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End -Term Examination

Failure Analysis of Materials (MS-421)

Duration: 3 hrs

Maximum Marks: 50

(4)

Attempt all the following questions.

- Q.1 Explain why constant stress creep tests is preferred over constant load creep tests with diagram to study sustained loading over long periods of time? Why does creep increase in a material subjected to high temperatures with grain size refinement? (5)
- Q.2 Write the creep strain rate dependence equation in terms of exponents 'p', 'n', 'Q'. Explain Harper-Dorn Creep mechanism and its exponent values? Explain the different measures with examples to improve creep resistance via factors like grain size, elastic modulus, stacking faults, purity, alloying additions etc.? (2+3+5)
- Q.3 What are deformation mechanism maps? Draw a typical schematic of deformation map showing the different creep mechanisms like Coble, Nabarro-Herring, dislocation creep, dislocation glide creep etc.?
- Q.4 Explain the difference between adhesive wear and abrasive wear with examples. (4)
- Q.5 What is the type of failure typically observed in: -

(a) failure of high-strength bolts used in offshore oil and gas production.

(b) failure of turbine blades in gas turbines used in power generation plants.

(c) failure of steel bridges due to exposure to saltwater.

(d) failure in airplane wing repeatedly exposed to changes in air pressure and temperature

- Q.6 Problem statement: A load-bearing beam failed to support the weight of a second-story floor of a residential building. It was made of ASTM A572 alloy steel. The owner of the house used heavy machinery on the 2nd floor which caused severe vibrations. Propose the type of load, Mode of failure, microstructural observations and preventive measures for the above case study?
- Q.7 Explain Faraday's law and Lenz's law with regards to eddy current testing. Explain in detail about Magnetic particle testing, its mechanism/principle, procedure, applications, advantages and disadvantages? (2+8)
- **Q.8** What is the thickness of a material that reduces the intensity of a beam of X-rays from 2000 units to 500 units, if the linear attenuation coefficient of the material is 0.2 cm⁻¹?(5)