 7 |

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| | • Corrective<br>• Preventive<br>• Predictive<br>• Emergency<br>1. Preventive Maintenance :<br>Scheduled Inspections: Regularly checking equipment to identify potential issues before they cause breakdowns.<br>Lubrication: Applying lubricants to reduce friction and wear.<br>Cleaning: Keeping equipment clean to prevent debris buildup that could affect performance.<br>Adjustments: Fine-tuning components to maintain optimal performance.<br>2. Predictive Maintenance: Condition Monitoring: Using tools and techniques like vibration analysis, thermal imaging, or oil analysis to monitor equipment health.<br>3. Corrective Maintenance: Repairs: Fixing equipment after it has failed or broken down. Replacements: Replacing faulty parts or components.<br>4. Emergency Maintenance: Occurs when a total breakdown or failure appears. | | | |
| V. | Arresting gear is used to hold the load being lifted without interfering in the hoisting process but preventing the load from coming down due to gravity.<br>Key components of arresting gear in hoisting devices may include:<br>• Safety Hooks and Latches: These are designed to securely attach the load to the lifting device and prevent accidental detachment.<br>• Emergency Brake Systems: Some hoisting devices are equipped with emergency brakes that automatically engage if the primary lifting mechanism fails, preventing the load from falling.<br>• Overload Protection: Sensors or devices that detect if the load exceeds safe operating limits and automatically stop or prevent further lifting until the issue is resolved.<br>• Fall Arrest Systems: In situations where personnel are involved in lifting operations, fall arrest systems may be integrated into the hoisting equipment to protect workers in case of a fall.<br>• Load Monitoring and Control Systems:Advanced hoisting devices may include systems that monitor load weight, position, and movement, providing real-time feedback to operators to ensure safe lifting practices. | 7 | 7 | 7 |
| VI. | STARTING &STOPPING OF MOTION IN HOISTING MECHANISM<br>In hoisting mechanisms, which are used for lifting and lowering heavy loads, several mechanisms are employed for starting and stopping the motion effectively and safely. The choice of mechanism depends on factors such as load capacity, speed | 7 | 7 | 7 |

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| | requirements, and the precision needed for positioning the load. Here are common mechanisms used for starting and stopping motion in hoisting mechanisms:<br>Electric Motor and Brake System: Electric Motor and Brake System:<br>• Electric Motor: Hoisting mechanisms often use electric motors to provide the driving force for lifting and lowering operations. Electric motors offer precise control over speed and torque, which is crucial for handling heavy loads.<br>• Brake System: To control the stopping of motion, especially when precise positioning or holding of the load is required, a brake system is essential. This can include electromagnetic brakes, mechanical brakes, or dynamic braking systems that dissipate energy as heat to slow down the load. Clutch Mechanism:<br>• Clutches are used to engage or disengage the motor from the hoisting mechanism. They allow for smooth starting and stopping of motion by controlling the transmission of power from the motor to the lifting mechanism. Clutches can be mechanical, electromagnetic, or hydraulic depending on the application.<br>Variable Frequency Drives (VFDs):<br>• VFDs are electronic devices used to control the speed of electric motors<br>• VFDs are electronic devices used to control the speed of electric motors by varying the frequency and voltage of the power supplied to the motor. They enable smooth acceleration and deceleration of the hoisting mechanism, reducing wear and tear on mechanical components and providing precise control over the lifting process. | | | |
| VII. | **Roller Conveyor** is a type of Conveyors with a series of rollers supported in a frame over which objects are advanced manually, by gravity, or by power. A roller conveyor is a conveyor that consists of a series of parallel rotating bars that move goods along to their end destination. Roller conveyors are used in environments like warehouses and manufacturing facilities. These conveyors are containing sprocket at one terminal and a bearing housing at other. A roller shaft runs through the rollers, which are mounted on the extruded aluminum rails. Roller conveyors are the proper choice when you need to side load, push off, accumulate a product or adjust pressure on carrying rollers. Roller conveyor types are chain driven, belt driven, line shaft driven, accumulation, or non-powered (gravity). Using roller conveyors instead of slider bed conveyors adds versatility to the type of transfers, diverters and stops that can be used in a system. Rollers are available in mild steel, galvanized, plastic or stainless steel. | 7 | 7 | 7 |
| | Among different manufacturers, the term oscillating conveyor will sometimes appear. Oscillating conveyors are sometimes | | | |

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| VIII. | described as being a specific type of vibrating conveyor wherein they operate using a relatively low frequency and a larger amplitude of motion than would typically be employed with a vibrating conveyer. As a result, oscillating conveyors are used to bulk materials such as in the timber industry or waste management/recycling industry. For example, these conveyors may be used to transport wooden scraps from an upstream system and send these to a discharge point. When contrasted with vibrating conveyors that operate at lower amplitudes and higher frequencies, the motion or movement of the material is gentler with a vibrating conveyor than with an oscillating conveyor. In quarrying applications, oscillating conveyors are sometimes referred to as jump conveyors and are called grasshopper conveyors in hard rock mining applications.<br>OSCILLATING CONVEYORS are utilized to convey sand or other granular particles at a desired rate. The conveyor is generally placed under a vibrating shakeout or a grid to eliminate direct handling of hot sand by the belt conveyor. In the process of reciprocation, the oscillating conveyor cools the hot sand to some extent which increases the life of the return sand conveyor belt.<br>The equipment comprises a metallic trough carried on inclined arms which are fitted with rubber bushes to handle the reciprocating motion of the trough. The oscillating motion of the trough is achieved via specially designed inclined arms and an eccentric shaft driven by a motor through V-belts.<br>The eccentric shaft is mounted on anti-friction bearings and has V-pulleys at both ends with weights on them to counteract the unbalancing force. The rotation of the eccentric shaft provides a forward and backward motion to a connecting arm attached to the trough through a rubberized pin. A retaining spring assembly at the back of the trough absorbs shock load. | 7 | 7 | 7 |
| IX. | A gravity conveyor moves the load without utilizing motor power sources, usually down an incline or through a person pushing the load along a flat conveyor.<br>WORKING PRINCIPLE<br>1. Incline: Gravity conveyors typically operate on an inclined plane. The incline allows gravity to naturally move the materials from the higher end of the conveyor to the lower end higher end of the conveyor to the lower end.<br>2. Rollers or Skate Wheels: The most common types of gravity conveyors use either rollers or skate wheels to support and move the products.<br>a. Roller Conveyors: These have a series of cylindrical rollers mounted in a frame. The product moves across these rollers due to gravity.<br>b. Skate Wheel Conveyors: These have a series of small wheels mounted on a frame, which facilitate the movement of lighter products. | 7 | 7 | 7 |

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| | 3. Adjustable Angle: Many gravity conveyors are adjustable, allowing the angle of the incline to be modified. This adjustability can help optimize the flow of materials depending on the load and the space available.<br>Components<br>1. Frame: The structural framework supports the rollers or wheels and maintains the conveyor's alignment. It is often made of metal or heavy-duty plastic.<br>2. Rollers or Wheels: These are the parts that the products roll over. Rollers are cylindrical, while skate wheels are small, free-spinning wheels. Both types are designed to reduce friction and facilitate smooth movement.<br>3. Supports: Support structures are used to hold the conveyor at the desired angle and ensure stability.<br>4. End Stops: At the end of the conveyor, there are usually end stops or guards to prevent products from rolling off the end.<br>5. Chutes or Guides: Sometimes, additional components like chutes or guides are used to direct the flow of materials or to ensure that products stay aligned on the conveyor. | | | |
| X. | Automated Guided Vehicles (AGVs) are mobile robots used to transport materials within a facility without human intervention. They operate based on various principles and technologies to navigate and perform tasks efficiently.<br>1.Navigation and Guidance<br>Guide Paths: AGVs follow predefined paths or routes, which can be established using various methods:<br>– Magnetic Strips: AGVs equipped with magnetic sensors follow magnetic<br>– Magnetic Strips: AGVs equipped with magnetic sensors follow magnetic strips embedded in the floor.<br>– Optical Markers: AGVs use optical sensors to detect and follow visual markers or lines on the floor.<br>– Laser Guidance: AGVs use laser scanners to detect and navigate based on reflections from walls and objects.<br>– Inertial Navigation: Some AGVs use gyroscopes and accelerometers to track their position and movement without physical guide paths.<br>– GPS<br>2. Control Systems<br>Onboard Controllers: AGVs are equipped with onboard computers that process data from sensors and make real-time decisions regarding movement and task execution.<br>Centralized Control: In some systems, a central computer or control system manages multiple AGVs, coordinating their actions to optimize routes and prevent collisions.<br>3. Obstacle Detection and Avoidance<br>Sensors: AGVs use various sensors to detect and avoid obstacles.<br>This includes: | 7 | 7 | 7 |

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| | – Cameras: Used for visual recognition and obstacle detection.<br>– Proximity Sensors: Detect nearby objects and help in collision avoidance.<br>4. Path Planning and Routing<br>Dynamic Routing: AGVs can adjust their paths in real-time based on changes in the environment or obstacles.<br>Predefined Routes: In simpler systems, AGVs follow fixed routes with minimal dynamic adjustment.<br>Algorithms: Advanced AGVs use algorithms to plan and optimize routes, considering factors like distance, obstacles, and operational efficiency.<br>5. Communication Systems<br>AGVs communicate with a central control system or other AGVs via wireless networks (e.g., Wi-Fi, radio frequency).<br>6. Power Supply and Management<br>• Batteries: AGVs are typically powered by batteries, which need to be recharged or replaced regularly.<br>• Charging Stations: Some AGVs automatically navigate to charging stations when their battery levels are low.<br>7. Load Handling and Manipulation<br>• Load Carriers: AGVs may have specialized equipment for carrying or manipulating loads, such as forks, conveyor belts, or custom-designed fixtures.<br>• Automated Loading/Unloading: Some AGVs are equipped to automatically load and unload goods at designated points. | | | |
| XI | Lever-operated hoists, also known as lever hoists or chain hoists, are mechanical devices used to lift heavy loads. They rely on a lever mechanism to create mechanical advantage, allowing users to lift weights with minimal effort.<br>Construction & working<br>– Frame: The sturdy outer structure that houses the internal Components<br>.– Lever Arm: The handle that the operator pulls to lift the load. It's designed to provide leverage.<br>– Load Chain: Adurable chain that wraps around the load hook and connects to the lifting mechanism with a safety latch<br>.– Load Hook: The attachment point for the load, usually equipped with a safety latch.<br>– Ratchet Mechanism: A series of gears that allows the load chain to be pulled up while preventing it from slipping back down.<br>– Brake System: Ensures the load remains securely lifted and controls descent.<br>– Sheave (Pulley): Guides the load chain and aids in smooth operation.<br>Working Principle<br>• Setup:– The hoist is attached to a secure overhead point, and the load is connected to the load hook.<br>• Lifting the Load:– Pulling the Lever: The operator pulls | 7 | 7 | 7 |

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| | down on the lever arm. This action engages the ratchet mechanism, which allows the load chain to be pulled upward.– Mechanical Advantage: The lever arm's length provides a mechanical– Mechanical Advantage: The lever arm's length provides a mechanical advantage, allowing the operator to lift heavy loads with less effort.<br>• Holding the Load:– Once the load reaches the desired height, the brake system engages automatically, holding the load in place without requiring continuous force from the operator.<br>• Lowering the Load:– To lower the load, the operator gently pulls the lever in the opposite direction. The ratchet mechanism allows for controlled descent, enabling the operator to lower the load safely. | | | |
| XII | Differential hoists, also known as differential gear hoists, utilize a unique mechanical arrangement to lift heavy loads efficiently. They combine the principles of leverage and gear systems to provide a high lifting capacity with minimal input effort.<br>Construction of differential hoist<br>– Frame: The sturdy structure that supports the entire hoist and houses the internal mechanisms.<br>– Pulley System: A set of pulleys arranged in a differential configuration to allow for efficient load lifting.<br>– Load Chain or Wire Rope: Connects the load to the hoist and moves through the pulleys.<br>– Differential Gear Mechanism: A system of gears that allows for the multiplication of force applied by the allows for the multiplication of force applied by the operator.<br>– Crank Handle or Lever: The operator uses this to engage the gear mechanism and lift the load.<br>– Load Hook: A secure attachment point for the load, often equipped with a safety latch.<br>– Brake System: Engages automatically to hold the load securely in place once lifted.<br>Working Principle<br>• Initiating the Lift:– Crank Operation: The operator turns the crank handle or activates the motor, which engages the differential gear system.<br>• Power Transmission:– As the driving gear rotates, it turns the connected driven gears. The unique arrangement allows for the input motion to be transformed into a lifting motion while distributing the load across multiple gears.<br>• Lifting the Load:– The movement of the driven gears pulls the load chain or wire rope, lifting the attached load. The differential gearing provides significant mechanical advantage, allowing heavy loads to be lifted with minimal effort.<br>• Controlled Descent:–To lower the load, the operator reverses the crank or motor direction. The brake system helps control the descent, allowing for safe and precise lowering of the load. | 7 | 7 | 7 |

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| XIII | Bridge cranes, also known as overhead cranes, are widely used in industrial environments for lifting and moving heavy loads across large spaces. They consist of a horizontal beam (bridge) that moves along a set of tracks or runways.<br>Construction<br>• Bridge (Main Girder):– The horizontal beam that spans the workspace. It supports the hoisting mechanism and is usually made of steel for strength.<br>• EndTrucks:– Located at both ends of the bridge, these components contain wheels that run on the tracks or runways. They allow the bridge to move horizontally.<br>• Hoisting Mechanism:– Typically consists of a hoist that includes:<br>Drum:Woundwith a cable or chain.<br>Motor: Drives the drum to lift or lower the load.<br>Load Hook: The attachment point for the load, often equipped with a safety latch.<br>• Runways:– The tracks or beams on which the end trucks travel. They are mounted to the building structure or supported by columns.<br>• Control System– A system that includes controls for the hoist and the bridge movement, which can be manual or remote-operated.<br>• Safety Features - Includes limit switches, overload protection, and emergency stop buttons to ensure safe operation.<br>Working Principle<br>• Horizontal Movement:– The operator uses the control system to move the entire bridge horizontally along the runways. This allows access to different areas of the workspace.<br>• Lifting the Load:– The hoisting mechanism is activated by the operator. When the drum rotates, it winds the cable or chain, which lifts the load attached to the load hook.<br>• Positioning the Load:– With the load lifted, the operator can maneuver the bridge to position– With the load lifted, the operator can maneuver the bridge to position the load accurately over the desired location.<br>• Lowering the Load:– Tolower the load, the operator reverses the drum rotation, allowing the cable or chain to unwind gradually, lowering the load to the ground or another surface.<br>• Safety Features:– Bridge cranes are equipped with limit switches and overload protection systems to ensure safe operation. These features prevent the crane from exceeding its capacity and help avoid accidents. | 7 | 7 | 7 |
| XIV | Safety principle of materials handling, demands that the "handling methods and handling equipment use must be safe". A safe materials handling means the activity is free from recognized hazards that can cause or likely to cause physical harm including death to employees or public and damage to materials. Materials should always be handled such that injuries | 7 | 7 | 7 |

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| | or damages are brought to the minimum, if cannot be eliminated altogether.<br>In order to achieve a safe materials handling operation, it is essential to follow a safety policy in the plant or workplace. This safety policy provides guidelines for elimination or reduction of accidents causing injuries and damage due to both manual and equipment assisted materials handling. The safety policy generally include training provisions, guidelines for manual and equipment assisted materials handling, materials storage and also provides guidelines on housekeeping, securing load on vehicles, fire-fighting, requirements for guarding, illumination, labels, signs, makings etc. The safety policy may also specify the responsibility towards safety procedures of various personnel and departments of an organisation. | | | |