SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai
Accredited by NAAC-UGC with 'A++' Grade (Cycle III) &
Accredited by NBA (B.E - CSE, EEE, ECE, Mech & B.Tech.IT)
COIMBATORE-641 035, TAMIL NADU

B.E/B.Tech- Internal Assessment – III
Academic Year 2024-2025 (EVEN Semester)
Sixth Semester
19MEO303 - INDUSTRIAL SAFETY

A

ANSWER KEY

		CO	Blooms
1.	What is the role of government agencies in safety education and training? Mention two key responsibilities. **(GATE 2021&GATE 2023)** Government agencies play a crucial role in promoting workplace safety through education and training. Two key responsibilities are: • **Formulating and enforcing safety standards** (e.g., OSHA, DGMS, etc.). • **Conducting awareness campaigns and providing training programs** to educate workers and employers on occupational hazards and preventive measures.	CO 4	**REM**
2.	Analyze two future directions for ergonomics. • **Integration of AI and wearable technology** to monitor real-time ergonomics and prevent injuries through smart feedback systems. • **Designing for inclusivity and aging workforce**, ensuring ergonomic solutions accommodate diverse physical and cognitive capabilities.	CO 4	**ANA**
3.	What are Competence Building Techniques (CBT)? Competence Building Techniques (CBT) are structured methods used to enhance employees' skills, knowledge, and attitudes for improved job performance. Examples include: • **On-the-job training** • **Mentoring and coaching** • **Simulation-based learning**	CO 5	**REM**
4.	List any three workplace risk factors that contribute to musculoskeletal disorders (MSDs). **(GATE 2020)** • **Repetitive motions** (e.g., assembly line tasks) • **Awkward or static postures** (e.g., prolonged sitting or bending) • **Manual handling of heavy loads**	CO 5	**UND**

5.		Apply the concept of motivation to improve employee participation in safety programs. Motivation can enhance participation through: • **Intrinsic rewards**: Promoting a sense of personal responsibility and achievement in maintaining a safe workplace. • **Extrinsic rewards**: Offering recognition, incentives, or bonuses for compliance and proactive safety behavior.		CO 5	**APP**
PART – B (2*13=26 Marks) & (1*14=14 Marks)					
				CO	**Blooms**
6.	(a)	Explain the history of ergonomics and its evolution in modern industries. **History:** • **Ancient roots**: Early ergonomic principles observed in Greek and Egyptian tool designs and workplace organization. • **Industrial Revolution**: Mechanization led to higher injury rates, highlighting the need for worker-machine fit. • **World War I & II**: Military demands for improved efficiency and safety accelerated ergonomic studies, especially in aviation and control systems. • **Post-War (1950s)**: Emergence of ergonomics as a formal discipline; human factors were integrated into system design. **Evolution in Modern Industries:** • **Human-centered design** in machinery, tools, and software interfaces. • **Ergonomic risk assessment** using tools like RULA, REBA. • **Integration with automation and AI** for real-time posture and fatigue monitoring. • **Focus on well-being**: Holistic approaches including mental workload and cognitive ergonomics.	13	CO 4	**REM**
		(or)			
	(b)	Conduct a case study on the impact of ergonomics on workplace productivity. **Case Study: Electronics Assembly Unit** **Problem:** • Workers reported wrist pain and back discomfort. • Errors in circuit board assembly increased. **Ergonomic Interventions:** • Adjustable chairs and workstations introduced. • Task rotation implemented to reduce repetitive strain.	13	CO 4	**ANA**

		• Anti-glare screens and better lighting provided. **Results:** • 40% reduction in musculoskeletal complaints. • 25% increase in assembly line accuracy. • Improved worker satisfaction and lower absenteeism. **Conclusion:** Ergonomic interventions significantly enhanced productivity and reduced health risks.			
7.	(a)	Define Competence Building Techniques and explain their role in safety training. **Definition:** Competence Building Techniques (CBT) are systematic methods used to develop employees' knowledge, skills, and attitudes required for safe job performance. **Role in Safety Training:** • **Skill enhancement**: CBT provides hands-on experience, ensuring workers are skilled in safety procedures. • **Behavioral change**: Reinforces safety culture and promotes proactive hazard identification. • **Examples**: On-the-job training, workshops, simulations, e-learning modules. **Benefits:** • Reduction in human errors. • Higher compliance with safety regulations. • Improved emergency response.	13	CO 5	**REM**
		(or)			
	(b)	Compare different methods of promoting safe practices in industries. | Method	Features	Advantages	Limitations | |---|---|---|---| | Safety Training | Classroom, on-site, simulations | Knowledge transfer, engagement | Needs repetition and evaluation | | Safety Posters & Displays | Visual reminders | Constant visibility, low cost | Passive learning | | Toolbox Talks | Short daily discussions | Practical, team involvement | Needs effective facilitator | | Incentive Programs | Rewards for safe behavior | Motivation, active participation | May lead to underreporting | | Audits & Inspections | Systematic evaluation | Identifies hazards, continuous improvement | Requires trained auditors | **Conclusion:** A combination of methods yields better results than any single approach.	13	CO 5	**ANA**
8.	(a)	A medium-scale manufacturing firm is reporting increased complaints of shoulder pain, eye strain, and fatigue among its inspection-line workers. Most workstations are at fixed height and lighting is fluorescent overhead. **(GATE 2020 & GATE 2022)** **Problem Analysis:** • Fixed-height workstations cause awkward postures.	14	CO 4	**APP**

		• Overhead fluorescent lighting contributes to eye strain. • Repetitive tasks and static postures result in fatigue. **Recommendations:** 1. **Adjustable workstations** to suit worker height. 2. **Task variation** to avoid repetitive strain. 3. **Ergonomic tools** with cushioned grips. 4. **Improved lighting**: Use of natural light or adjustable task lighting. 5. **Anti-fatigue mats** for standing workers. 6. **Regular breaks and eye exercises** to reduce fatigue. **Outcome Expectations:** • Reduced MSD complaints. • Increased inspection accuracy. • Better worker morale.			
		(or)			
	(b)	A steel foundry with accident records wants to implement a reward-based system to promote safety reporting and hazard identification. **(GATE 2022 & GATE 2023)** **Background:** High accident rates suggest underreporting and lack of safety culture. **System Design:** • **Reward points** for reporting near misses and identifying hazards. • **Monthly recognition** of top contributors. • **Team-based rewards** to encourage peer participation. • **Anonymous reporting channels** to reduce fear. **Benefits:** • Increase in hazard reporting. • Improved awareness of unsafe practices. • Stronger safety culture. **Precautions:** • Avoid over-rewarding trivial reports. • Ensure follow-up action is taken on reported issues. **Conclusion:** A well-designed reward system enhances worker engagement and strengthens proactive safety behavior.	14	CO 5	**APP**

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B

ANSWER KEY

		CO	Blooms
1.	Define ergonomics and mention any two of its areas of application in the work system. **(GATE 2021)** **Ergonomics** is the scientific discipline concerned with understanding interactions among humans and other elements of a system, and applying theory, principles, and methods to optimize human well-being and system performance. **Two areas of application:** • **Workstation design** (e.g., desk/chair arrangement for office workers) • **Tool design** (e.g., ergonomic hand tools to reduce fatigue and injury)	CO 4	**UND**
2.	Explain the relationship between ergonomics and workplace productivity. Effective ergonomic design reduces physical strain, fatigue, and injury, leading to fewer work-related absences and higher comfort levels. This results in: • **Increased efficiency and focus**, and • **Improved overall productivity** due to better health and job satisfaction.	CO 4	**UND**
3.	Analyze the impact of government and private consultancy agencies on safety education. • **Government agencies** set regulatory frameworks, fund training programs, and enforce compliance (e.g., OSHA, DGFASLI in India). • **Private consultancies** offer specialized training, conduct audits, and provide customized solutions, thereby enhancing the depth and reach of safety education.	CO 5	**ANA**
4.	Compare the effectiveness of different safety training methods. • **Classroom training** is good for theoretical knowledge but may lack engagement. • **Hands-on training** offers practical experience and higher retention. • **Simulations and e-learning** provide interactive, scalable, and repeatable learning experiences.	CO 5	**ANA**

		Conclusion: Effectiveness increases when methods are tailored to audience needs and combined appropriately.		
5.		How do safety posters and safety displays help in promoting safe practices? **(GATE 2023)** • **Visual reminders**: They continuously reinforce safety messages and procedures. • **Awareness generation**: Attract attention and stimulate safety-conscious behavior among workers, especially in high-risk areas.	CO 5	**UND**
PART – B (2*13=26 Marks) & (1*14=14 Marks)				
				CO	**Blooms**
6.	(a)	Define musculoskeletal disorders (MSDs) and explain their common causes. **Definition:** Musculoskeletal Disorders (MSDs) are injuries or disorders that affect the human body's movement or musculoskeletal system — including muscles, tendons, ligaments, nerves, discs, and joints. **Common Causes:** 1. **Repetitive Movements** – Continuous repetition without rest (e.g., typing, assembly). 2. **Awkward Postures** – Bending, twisting, or overreaching. 3. **Forceful Exertions** – Lifting heavy loads or applying force using tools. 4. **Vibration Exposure** – Use of power tools or machinery (e.g., jackhammers). 5. **Poor workstation design** – Non-ergonomic furniture or tool placement. 6. **Lack of rest breaks** – Continuous work without adequate recovery. **Conclusion:** Identifying and mitigating these causes through ergonomic interventions helps reduce MSD risk.	13	CO 4	**REM**
		(or)			
	(b)	Apply ergonomics principles to improve the working conditions of a factory worker. **Ergonomic Principles & Application:** 1. **Workstation Design:** o Adjustable tables and chairs to fit the worker's body dimensions. o Tools and materials positioned within easy reach. 2. **Posture and Movement:** o Encourage neutral posture (e.g., straight back, supported arms). o Use sit-stand options to alternate positions. 3. **Tool Design:**	13	CO 4	**APP**

		○ Use of ergonomically designed tools with non-slip handles. ○ Lightweight and vibration-reducing equipment. 4. **Lighting and Environment:** ○ Ensure adequate task lighting to reduce eye strain. ○ Maintain comfortable temperature and noise levels. 5. **Work Organization:** ○ Job rotation to avoid repetitive strain. ○ Incorporate micro-breaks for recovery. **Outcome:** Reduction in fatigue, improved productivity, and lower risk of MSDs.			
7.	(a)	Explain how safety posters, safety displays, and campaigns contribute to awareness. **1. Safety Posters:** • Visually communicate key safety messages. • Reinforce rules and procedures (e.g., PPE usage, hazard signs). • Use images and symbols, useful for low-literacy environments. **2. Safety Displays:** • Real-time updates (e.g., days without accidents, emergency contacts). • Display of MSDS charts, evacuation routes, and incident stats. **3. Safety Campaigns:** • Time-bound initiatives promoting specific safety themes. • Activities include quizzes, demonstrations, guest talks. • Increase employee engagement and foster a safety culture. **Benefits:** • Continuous reinforcement of safety behavior. • Encourage worker participation. • Improve hazard perception and responsiveness.	13	CO 5	**UND**
		(or)			
	(b)	Conduct a case study on a successful workplace safety training program. **Case Study: Automobile Assembly Plant** **Problem:** High rate of minor injuries from slips and improper tool handling. **Training Program:** • **Initial Assessment:** Safety audit and incident data review.	13	CO 5	**ANA**

		• **Training Methods:** Video demonstrations, tool handling simulations, and group discussions. • **Duration:** 2 weeks. • **Follow-Up:** Surprise audits and feedback sessions. **Results:** • 60% reduction in minor injuries over 3 months. • Improved safety audit scores. • Workers demonstrated increased compliance with PPE and safety protocols. **Conclusion:** A structured and interactive safety training program led to measurable safety improvements and stronger worker awareness.			
8.	(a)	A paint factory with frequent minor incidents (chemical splashes, slips, and minor fires) wants to launch a one-month safety campaign. **(GATE 2023)** **Issues Identified:** • Minor incidents like chemical splashes, slips, and fires. **Campaign Objective:** To raise awareness, correct unsafe behaviors, and reinforce emergency procedures. **Plan Components:** 1. **Theme:** "Safe Hands, Safe Workplace" 2. **Week 1:** Training on PPE use and chemical handling. 3. **Week 2:** Slips and trips – housekeeping drills and safety signage. 4. **Week 3:** Fire safety drills – extinguishers, alarms, evacuation. 5. **Week 4:** Safety quiz, feedback sessions, and recognition for safe workers. **Support Materials:** • Posters, banners, short videos, and toolbox talks. **Expected Outcomes:** • Increased reporting of near-misses. • Enhanced chemical handling safety. • Reduction in minor incidents.	14	CO 4	**APP**
		(or)			
	(b)	In a fireworks manufacturing unit, most workers have low literacy levels and face recurring minor injuries. The management wants to implement a CBT based safety module. **(GATE 2023)**	14	CO 5	**APP**

		Context: • Low literacy among workers. • Recurring injuries due to unsafe handling and ignorance. **CBT Strategy:** 1. **Audio-Visual Training Modules:** Use of vernacular language videos and animations. 2. **Demonstration-Based Learning:** Live demos of safe practices in mixing and handling. 3. **Peer Trainers:** Select literate workers as facilitators for group sessions. 4. **Pictorial Instructions:** Posters with step-by-step illustrations. 5. **Reinforcement Tools:** Flashcards, role-play, safety skits. **Monitoring & Feedback:** • Daily recap sessions. • Short oral quizzes or picture-matching activities. **Outcome:** • Improved understanding of safe practices. • Decrease in minor injuries. • High engagement due to practical and relatable content.			

Bloom's Taxonomy: REM – Remember UND – Understand APP– Apply ANA– Analyze EVA - Evaluate CRT - Create