Entrance Examination Topics for Digital Production for Sustainable Manufacturing

1. **Engineering Mathematics** — vectors and scalar and vector products, matrices, determinants and rank, systems of linear equations, limits, definite and indefinite integrals, and convergence of numerical series.
2. **Probability, Statistics and Data Analysis** — frequency distributions, histograms and box plots, measures of dispersion and skewness, normal, binomial and Poisson distributions, confidence intervals, hypothesis testing, analysis of variance, rank correlation and association between categorical variables.
3. **Engineering Mechanics, Fluid Mechanics and Thermodynamics** — equilibrium of forces, centre of mass, friction, support reactions, shear force and bending moment, hydraulic devices, pressure losses in fluid flow, and the use of steam as a heat-transfer medium.
4. **Electrical Engineering and Measurement Systems** — electric and magnetic fields, Ohm's and Kirchhoff's laws, equivalent resistance and capacitance, electrical measurements, sensors and transducers, strain gauges, and gauge repeatability and reproducibility (GR&R).
5. **Technical Drawing and Engineering Materials** — sketches, views, sections and dimensional tolerances, tensile and compressive strength, yield strength, elasticity, hardness, fatigue and fracture, and the selection of material testing methods.
6. **Manufacturing Processes and Technologies** — casting, forging, extrusion, drawing and stamping, turning, drilling, milling and abrasive machining, tool and workpiece motions, and the distinction between rapid prototyping and rapid manufacturing.
7. **Operation and Maintenance of Technical Systems** — basic principles of operating, maintaining and monitoring technical systems throughout their life cycle, including how failures affect system performance.
8. **Industrial Automation and Control** — on–off and continuous control, transfer functions, PID control and tuning, stability, steady-state error and settling time, combinational and sequential logic, switching functions, and state encoding in Mealy and Moore machines.
9. **Computing, Algorithms and Databases** — operating systems, open-source software, HTTP and URLs, algorithm flowcharts, structured programming, testing and verification of program results, and database field types and queries.
10. **Operations Research and Optimisation** — formulation of decision variables, objective functions and constraints, linear and discrete programming, resource allocation, the knapsack problem, assembly line balancing and hierarchical decision-making.
11. **Production System Design and Performance** — production and manufacturing subprocesses, workstation layout, flexible manufacturing systems, takt time and output rate, bottlenecks, cycle time, work in progress and Little's law, and the effects of machine utilisation, breakdowns and changeovers on production flow.
12. **Logistics and Inventory Management** — logistics subsystems and supply chain management, warehousing and order picking, RFID, inventory functions and costs, XYZ classification, reorder points, stock turnover and Kanban in pull production systems.
13. **Quality Management and Workplace Safety** — process mapping, the PDCA cycle, the Ishikawa diagram and other classical quality tools, ISO-based management systems and auditing, 5S, occupational risk assessment and collective protection measures.
14. **Economics and Sustainability** — resource allocation, factors of production, diminishing marginal productivity, GDP and economic growth, environmental externalities, the polluter-pays principle, environmental taxes and fees, valuation of ecosystem services and life-cycle costing.
15. **Business Management** — organisational structures, delegation and leadership styles, analysis of the business environment using PEST, SWOT and Porter's Five

Forces, fixed and variable costs, variable costing and break-even analysis, and industrial market segmentation, targeting and communication.