

SSC-JE

Junior Engineer
Mechanical Engineering

SOLUTIONS

Previous Paper

Preface

This book is an essential to all Mechanical Engineering (Diploma/Degree) students. It is very important to know the type of questions asked in previous years, its difficulty level and topics which are frequently asked in exam of SSC Junior Engineer (JE).

Real aspirants must practice these questions and resort to memorize the theoretical concepts, important formulae and facts of the topics. Every year few questions seems to be repeated directly or indirectly, so practice of these questions are beneficial.

This book is designed to provide in-depth knowledge and concise understandings to qualify JE/AE level examinations. It presents topic wise solutions in easy language with intend of error free and authentic solutions. This book is well stocked with detailed solutions in easy and illustrative manner, many alternate solutions are given for suitable problems to minimize the time and to develop skills to cross-check with short cuts / tricks.

Some of the PSU's and state governing organisations have been asking questions in their exams from SSC JE previous year's papers. So, practicing of this book is the need of day. This book will work out to be an indispensable tool for JE/AE aspirants.

Readers are requested to intimate any errors and any other useful suggestions to improve this work for the next edition.

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Syllabus: Mechanical Engineering

Theory of Machines and Machine Design

Concept of simple machine, Four bar linkage and link motion, Flywheels and fluctuation of energy, Power transmission by belts – V-belts and Flat belts, Clutches – Plate and Conical clutch, Gears – Type of gears, gear profile and gear ratio calculation, Governors – Principles and classification, Riveted joint, Cams, Bearings, Friction in collars and pivots.

Engineering Mechanics and Strength of Materials

Equilibrium of Forces, Law of motion, Friction, Concepts of stress and strain, Elastic limit and elastic constants, Bending moments and shear force diagram, Stress in composite bars, Torsion of circular shafts, Buckling of columns – Euler's and Rankin's theories, Thin walled pressure vessels

Thermal Engineering

Properties of Pure Substances : p-v & P-T diagrams of pure substance like H₂O, Introduction of steam table with respect to steam generation process; definition of saturation, wet & superheated status. Definition of dryness fraction of steam, degree of superheat of steam. h-s chart of steam (Mollier's Chart).

1st Law of Thermodynamics

Definition of stored energy & internal energy, 1st Law of Thermodynamics for cyclic process, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow; Steady State Steady Flow Energy Equation.

2nd Law of Thermodynamics

Definition of Sink, Source Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator; Thermal Efficiency of Heat Engines & co-efficient of performance of Refrigerators, Kelvin – Planck & Clausius Statements of 2nd Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius Integral, Entropy, Entropy change calculation for ideal gas processes. Carnot Cycle & Carnot Efficiency, PMM-2; definition & its impossibility.

Air standard Cycles for IC engines : Otto cycle; plot on P-V, T-S Planes; Thermal Efficiency, Diesel Cycle; Plot on P-V, T-S planes; Thermal efficiency.

IC Engine Performance, IC Engine Combustion, IC Engine Cooling & Lubrication.

Rankine cycle of steam

Simple Rankine cycle plot on P-V, T-S, h-s planes, Rankine cycle efficiency with & without pump work.

Boilers, Classification, Specification, Fittings & Accessories

Fire Tube & Water Tube Boilers.

Air Compressors & their cycles; Refrigeration cycles; Principle of a Refrigeration Plant; Nozzles & Steam Turbines

Fluid Mechanics & Machinery

Properties & Classification of Fluids

Ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids.

Fluid Statics : Pressure at a point.

Measurement of Fluid Pressure: Manometers, U-tube, Inclined tube.

Fluid Kinematics: Stream line, laminar & turbulent flow, external & internal flow, continuity equation.

Dynamics of ideal fluids: Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equation.

Measurement of Flow rate Basic Principles : Venturimeter, Pilot tube, Orifice meter.

Hydraulic Turbines: Classifications, Principles.

Centrifugal Pumps : Classifications, Principles, Performance.

Production Engineering

Classification of Steels : mild steel & alloy steel, Heat treatment of steel, Welding – Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques i.e. TIG, MIG, etc. (Brazing & Soldering), Welding Defects & Testing; NDT, Foundry & Casting – methods, defects, different casting processes, Forging, Extrusion, etc, Metal cutting principles, cutting tools, Basic Principles of machining with (i) Lathe (ii) Milling (iii) Drilling (iv) Shaping (v) Grinding, Machines, tools & manufacturing processes.

Contents

Questions arranged as per Topics below

1. THERMODYNAMICS

1. Basic Concepts of Thermodynamics
2. Forms of energy & Energy Interactions
3. First Law of Thermodynamics
4. Control volume Analysis
5. Second Law of Thermodynamics
6. Entropy analysis
7. Properties of Pure Substance

2. REFRIGERATION & AIR-CONDITIONING-RAC

1. Refrigerator and heat pump
2. Refrigeration cycles
3. Refrigerant and refrigeration equipments
4. Air conditioning and human comfort

3. POWER PLANT

1. Steam power Cycle
2. Thermal Power Plant Components
3. Steam Turbine
4. Gas Power Cycle
5. Air Compressors (Rotary & Reciprocating)
6. Compressible Flow

4. INTERNAL COMBUSTION ENGINE

1. Basics and Air Standard Cycles
2. Combustion and Knocking in SI & CI Engine
3. Fuels & Emissions
4. Testing and Performance of IC Engine
5. Fuel Injection, Ignition, Cooling and Lubrication

5. FLUID MECHANICS & FLUID MACHINERY

1. Fluid & ITS Properties
2. Fluid Pressure and its Measurement
3. Hydrostatic forces on surfaces
4. Buoyancy and Floatation
5. Fluid Kinematics
6. Fluid Dynamics
7. Flow Measurement
8. Flow through Pipes
9. Laminar flow through pipes
10. Turbulent flow through Pipes
11. Dimensional Analysis
12. Lift & Drag
13. Impulse of Jet & Hydraulic Turbines
14. Hydraulic pump

6. Engineering Mechanics

1. FBD, Equilibrium & System of Forces
2. Motion of Particles
3. Centroids & Moment of Inertia

4. Friction
5. Work & Energy
6. Impulse, Momentum & Collision

7. STRENGTH OF MATERIALS-SOM

1. Mechanical Properties of Material
2. Simple Stress & Strains
3. Elastic Constants
4. Shear Force & Bending Moment
5. Bending Stress in Beams
6. Shear Stress in Beams
7. Principle Stress strain and Mohr's Circle
8. Theories of Elastic Failure
9. Deflection of Beams
10. Torsion of shaft
11. Thick & Thin Pressure Vessels
12. Columns

8. MACHINE DESIGN

1. Bolted, Riveted & Welded Joint
2. Cutter and Knuckle Joint
3. Threads & Power screw
4. Keys and Couplings
5. Design against Fluctuating Loads
6. Belt, Rope & Chain Drives
7. Gears
8. Breaks & Clutches
9. Bearings
10. Theory of Spring

9. THEORY OF MACHINES-TOM

1. Mechanisms & Machines
2. Velocity and Acceleration Analysis
3. Gears and Gear Trains
4. Dynamic Force Analysis and Flywheel
5. Balancing
6. Cams
7. Governors
8. Vibration

10. Production Engineering

1. Machining & Machining Tools
2. Metal Cutting
3. Engineering Metrology & Instrumentation
4. Metal Forming
5. Casting
6. Welding
7. Material Science

11. Miscellaneous