SSC-JE 2025

STAFF SELECTION COMMISSION
[JUNIOR ENGINEER]

PRELIMINARY EXAMINATION

CIVIL ENGINEERING
PREVIOUS YEARS TOPICWISE OBJECTIVE
DETAILED SOLUTION WITH THEORY

2004-2024

IES MASTER PUBLICATION

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PREFACE

There is no better way to get into SSC-JE in an effortless manner than to get into the minds of the examiner/commission. And, the route to it is reverse engineering the previous years' questions while understanding the psychological requirements of learning. What if, in doing so, you not only memorise but also acquire the ability to project upon the probabilities of the upcoming exam.

As you dive into the revised and updated edition of the book '**IES Master Previous Year Topic-wise Objective Detailed Solutions with Theory**' carrying **55** previous years question paper sets, you will start feeling the pulse of the exam whereby which in turn will help you to develop the feel of subjects. The previous years' questions decoded in a Question-Answer format not only give you ample amount of relevant theory, but an extra theory along with reasoning for other given options.

So, what might appear to other students as disorder, randomness, and wide coverage, becomes order for you as you work through topic-wise solutions. While delving into the knowledge base, the numbers dance to your fingers, and the weights assigned to the subjects fit in like a jigsaw puzzle. From here on, you know what to read, where to read, and how to read.

This masterpiece from IES Master's Research & Development team ensures that your level of preparedness matches exactly to that required in the actual SSC-JE exam. Thus far, and no further, the book leaves no stone unturned in its easy-to-understand language, optimized with fonts and layout that your eyes will surely relish.

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HOW TO GET THE MOST OUT OF THIS BOOK

To get the most out of any book in the most effortless and effective manner, one needs to move ahead in a strategic manner rather than just wrestling with the content. How a book is read is the biggest determining factor in getting the most out of any book. Therefore, to help the readers of this book understand its value, we are going to present hereby a multi-step process that needs to be followed.

Before going into the details about the process, first of all let us understand the structure of this book's content. The book includes questions from previous year SSC-JE question papers. The questions are arranged in a topic-wise manner, and each question has a detailed solution followed by a crux theory related to that particular question's topic. A good amount of research has gone into preparing this crux theory as previous years' question papers of SSC-JE, State PSCs, and other engineering exams have been comprehensively analysed in a topic-wise manner. The crux theory has been prepared in such a comprehensive manner that the probability of questions coming in the forthcoming SSC-JE, State PSCs or other engineering exams from that particular topic becomes very high.

Now let's see how the worth of reading this book can be realised in an effective manner. To start with, one need to read in one go any particular topic-related question, its detailed solution, and the related crux theory. Memorise the crux theory of that topic before jumping on to the next topic question. As the questions in the book have been arranged in a topic-wise manner, memorising the theory along with detailed solution will facilitate covering any particular topic in the most efficient as well as effective manner.

Thus, by reading this book in such a selective and targeted manner, one will cover the entire exam syllabus well before time leaving no stone unturned.

Our main objective behind bringing out this book is that you as a reader benefit the most from reading it. Hope by implementing the above-discussed strategy, you achieve success in fulfilling your dream of clearing SSC-JE, State PSCs or other engineering exams.

All the best!!!

EXAM PATTERN

PAPERS	MODE OF EXAMINATION	SUBJECT	NUMBER OF QUESTIONS	MAXIMUM MARKS	DURATION & TIMINGS
Paper-I Objective Type	Computer Base Mode	(i) General Intelligence Reasoning	50	50	2 Hours
		(ii) General Awareness	50	50	Morning Shift
		(iii) General Engineering (Civil and Structural)	100	100	Evening Shift
Paper-II Conventional Type	Written Examination	General Engineering (Civil and Structural)		300	2 Hours

SYLLABUS

PAPER-I

General Intelligence & Reasoning

The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.

General Awareness

Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.

General Engineering

Civil and Structural

Theory of Structures, RCC Design, Steel Design, Building Materials and Concrete Technology, Estimating, Costing and Valuation, Environmental Engineering, Soil Mechanics, Hydraulics, Irrigation Engineering, Transportation Engineering and Surveying.

PAPER-II

Structural Engineering : Theory of structures: Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section.

RCC Design : RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining wall, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).

Steel Design : Steel design and construction of steel columns, beams roof trusses plate girders.

Building Materials : Physical and Chemical properties, classification, standard tests, uses and manufacture / quarrying of materials e.g. building stones, silicate based materials, cement (Portland), asbestos products, timber and wood based products, laminates, bituminous materials, paints, varnishes.

Concrete Technology : Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures.

Estimating, Costing and Valuation : Estimate, glossary of technical terms, analysis of rates, methods and unit of measurement, items of work – earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering, Boundary wall, Brick building, Water Tank, Septic Tank, Bar bending schedule, Centre line method, Mid-section formula, Trapezodial formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, Tube well, isolates and combined footings, Steel Truss, Piles and pilecaps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

Environmental Engineering : Quality of water, source of water supply, purification of water, distribution of water, need of sanitation, sewerage systems, circular sewer, oval sewer, sewer appurtenances, sewage treatments. Surface water drainage. Solid waste management – types, effects, engineered management system. Air pollution – pollutants, causes, effects, control. Noise pollution – cause, health effects, control.

Soil Mechanics : Origin of soil, phase diagram, Definitions-void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters. Grain size distribution curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.

Hydraulics : Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, flow through pipes, flow in open channels, weirs, flumes, spillways, pumps and turbines.

Irrigation Engineering : Definition, necessity, benefits, ill effects of irrigation, types and methods of irrigation, Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, types of canal irrigation, loss of water in canals. Canal lining – types and advantages. Shallow and deep to wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, causes and effects, methods of flood control, water logging, preventive measure. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

Transportation Engineering : Highway Engineering – cross sectional elements, geometric design, types of pavements, pavement materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage.

Railway Engineering : Components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards. Traffic Engineering – Different traffic survey, speed-flow-density and their inter-relationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.

Surveying : Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling. Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment.

ANALYSIS OF PREVIOUS YEARS QUESTIONS																		
SUBJECT/YEAR	2004	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2022	2023	2024
THEORY OF STRUCTURE	08	19	04	14	12	10	13	24	24	12	12	16	13	07	35	13	21	18	23
RCC DESIGN	08	12	25	10	18	15	12	10	12	08	11	11	11	10	45	16	32	33	43
STEEL DESIGN	09	10	14	11	09	12	10	11	04	10	13	07	06	06	26	13	27	20	8
BUILDING MATERIALS AND CONCRETE TECHNOLOGY	26	15	18	27	24	23	22	18	19	30	25	27	25	14	73	28	60	62	56
ESTIMATING, COSTING AND VALUATION	00	00	00	00	00	00	04	06	05	08	06	07	08	10	55	22	40	28	30
ENVIRONMENTAL ENGINEERING	13	12	13	08	07	08	06	04	05	03	03	03	02	08	41	17	32	36	47
SOIL MECHANICS	13	15	10	12	13	12	09	05	04	04	05	04	05	08	40	18	31	35	35
HYDRAULICS	14	10	10	09	08	10	07	09	10	11	10	10	15	09	46	19	37	43	42
IRRIGATION ENGINEERING	00	00	00	00	00	00	04	01	02	02	02	02	02	09	45	17	38	43	39
TRANSPORTATION ENGINEERING	00	00	02	00	01	02	07	02	03	02	04	03	03	07	43	17	41	31	40
SURVEYING	09	07	04	09	08	08	06	10	12	10	09	10	10	09	51	20	41	51	37

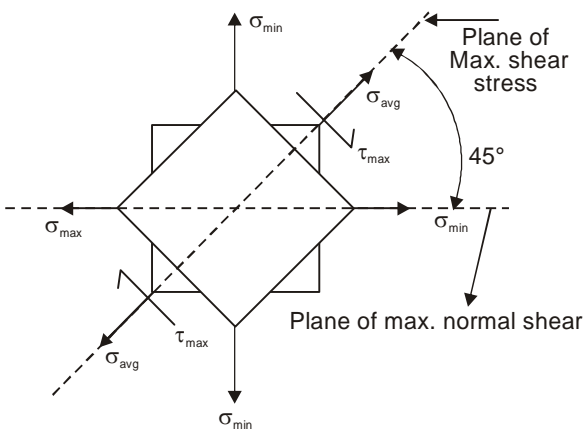## CONTENT

1. The plane carrying maximum shear stress are:

(a) Principal planes

(b) Inclined at 90° to those of principal planes

(c) Inclined at 45° to principal planes

(d) Parallel to principal planes

Sol–(c)
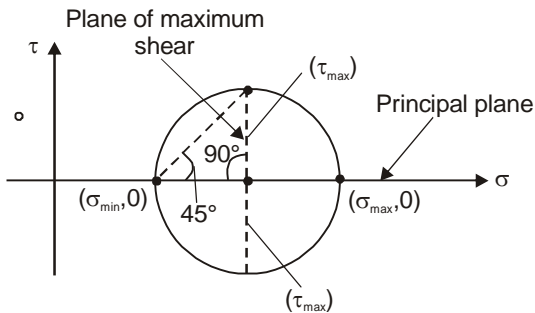
In mohr circle, plane of max. shear stress is inclined at 90° from principal planes.

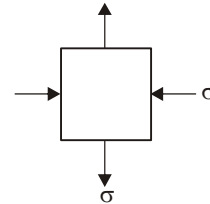∴ On an element, plane of max. shear stress is inclined at 45° from principal planes.

Small stress element

Here,

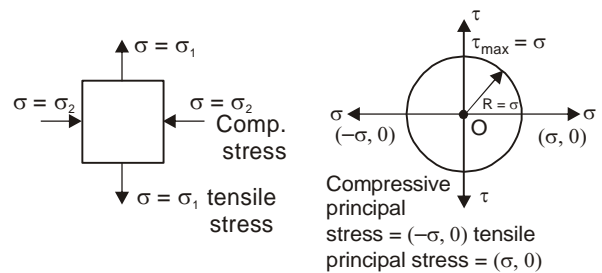$$\sigma_{avg} = \frac{\sigma_{max} + \sigma_{min}}{2}$$

2.

For such element only under normal stresses, the radius of Mohr circle is :

(a) σ (b) $\sigma/2$

(c) 2σ (d) 0.6σ

Sol–(a)

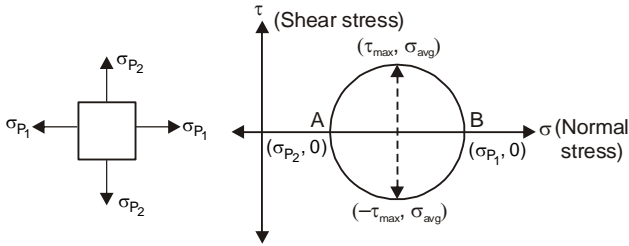∴ Radius of mohr circle = $\dfrac{\sigma_1 - \sigma_2}{2} = \dfrac{\sigma - (-\sigma)}{2} = \sigma$

$\tau_{max} = \sigma$

Centre = (0, 0)

3. In case of biaxial stress, the maximum value of shear stress is given by :

(a) Difference of the normal stresses

(b) Half the difference of the normal stresses

(c) Sum of the normal stresses

(d) Half the sum of the normal stresses

Sol–(b)

- *Max. value of shear stress = Radius of mohr circle.*

$$= \frac{\sigma_{p_1} - \sigma_{p_2}}{2}$$

- Half the difference of the normal stresses (σ_{P_1} and σ_{P_2} value should be put with sign).

4. **In a Mohr's circle of $\sigma - \tau$ plane (σ = normal stress, τ = shear stress), the vertical diameter represents:**

    (a) **Maximum shear stress**

    (b) **Maximum normal stress**

    (c) **Principal stress**

    (d) **Minimum normal stress**

Sol–(a)

Mohr's Circle
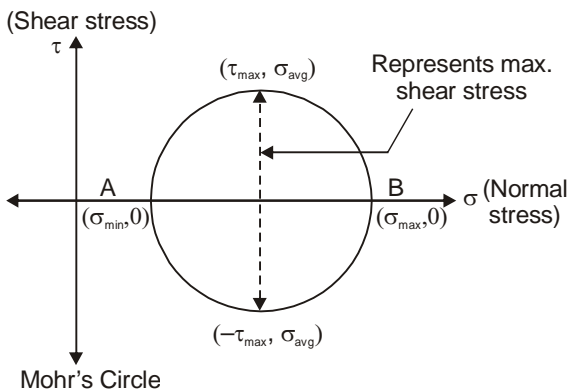
$$\boxed{\sigma_{avg} = \frac{\sigma_{max} + \sigma_{min}}{2}}$$

Note:

- Every point on circle represent a state of stress. At point at A & B shear stress are zero and normal stresses are max. and min.
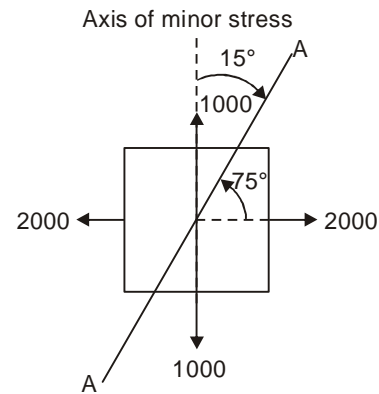
- The maximum & minimum normal stresses are called principal stresses.

5. **At a point in a strained material, if two mutually perpendicular tensile stresses of 2000 kg/cm^2 and 1000 kg/cm^2 are acting, then the intensity tensile stress on a plane inclined at 15° to the axis of the minor stress will be –**

    (a) **125 kg/cm^2**   (b) **250 kg/cm^2**

    (c) **500 kg/cm^2**   (d) **1000 kg/cm^2**

Sol–(d)

Normal stress are plane A–A

$$\boxed{\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta}$$

$$= \frac{2000 + 1000}{2} + \frac{2000 - 1000}{2}\cos(2 \times 75°) + 0$$

= 1066.98 kg/cm^2

Closest opton is (d)

6. **The ratio of tangential and normal components of a stress on an inclined plane through θ° to the direction of the force is __**

    (a) **$\sin\theta$**   (b) **$\cos\theta$**

    (c) **$\tan\theta$**   (d) **$\operatorname{cosec}\theta$**