



**State exam questions  
Mechanical Engineering BSc  
Operation and Maintenance specialization**

**Machine Repairing**

1. Role of machine repairing. Machine lifetime, bathtub curve, wear periods, maintenance strategies, CM (Condition Monitoring). Methods for condition monitoring.
2. Field of tribology, types of wear: adhesive, abrasive, surface fatigue, erosive, fretting, cavitation, damages of machine elements.
3. Friction, static friction, rolling friction, fluid friction, lubricated friction. Laws of dry friction, Coulomb's Law of Friction, coefficient of friction, Effect of Sliding Velocity on coefficient of friction.
4. Lubrication, Reducing friction, Hydrodynamic lubrication, Elastohydrodynamic lubrication, Boundary lubrication Lubricants, characteristics and purpose of lubricants, liquid lubricants, Performance, Operational tolerance, Longevity, Grease, Soaps. Internal-combustion-engine oils, additives, SAE viscosity grade system for engine oils.
5. Fatigue, cracks, characteristics of fatigue, s-n curve, probabilistic nature of fatigue, normal and weibull distribution. Factors that affect fatigue-life. Cyclic stress state. Surface quality. Material type. Residual stresses. Size and distribution of internal defects. Environment and temperature influences.
6. Corrosion, Type of corrosion, Stress corrosion cracking. Galvanic corrosion. Electropotential series. Pitting corrosion. Crevice corrosion, Stress corrosion cracking (SCC). Protection from corrosion, Applied coatings, Shrink wraps. Anodization. Galvanizing, Biofilm coatings. Cathodic protection. Corrosion in nonmetals. Corrosion of polymers and glasses.
7. Probabilistic risk assessment (PRA). Fault tree analysis (FTA), FTA analysis involves steps. Event Tree Analysis (ETA). Failure Mode and Effects Analysis (FMEA)
8. Machine Fault Diagnosis before machine repairing, diagnosis methods, trend analysis. Vibration measurement methods, devices, sensors.
9. Evaluation due to ISO 10816, assessment zones. Damage frequencies: bearings, unbalance, misalignment, shaft bending, looseness, belt drive faults, gear faults, electrical motors
10. Thermography in machine repairing. Advantages of thermography. Limitations and disadvantages of thermography.
11. Nondestructive testing methods: ultrasonic testing, acoustic emission, eddy-current testing, industrial computed tomography (CT) scanning, dye penetrant inspection, hardness test, scanning electron microscope (SEM), atomic force microscopy (AFM).



12. Measuring instruments for checking machines before and after machine repairing, Tachometer, stroboscope, accelerometer, force gauge, load cell transducer, strain gauge, dynamometer, tribometer, pressure measurement, voltage and current measurement. Quality inspection.
13. Parts cleaning methods, Manual washing, Ultrasonic cleaning, type of Contaminations, Cleaning equipment and procedure, part washer Solvent degreasing, vapor degreasing, abrasive blasting
14. Hot-dip galvanization, composition of the baths, plating, chrome plating, zinc plating, nickel plating. Paints and protective coatings, paint ingredients. Coating methods. Coating with plastic.
15. Soldering and brazing technologies, desoldering and resoldering.
16. Heat treatment, annealing, normalizing, stress relieving, quenching, tempering, case hardening, induction hardening after machine repairing.
17. Cutting processes in machine repairing: turning, boring, drilling, reaming, threading, broaching. milling, milling cutters, gear manufacturing
18. Abrasive processes, grinders, grinding wheels, selection of abrasive
19. Welding and cutting. Heat and filler Metal, shielding and fluxing, Shielded Metal Arc Welding (SMAW). Flux Cored Arc Welding (FCAW), Gas Tungsten Arc Welding (GTAW). Submerged Arc Welding (SAW), Gas Metal Arc Welding (GMAW)
20. Gas welding applications in machine repairing.
21. Repair welding applications in machine repairing.
22. Adhesives, pressure-sensitive adhesives, contact adhesives, hot adhesives, multi-part adhesives. Synthetic adhesives, joining metal with adhesives.
23. Repair and of maintenance mechanical equipment: diagnosis of used bearings. Normal Appearance and Wear. Reconditioning. Cold Mountings. Temperature Mountings. Induction heater, Dismounting.
24. Repair, diagnosis and maintenance of precision chain drives, gear tooth wear and failure, tooth repair. Gear drives diagnosis and repair methods.
25. Repair, diagnosis and maintenance of pumps, compressors, pneumatic and hydraulic systems, cylinders, pipeline networks, fittings and their repairing.