



**MADE EASY**  
India's Best Institute for IES, GATE & PSUs

**ESE - 2016**

**Detailed Solutions of**  
**CIVIL ENGINEERING**  
**PAPER-I**

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# Director's Message

UPSC has introduced the sectional cutoffs of each paper and screening cut off in three objective papers (out of 600 marks). The conventional answer sheets of only those students will be evaluated who will qualify the screening cut offs.

In my opinion the General Ability Paper was easier than last year but Civil Engineering objective Paper-I and objective Paper-II both are little tougher/lengthier. Hence the cut off may be less than last year. The objective papers of ME and EE branches are average but E&T papers are easier than last year.

Expected Screening Cut offs out of 600 (ESE 2016)				
Branch	Gen	OBC	SC	ST
CE	225	210	160	150
ME	280	260	220	200
EE	310	290	260	230
E&T	335	320	290	260

**Note:** These are expected screening cut offs for ESE 2016. MADE EASY does not take guarantee if any variation is found in actual cutoffs.

**B. Singh (Ex. IES)**

CMD, MADE EASY Group

MADE EASY team has tried to provide the best possible/closest answers, however if you find any discrepancy then contest your answer at [www.madeeasy.in](http://www.madeeasy.in) or write your query/doubts to MADE EASY at: [info@madeeasy.in](mailto:info@madeeasy.in)

MADE EASY owes no responsibility for any kind of error due to data insufficiency/misprint/human errors etc.

**Paper-I (Civil Engineering)**

1. Consider the following statements:
1. There will be no defects in select grade timbers.
  2. The codal values for strength of grade-II timber without defects may be reduced by 37.5%.
  3. For timber used as columns, the permissible stress in ungraded timbers is adopted with a multiplying factor of 0.50.
  4. In case of wind force and earthquakes, a modification factor of 1.33 is adopted.

Which of the above statements are correct?

- (a) 1 and 3 only                                      (b) 1 and 4 only  
(c) 2 and 4 only                                      (d) 2 and 3 only

**Ans. (b)**

Select grade is grade-I timber which is of highest quality and has no defects. Hence 1 is correct.

As per IS 1331 : 1971, the codal values for strength of grade-II timber without defects may be reduced by 25%.

As per IS 883 : 1994, in case of wind force and earthquakes, a modification factor ( $K_s$ ) of 1.33 is adopted (refer table 5 IS 883 : 1994).

● ● ● **End of Solution**

2. Consider the following statements regarding timber:
1. The strength of timber increases by Kiln seasoning.
  2. Cutting of wood is to be done prior to treatment.
  3. Water seasoning is good for prevention of warping.
  4. ASCU treatment enhances the strength of wood.

Which of the above statements are correct?

- (a) 1, 2 and 3 only                                      (b) 2, 3 and 4 only  
(c) 1, 3 and 4 only                                      (d) 1, 2, 3 and 4

**Ans. (a)**

Application of AsCu solution increases the resistance of timber section against the action of white ants and doesn't alter the strength characteristics of timber.

● ● ● **End of Solution**

3. Gase(s) emitted during rotting or decomposition of timber is/are mainly
- (a) Methane and Hydrogen                                      (b) Hydrogen Sulphide  
(c) Carbonic acid and Hydrogen                                      (d) Ammonia

**Ans. (c)**

Rot in timber is decomposition or putrefaction, generally results due to dampness and which is followed by the emission of gases, mainly carbonic acid and hydrogen.

● ● ● **End of Solution**

4. Efflorescence of bricks is due to
- |                                 |                                          |
|---------------------------------|------------------------------------------|
| (a) Excessive burning of bricks | (b) High silt content in brick clay      |
| (c) High porosity of bricks     | (d) Soluble salts present in parent clay |

**Ans. (d)**

Efflorescence is a crystalline deposit on surfaces of masonry, concrete, bricks, etc. whitish in appearance. It is caused due to deposition of water soluble salts on their surfaces. There are many sources for these water soluble salts with some salts more soluble than others. The clay products like bricks generally show efflorescence when soluble salts are present in the parent clay. Most common salt present in clay is calcium sulphate.

● ● ● **End of Solution**

5. Disintegration of brick masonry walls is primarily due to
- |                             |                                 |
|-----------------------------|---------------------------------|
| 1. Efflorescence            | 2. Magnesium sulphate in bricks |
| 3. Calcined clay admixtures | 4. Kankar nodules               |
- Which of the above statements are correct ?
- |                     |                     |
|---------------------|---------------------|
| (a) 1, 2 and 3 only | (b) 1, 2 and 4 only |
| (c) 3 and 4 only    | (d) 1, 2, 3 and 4   |

**Ans. (b)**

Disintegration of bricks or brickworks is due to efflorescence which may be due to presence of Magnesium Sulphate in the brick, presence of impurities such as stones, kankar nodules, etc.

Calcined clay admixture in brick preparation is used to make the bricks fire resistant upto certain extent. The bricks prepared by this method retain their shape during subsequent drying and burning.

● ● ● **End of Solution**

6. Consider the following tests :
- |                             |                           |
|-----------------------------|---------------------------|
| 1. Transverse strength test | 2. Water absorption test  |
| 3. Impact test              | 4. Breaking strength test |
- Which of the above are relevant to testing of tiles?
- |                     |                     |
|---------------------|---------------------|
| (a) 1, 2 and 3 only | (b) 1, 2 and 4 only |
| (c) 3 and 4 only    | (d) 1, 2, 3 and 4   |

**Ans. (d)**

● ● ● **End of Solution**

7. Which of the following statements is/are correct regarding the strength of cement?
- |                                                                                        |
|----------------------------------------------------------------------------------------|
| 1. Particle sizes less than 3 $\mu\text{m}$ increase the viscous nature of the cement. |
| 2. Finer particles in cement can be replaced by fly-ash to improve the strength.       |
- |                  |                     |
|------------------|---------------------|
| (a) 1 only       | (b) 2 only          |
| (c) Both 1 and 2 | (d) Neither 1 nor 2 |

**Ans. (\*)**

Statement 1 is vague whereas statement 2 is correct.

● ● ● **End of Solution**

8. The constituent compound in Portland cement which reacts immediately with water, and also sets earliest, is
- (a) Tricalcium silicate (b) Dicalcium silicate  
(c) Tricalcium aluminate (d) Tetracalcium aluminoferrite

**Ans. (c)**

Tricalcium aluminate ( $C_3A$ ) hydrates and hardens the quickest. It liberates a large amount of heat almost instantaneously and contributes somewhat to early strength.

● ● ● **End of Solution**

9. Which of the following statements are correct with regard to cement mortar?
1. Workability of cement mortar can be improved by addition of lime.
  2. Fly-ash cement is economical in plastering jobs.
  3. Addition of saw dust improves workability.
  4. Sand in mortar can be replaced by finely crushed fire bricks.
- (a) 1, 2, 3 and 4 (b) 1, 2 and 3 only  
(c) 3 and 4 only (d) 1, 2 and 4 only

**Ans. (d)**

Saw Dust is a suitable material for use as a pozzolanic material since it satisfies the requirement for such a material by having a combined  $SiO_2 + Al_2O_3 + Fe_2O_3$  of more than 70%.

Concrete becomes less workable as the Saw Dust percentage increases meaning that more water is required to make the mix more workable. This implies Saw Dust addition increases water demand for same workability.

● ● ● **End of Solution**

10. In a concrete mix of proportion 1 : 3 : 6, the actual quantity of sand, which is judged to have undergone 15% bulking, per unit volume of cement, will be
- (a) 3.00 (b) 3.45  
(c) 4.50 (d) 6.00

**Ans. (b)**

● ● ● **End of Solution**

11. The Rheological behaviour of concrete, when represented by shear stress vs rate of shear, is characterized as

(a)  $\tau = \tau_0 + \mu \cdot \dot{\gamma}$  (b)  $\tau_0 = \tau + \mu \cdot \dot{\gamma}$   
(c)  $\frac{\tau}{\tau_0} = \mu \cdot \dot{\gamma}$  (d)  $\tau = \mu \cdot \dot{\gamma}$

where :  $\tau$  = shear stress,  
 $\tau_0$  = (initial) yield value  
 $\mu$  = at-point plastic viscosity,  
 $\dot{\gamma}$  = at-point rate of shear.

**Ans. (a)**

Concrete, as a fluid, is most often assumed to behave like a Bingham Fluid. In this case, its flow is defined by two parameters, yield stress and plastic viscosity. The Bingham equation is  $\tau = \tau_0 + \mu \dot{\gamma}$ .

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• • • **End of Solution**

12. Which method of curing of concrete is recommendable for rapid gain of strength of concrete?

- (a) Sprinkling water                                                  (b) Membrane curing  
(c) High-pressure steam curing                                          (d) Infrared radiation curing

**Ans. (c)**

High pressure steam curing, also called as accelerated curing is the method by which high early strength is achieved in concrete. This is specially useful in prefabricated works wherein high early age strength enables the early removal of formwork resulting in a economy and rapid construction.

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• • • **End of Solution**

13. Which of the following is appropriate as a simple field method for assessing consistency of concrete?

- (a) Compacting factor                                                  (b) Slump test  
(c) Vee-Bee test                                                                  (d) Kelly Ball test

**Ans. (d)**

Kelly Ball Test is the simplest field method adopted for accessing consistency of concrete though it is not specified in Indian Standards.

Slump cone test is most commonly adopted test for assessing consistency.

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• • • **End of Solution**

14. Which of the following are relatable to Autoclaved Aerated Concrete?

- |                     |                     |
|---------------------|---------------------|
| 1. Light weight     | 2. Strong           |
| 3. Inorganic        | 4. Non-toxic        |
| (a) 1, 2 and 3 only | (b) 1, 2 and 4 only |
| (c) 3 and 4 only    | (d) 1, 2, 3 and 4   |

**Ans. (d)**

Autoclaved Aerated Concrete, also known as Autoclaved Cellular Concrete (ACC) or cellular concrete is a lightweight, strong, precast, inorganic and non-toxic concrete. The lightweight is attributed to the porous nature due to air entrainment.

**Advantages:**

1. Improved thermal efficiency thereby reducing the heating and cooling load in buildings.
2. Porous structure allows for superior fire resistance.
3. Lightweight saves cost and energy in transportation, labour expenses.



# MADE EASY

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## Roadmap for ESE 2017 Prelims

## Paper-I General Studies & Engineering Aptitude

“MADE EASY offers well planned Classroom and Postal Study Course which is designed by senior and expert faculty members. MADE EASY announces exclusive batches for General Studies and Engineering Aptitude to cover the syllabus of Paper-I of Preliminary exam. The classes will be conducted by experienced faculties of MADE EASY focusing on new pattern of Engineering Services Examination, 2017. Latest and updated study material with effective presentation will be provided to score well in Paper-I.”

### Paper-I : General Studies & Engineering Aptitude

#### Course content

- 1. Current Affairs:** Current National and International issues, bilateral issues, current economic affairs, Defence, Science and Technology, Current Government Schemes, Persons in news, Awards & honours, current environment & wildlife, current sports, books & authors etc.
- 2. Reasoning and Aptitude :** Algebra and Geometry, Reasoning and Data Interpretation, Arithmetic, coding and decoding, Venn diagram, number system, ratio & proportion, percentage, profit & loss, simple interest & compound interest, time & work, time & distance, blood relationship, direction sense test, permutation & combinations etc.
- 3. Engineering Mathematics :** Differential equations, complex functions, calculus, linear algebra, numerical methods, Laplace transforms, Fourier series, Linear partial differential equations, probability and statistics etc.



**Scroll down**  
For Answer Key of ESE-2016

- 4. General Principles of Design, Drawing, Importance of Safety :** Engineering Drawing, Drawing instruments, drawing standard, geometric construction and curves, orthographic projections, methods of projection, profile planes side views, projection of points, projection of straight lines, positions of a straight line with respect to HP and VP, determining true length and true inclinations of a straight line, rotation methods, trace of a line, projection of planes, importance of safety etc.
- 5. Standards and quality practices in production, construction, maintenance and services:** ISO Standards, ISO-9000 Quality Management, ISO-14000 other, BIS Codes, ECBC, IS, TQM ME, TPM, PDCA, PDSA, Six Sigma, 5S System, 7 Quality Control Tools , ISHIKAWAS -7QC Tools, Kaizer Tools-3m, TQM : Most Importance, Deming's: 14 Principles, Lean Manufacturing ME, Quality Circles, Quality Control, Sampling.
- 6. Basics of Energy and Environment:** Renewable and non renewable energy resources, energy conservation, ecology, biodiversity, environmental degradation, environmental pollution, climate change, conventions on climate change, evidences of climate change, global warming, greenhouse gases, environmental laws for controlling pollution, ozone depletion, acid rain, biomagnification, carbon credit, environment impact assessment (EIA), benefits of EIA etc.
- 7. Basics of Project Management:** Project characteristics and types, Project appraisal and project cost estimations, project organization, project evaluation and post project evaluation, risk analysis, project financing and financial appraisal, project cost control etc.
- 8. Basics of Material Science and Engineering:** Introduction of material science, classification of materials, Chemical bonding, electronic materials, insulators, polar molecules, semi conductor materials, photo conductors, classification of magnetic materials, ceramics, polymers, ferrous and non ferrous metals, crystallography, cubic crystal structures, miller indices, crystal imperfections, hexagonal closed packing, dielectrics, hall effect, thermistors, plastics, thermoplastic materials, thermosetting materials, compounding materials, fracture, cast iron, wrought iron, steel, special alloys steels, aluminum, copper, titanium, tungsten etc.
- 9. Information and Communication Technologies :** Introduction to ICT, Components of ICT, Concept of System Software, Application of computer, origin and development of ICT, virtual classroom, digital libraries, multimedia systems, e-learning, e-governance, network topologies, ICT in networking, history and development of internet, electronic mail, GPS navigation system, smart classes, meaning of cloud computing, cloud computing architecture, need of ICT in education, national mission on education through ICT, EDUSAT (Education satellite), network configuration of EDUSAT, uses of EDUSAT, wireless transmission, fibre optic cable etc.
- 10. Ethics and values in engineering profession:** ethics for engineers, Ethical dilemma, elements of ethical dilemmas, indian ethics, ethics and sustainability, ethical theories, environmental ethics, human values, safety, risks, accidents, human progress, professional codes, responsibilities of engineers etc.



## Classroom Course : Paper -1

### Course Details : General Studies and Engineering Aptitude Batches

**Course Duration :** Regular batches : 2 months | Weekend batches : 3 months

**Teaching Hours :** 250-300 hours

**Timings :** Regular batches : 6-7 days a week and 4 hours a day. | Weekend batches : 8 hours everyday on Sat & Sun.

**Study material :** Well designed comprehensive study material including theory & Practice questions prepared by experienced faculty members will be provided

#### Batch Commencement

	Batch	Commencement Date	Venue	Timing
<b>Classroom Course</b>	Regular Batch	23rd June, 2016	Saket / Lado Sarai (Delhi)	7:30 a.m. to 11:30 a.m.
	Weekend Batch	2nd July, 2016	Saket / Lado Sarai (Delhi)	8:00 a.m. to 6:00 p.m.
	Regular Batch	1st July, 2016	MADE EASY Hyderabad	Evening Batch

**Note :** General Studies and Engineering Aptitude Batches will be commenced at all MADE EASY centres.  
For latest updates and information keep visit: [www.madeeasy.in](http://www.madeeasy.in)

#### Postal Course

Postal Study Course for GS & Engineering Aptitude Paper-I will be available after 15<sup>th</sup>-July-2016  
Buy online at : [www.madeeasy.in](http://www.madeeasy.in)

#### Fee Structure

Non-MADE EASY Students	Ex. MADE EASY Students	
	Those students who were enrolled in Postal Study Course, Rank Improvement, Conventional, G.S., Post GATE batches	Those students who were enrolled in long term classroom programs
Rs. 18,500/-	Rs. 15,500/-	Rs.12,500/-

## Newly added technical subjects for ESE-2017

Interested students may join subjectwise classes for newly added technical subjects for ESE-2017

CE	ME	EE	E&T
—	1. Mechatronics & Robotics 2. Renewable Source of Energy	1. Signals & Systems 2. Computer Fundamentals	1. Advanced Electronics 2. Basics of Electrical Engineering 3. Advanced Communication

#### Fee Structure

Non-MADE EASY Students	Ex. MADE EASY Students
Rs. 6,500/- per subject	Rs.4,500/- per subject

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4. There are no toxic gases or other toxic substances in ACC. Therefore it does not attract rodents or other pests nor can it be damaged by such.
5. The life of this material is extended because it is not affected by harsh climates or extreme changes in weather conditions. It will not degrade under climate changes.

● ● ● **End of Solution**

15. The workability of concrete becomes more reliable depending on
1. Aggregate-cement ratio
  2. Time of transit
  3. Grading of the aggregate
- (a) 1 only (b) 2 only  
(c) 3 only (d) 1, 2 and 3

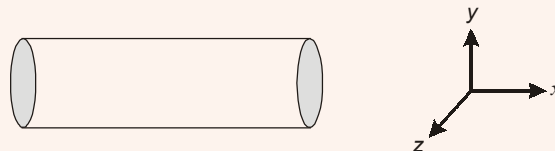
**Ans. (d)**

As aggregate to cement ratio increases, the harsh mix is formed. As time of transit increases, workability reduces. Workability in a well graded aggregate will be greater as compared to poorly or uniformly graded aggregate.

● ● ● **End of Solution**

16. The longitudinal strain of a cylindrical bar of 25 mm diameter and 1.5 m length is found to be 3 times its lateral strain in a tensile test. What is the value of Bulk Modulus by assuming  $E = 1 \times 10^5 \text{ N/mm}^2$ ?
- (a)  $2 \times 10^5 \text{ N/mm}^2$  (b)  $1.1 \times 10^5 \text{ N/mm}^2$   
(c)  $1 \times 10^5 \text{ N/mm}^2$  (d)  $1 \times 10^5 \text{ N/mm}^2$

**Ans. (c)**



$$\epsilon_x = 3\epsilon_y$$

$$\therefore \frac{\epsilon_y}{\epsilon_x} = \frac{1}{3} = \mu$$

Now,  $E = 3k(1 - 2\mu)$

$$k = \frac{E}{3(1-2\mu)} = 1 \times 10^5 \text{ N/mm}^2$$

● ● ● **End of Solution**

17. For an elastic material, Poisson's ratio is  $\mu$ , Modulus of Elasticity is  $E$ , Modulus of Rigidity is  $C$  and Bulk Modulus is  $K$ .  $\mu$  is expressible in terms of  $K$  and  $C$  as

(a)  $\frac{6K - 2C}{3K - 2C}$

(b)  $\frac{6K + 2C}{3K - 2C}$

(c)  $\frac{3K - 2C}{6K + 2C}$

(d)  $\frac{3K + 2C}{6K + 2C}$

Ans. (c)

$$\mu = \frac{3K - 2C}{6K + 2C}$$

● ● ● End of Solution

18. A mild steel bar of length 450 mm tapers uniformly. The diameters at the ends are 36 mm and 18 mm, respectively. An axial load of 12 kN is applied on the bar.  $E = 2 \times 10^5$  N/mm<sup>2</sup>. The elongation of the bar will be

(a)  $\frac{1}{3\pi}$  mm

(b)  $\frac{1}{6\pi}$  mm

(c)  $\frac{3\pi}{2}$  mm

(d)  $\frac{2}{3\pi}$  mm

Ans. (b)

Elongation, 
$$\Delta = \frac{4PL}{\pi d_1 d_2 E} = \frac{4 \times 12 \times 10^3 \times 450}{\pi \times 36 \times 18 \times 2 \times 10^5} = \frac{1}{6\pi} \text{ mm}$$

● ● ● End of Solution

19. Which of the following statements are correct for stresses acting on mutually perpendicular faces of a plane element?

- The sum of the normal stresses in mutually perpendicular planes is equal to the sum of the principal stresses.
- The shearing stresses in two mutually perpendicular planes are equal in magnitude and direction.
- Maximum shear stress is half of the difference between principal stresses.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

Ans. (d)

- The sum of normal stress on mutually perpendicular planes on any oblique plane remains constant.
- The shearing stress on two mutually perpendicular plane is same magnitude but opposite in sense of rotation.

- Maximum shear stress,  $\tau_{\max} = \frac{\sigma_1 - \sigma_2}{2}$

● ● ● End of Solution

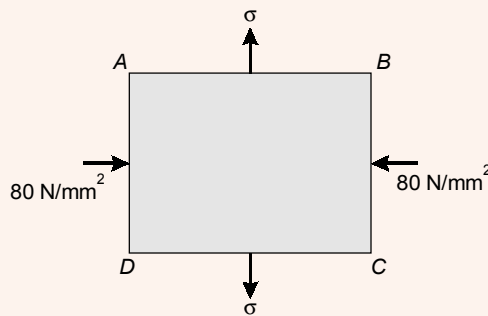
20. Which of the following statements are correct?
1. Strain in the direction of applied stress is known as longitudinal strain.
  2. Tensile stress results in tensile strain in linear and lateral directions.
  3. Strains in all directions perpendicular to the applied stress are known as lateral strain.
  4. Ratio of change in volume to original volume is known as volumetric strain.
- (a) 1, 2 and 3 only                      (b) 1, 3 and 4 only  
(c) 3 and 4 only                         (d) 1, 2, 3 and 4

**Ans. (b)**

- Longitudinal direction is that direction in which force or stress is acting.
- Due to tensile stress, longitudinal strain will be tensile but the lateral strain will be compressive.

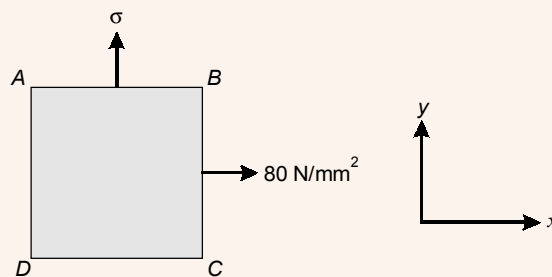
• • • **End of Solution**

21. The state of stress on an element is as shown in the figure. If  $E = 2 \times 10^5 \text{ N/mm}^2$  and Poisson's ratio = 0.3, the magnitude of the stress  $\sigma$  for no strain in BC is



- (a)  $84 \text{ N/mm}^2$                               (b)  $64 \text{ N/mm}^2$   
(c)  $34 \text{ N/mm}^2$                               (d)  $24 \text{ N/mm}^2$

**Ans. (d)**



Strain in BC,

$$\epsilon_y = \frac{\sigma_y}{E} - \mu \frac{\sigma_x}{E}$$

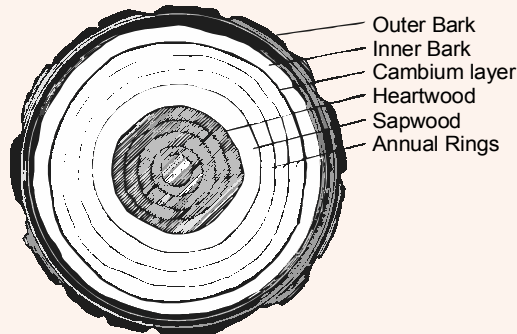
$$0 = \frac{\sigma}{E} - \frac{0.3 \times 80}{E}$$

$\therefore$   $\sigma = 24 \text{ N/mm}^2$

• • • **End of Solution**

22. In the cross-section of a timber, cambium layer can occur in
- (a) Inner Bark and Sap Wood                      (b) Pith and Heart Wood  
(c) Sap Wood and Heart Wood                  (d) Outer Bark and Sap Wood

Ans. (a)



● ● ● End of Solution

23. Consider the following statements :
1. In the infinitesimal strain theory, dilatation is taken as an invariant.
  2. Dilatation is not proportional to the algebraic sum of all normal stresses.
  3. The shearing modulus is always less than the elastic modulus.

Which of the above statements is/are correct ?

- (a) 1 only                                              (b) 1 and 2 only  
(c) 2 only                                              (d) 1, 2 and 3

Ans. (a)

Dilation (Volumetric change)

$$\epsilon_v = \frac{\sigma_x + \sigma_y + \sigma_z}{E} (1 - 2\mu)$$

Hence directly proportional to sum of all normal stress.

Shearing modulus,  $G < E$  if  $\mu > -0.5$

$G > E$ , if  $\mu < -0.5$

● ● ● End of Solution

24. Which one of the following represents 'constitutive relationship'?
- (a) Vertical displacements in a structure  
(b) Rotational displacements in a structure  
(c) System of forces in equilibrium  
(d) Stress-strain behaviour of a material

Ans. (d)

Constitutive relation is a relation between two physical quantities that is specific to a material or substance. Hooke's law is a constitutive law because it shows the relation between stress-strain behaviour.

● ● ● End of Solution

# Rank Improvement Batches



**MADE EASY**  
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“MADE EASY offers rank improvement batches for ESE 2017 & GATE 2017. These batches are designed for repeater students who have already taken regular classroom coaching or prepared themselves and already attempted GATE/ESE Exams, but want to give next attempt for better result. The content of Rank Improvement Batch is designed to give exposure for solving different types of questions within fixed time frame. The selection of questions will be such that the Ex. MADE EASY students are best benefitted by new set of questions.”

## Features :

- Comprehensive problem solving sessions
- Smart techniques to solve problems
- Techniques to improve accuracy & speed
- Systematic & cyclic revision of all subjects
- Doubt clearing sessions
- Weekly class tests
- Interview Guidance

## Eligibility :

- Old students who have undergone classroom course from any centre of MADE EASY or any other Institute
- Top 6000 rank in GATE Exam
- Qualified in ESE written exam
- Qualified in any PSU written exam
- M. Tech from IIT/NIT/DTU with minimum 7.0 CGPA

**Syllabus Covered :** Technical Syllabus of GATE-2017 & ESE-2017

**Course Duration :** Approximately 25 weeks (400 teaching hours)

Streams	Batch Type	Timing	Date	Venue
CE, ME	Weekend	Sat & Sun : 8:00 a.m to 5:00 p.m	2 <sup>nd</sup> July, 2016	Saket (Delhi)
EC, EE	Weekend	Sat & Sun : 8:00 a.m to 5:00 p.m	2 <sup>nd</sup> July, 2016	Lado Sarai (Delhi)
ME	Regular	8:00 a.m to 11:30 a.m (Mon-Fri)	4 <sup>th</sup> July, 2016	Saket (Delhi)

## Fee Structure

Batch	Non-MADE EASY Students	Ex. MADE EASY Students	
		Those students who were enrolled in Postal Study Course, Rank Improvement, Conventional, G.S, Post GATE batches	Those students who were enrolled in long term classroom programs only
Rank Improvement Batch	Rs. 26,500/-	Rs. 24,500/-	Rs. 22,500/-
Rank Improvement Batch + General Studies & Engineering Aptitude Batch	Rs. 41,500/-	Rs. 36,500/-	Rs. 31,500/-

**Fee is inclusive of classes, study material and taxes**

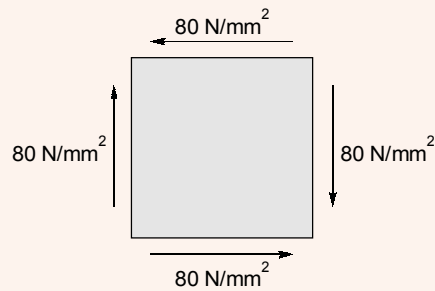
- Note:
1. These batches will be focusing on solving problems and doubt clearing sessions. Therefore if a student is weak in basic concepts & fundamentals then he/she is recommended to join regular classroom course.
  2. Looking at the importance and requirements of repeater students, it is decided that the technical subjects which are newly added in ESE 2017 syllabus over ESE 2016 syllabus will be taught from basics and comprehensively.
  3. The course fee is designed without Study Material/Books, General Studies and Online Test Series (OTS). However those subjects of technical syllabus which are added in ESE-2017 will be supplemented by study material. Study Material/ Books will be provided only for the technical syllabus which are newly added in ESE-2017.

**Rank Improvement Batches will be conducted at Delhi Centre only.**

**ADMISSIONS OPEN**

**Documents required :** M.Tech marksheet, PSUs/IES Interview call letter, GATE score card, MADE EASY I-card • 2 photos + ID proof





- (a) 2 and 2  
(c) 3 and 3
- (b) 2.5 and 2.5  
(d) 4 and 4

**Ans. (c)**

For pure shear

$$\sigma_1 = \tau = 80 \text{ N/mm}^2$$

$$\sigma_2 = -\tau = -80 \text{ N/mm}^2$$

$$\sigma_y = \pm 240 \text{ N/mm}^2$$

According to maximum normal shear theory

In tension,  $\sigma_1 \leq \frac{\sigma_y}{\text{FOS}}$

$\therefore \text{FOS} = 3$

In compression,  $\sigma_2 \leq -\frac{\sigma_y}{\text{FOS}}$

$\therefore \text{FOS} = 3$

● ● ● End of Solution

27. Principal stresses at a point are  $80 \text{ N/mm}^2$  and  $40 \text{ N/mm}^2$ , both tensile. The yield stress in simple tension for this material is  $200 \text{ N/mm}^2$ . The values of factors of safety according to maximum principal stress theory and maximum shear stress theory, respectively, are
- (a) 2.5 and 2.5  
(c) 5 and 5
- (b) 2.5 and 5  
(d) 5 and 1.67

**Ans. (a)**

$$\sigma_1 = 80 \text{ N/mm}^2$$

$$\sigma_2 = 40 \text{ N/mm}^2$$

$$\sigma_3 = 0$$

According to maximum principal stress theory,

$$\sigma_1 \leq \frac{\sigma_y}{\text{FOS}}$$

$$\text{FOS} = \frac{200}{80} = 2.5$$



According to maximum shear stress theory

$$\tau_{\max, \text{ absolute}} \leq \frac{\sigma_y}{2 \times \text{FOS}}$$

$$\therefore \frac{\sigma_1 - \sigma_3}{2} \leq \frac{\sigma_y}{2 \times \text{FOS}}$$

$$\therefore \text{FOS} = 2.5$$

● ● ● End of Solution

28. The principal stresses at a point are  $2\sigma$  (tensile) and  $\sigma$  (compressive), and the stress at elastic limit for the material in simple tension is  $210 \text{ N/mm}^2$ . According to maximum shear strain theory, the value of  $\sigma$  at failure is
- (a)  $70 \text{ N/mm}^2$  (b)  $105 \text{ N/mm}^2$   
(c)  $140 \text{ N/mm}^2$  (d)  $210 \text{ N/mm}^2$

**Ans. (a)**

There is no theory like maximum shear strain theory. However if we use maximum shear stress theory.

$$\tau_{\max, \text{ absolute}} \leq \frac{\sigma_y}{2 \times \text{FOS}}$$

Here,

$$\sigma_1 = 2\sigma$$

$$\sigma_2 = -\sigma$$

$$\sigma_3 = 0$$

$$\therefore \tau_{\max, \text{ absolute}} = \frac{\sigma_1 - \sigma_2}{2} = 1.5\sigma$$

$$\therefore 1.5\sigma \leq \frac{210}{2 \times \text{FOS}}$$

$$\therefore \sigma = \frac{210}{1.5 \times 2} \quad [\text{FOS} = 1]$$

$$= 70 \text{ N/mm}^2$$

● ● ● End of Solution

29. A thin steel ruler having its cross-section of  $0.0625 \text{ cm} \times 2.5 \text{ cm}$  is bent by couples applied at its ends so that its length  $l$  equal to  $25 \text{ cm}$ , when bent, as a circular arc, subtends a central angle  $\theta = 60^\circ$ . Take  $E = 2 \times 10^6 \text{ kg/cm}^2$ . The maximum stress induced in the ruler and the magnitude is
- (a)  $2618 \text{ kg/cm}^2$  (b)  $2512 \text{ kg/cm}^2$   
(c)  $2406 \text{ kg/cm}^2$  (d)  $2301 \text{ kg/cm}^2$



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For

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(On revised syllabus of ESE-2017 & GATE-2017)



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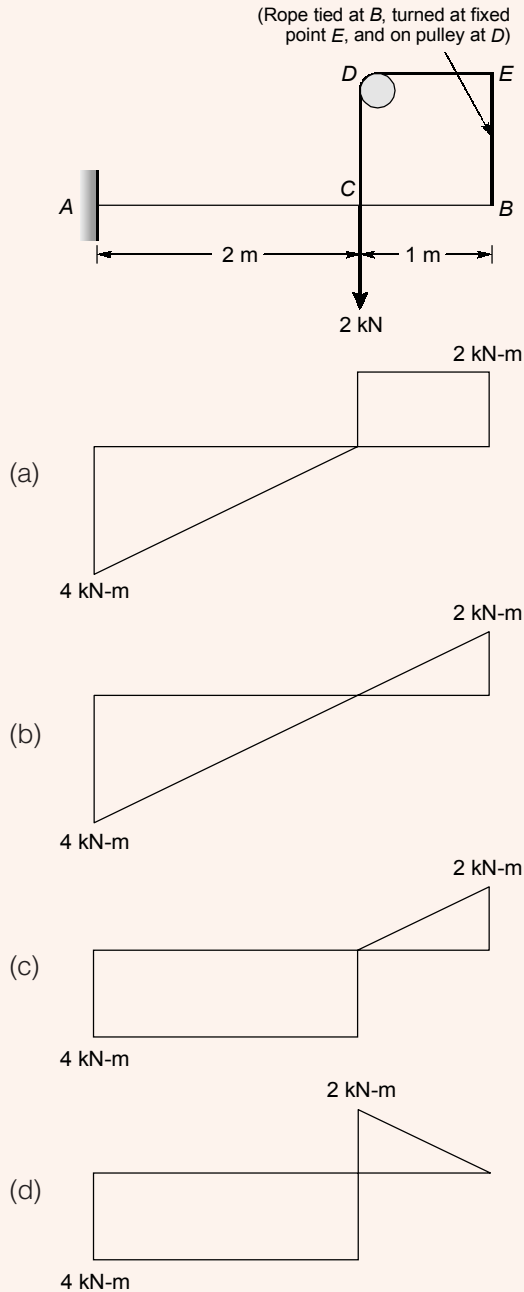


$$(3 \times 3) + (3) + (-M_A) = 0$$

$$M_A = 12 \text{ kN-m}$$

• • • End of Solution

35. The bending moment diagram for the beam shown below is



Ans. (\*)

Data given is vague and under the condition of data mentioned none of the option is correct.

• • • End of Solution

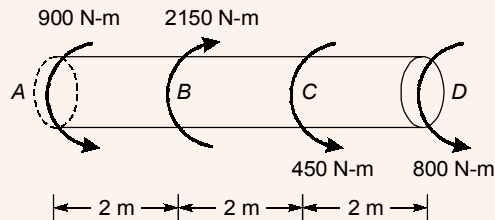
36. A circular shaft rotates at 200 rpm and is subject to a torque of 1500 Nm. The power transmitted would be
- (a)  $10 \pi$  kW (b)  $15 \pi$  kW  
(c)  $20 \pi$  kW (d)  $30 \pi$  kW

Ans. (a)

$$\begin{aligned}
 P &= T \times \omega \\
 &= 1500 \times 2\pi \times \frac{200}{60} \\
 &= 10\pi \text{ kW}
 \end{aligned}$$

• • • End of Solution

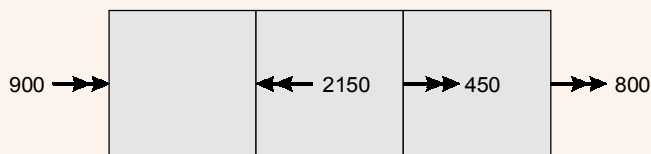
37. Torques are transmitted to the solid circular shaft as shown in the figure below. If the corresponding permissible stress in the shaft is  $60 \text{ N/mm}^2$ , the diameter of the shaft is nearly



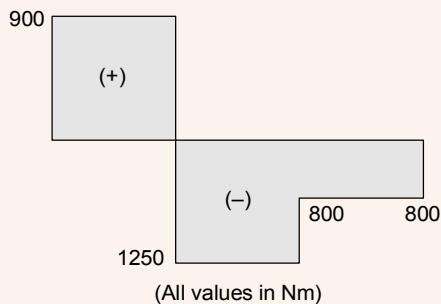
- (a) 57.3 mm (b) 47.5 mm  
(c) 37.3 mm (d) 27.3 mm

Ans. (b)

**Applied Torque**



**Torsional moment diagram**



$$\tau_{\max} = \frac{16T_{\max}}{\pi d^3}$$



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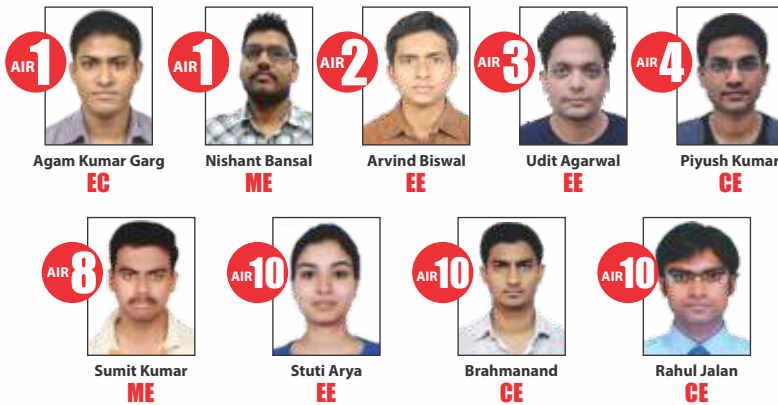
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**Note: 1.** Final year or Pass out engineering students are eligible.

**2.** Candidate should bring original documents at the time of admission. (Mark sheet, GATE Score card, ESE/PSUs Selection Proof, 2 Photographs & ID Proof).

**3.** Admissions in Super Talent Batch is subjected to verification of above mentioned documents.



$$60 = \frac{16 \times (1250 \times 10^3)}{\pi d^3}$$

$$d = 47.5 \text{ mm}$$

• • • End of Solution

38. A solid circular shaft has a diameter  $d$ . Its polar modulus will be

- (a)  $\frac{\pi}{16}d^2$  (b)  $\frac{\pi}{64}d^3$   
(c)  $\frac{\pi}{16}d^3$  (d)  $\frac{\pi}{32}d^2$

Ans. (c)

$$\text{Polar modulus} = \frac{I_z}{r} = \frac{\pi/32d^4}{d/2} = \frac{\pi}{16}d^3$$

• • • End of Solution

39. A hollow steel shaft has outside diameter  $d$  and inside diameter  $\frac{d}{2}$ . The value of  $d$  for the shaft, if it has to transmit 200 hp at 105 rpm with a working shear stress of 420 kg/cm<sup>2</sup>, is

- (a) 5.6 cm (b) 2.6 cm  
(c) 12.1 cm (d) 15.5 cm

Ans. (c)

$$P = 200 \text{ hp} = 149.14 \text{ kW}$$

$$\text{Power, } P = \frac{2\pi NT}{60}$$

$$\therefore T = 13.563 \text{ kNm}$$

For hollow cross-section

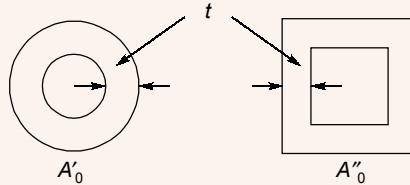
$$\tau_{\max} = \frac{16T}{\pi d_0^3 \left[ 1 - \left( \frac{d_i}{d_0} \right)^4 \right]}$$

$$420 \times 9.81 \times 10^4 = \frac{16 \times 13563}{\pi d^3 \left[ 1 - \left( \frac{1}{2} \right)^4 \right]}$$

$$\therefore d = 0.121 \text{ m} = 12.1 \text{ cm}$$

• • • End of Solution

40. Two thin-walled tubular members made of the same material have the same length, same wall thickness and same total weight and are both subjected to the same torque of magnitude  $T$ . If the individual cross-section are circular and square, respectively, as in the figures, then the ratios of the shear stresses reckoned for the circular member in relation to the square member will be



- (a) 0.785  
(b) 0.905  
(c) 0.616  
(d) 0.513

Ans. (a)

For tubular cross-section

$$\tau_{\max} = \frac{T}{2A_m t}$$

$A_m$  = Cross-sectional area under mean line.

$$\therefore \frac{\tau_{\max_c}}{\tau_{\max_s}} = \frac{A_{m_s}}{A_{m_c}}$$

Since weight is same for both tubes

$$\therefore A_c = A_s$$

$$\frac{\pi}{4} [d_0^2 - d_i^2] = b_0^2 - b_i^2$$

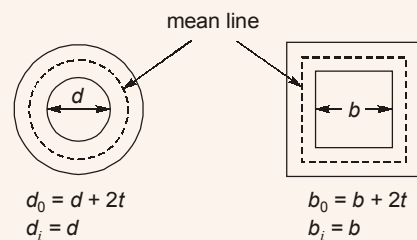
$$\frac{\pi}{4} [(d+2t)^2 - d^2] = (b+2t)^2 - b^2$$

$$\frac{\pi}{4} [d^2 + 4t^2 + 4td - d^2] = b^2 + 4t^2 + 4tb - b^2$$

$$\frac{\pi}{4} \cdot 4t(t+d) = 4t(t+b)$$

$$\therefore \frac{t+b}{t+d} = \frac{\pi}{4}$$

$$\therefore \frac{A_{m_s}}{A_{m_c}} = \frac{(t+b)^2}{\frac{\pi}{4}(d+t)^2} = \frac{\pi}{4} = 0.7853$$



• • • End of Solution

41. In the analysis of beams subjected to loads, the point with Nil Bending Moment can be a
1. Point of Contraflexure
  2. Point of Maximum Shear Force
  3. Point of Inflection
- Which of the above statements is/are correct?
- (a) 1 only (b) only  
(c) 3 only (d) 1, 2 and 3

**Ans. (a)**

Point of Contraflexure: Point where BMD changes sign.

Point of inflection: Point of curve (on deflected shape) changes being concave to convex or vice versa.

• • • End of Solution

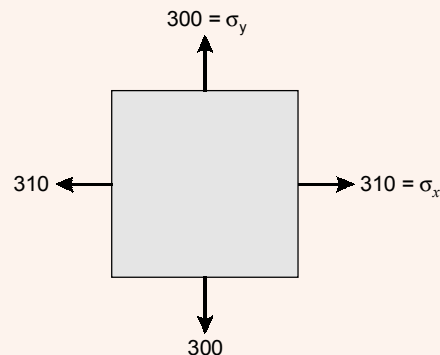
42. A mild steel bar, 1.5 m long, has a square section 40 mm × 40 mm. The bar is subjected to a two-dimensional stress,  $\sigma_x = 310$  N/mm (tensile) and  $\sigma_y = 300$  N/mm (compressive).  $E = 2 \times 10^5$  N/mm<sup>2</sup>, Poisson's ratio  $\mu = 0.3$ . The elongation of the bar in the direction of  $\sigma_x$  will be
- (a) 1.25 mm (b) 1.75 mm  
(c) 2.25 mm (d) 3 mm

**Ans. (d)**

$$\begin{aligned}\epsilon_x &= \sigma_x - \nu\sigma_y \\ &= \frac{1}{2 \times 10^5} [310 - (0.3)(-300)]\end{aligned}$$

$$\frac{\Delta L}{L} = \epsilon_x$$

$$\Delta L = \epsilon_x(L) = \epsilon_x(1.5 \times 10^3) = 3 \text{ mm}$$



• • • End of Solution

43. A tractor has a permissible loaded speed of 200 m/minute, which can increase by 25% when the load is removed/deposited. Generally, it is operated at 80% of the permissible speed (loaded or unloaded). It works at a location where haul distance is 120 m. Rest allowance per round-trip is taken as 50 seconds on an average. Fixed time per trip, for loading and unloading and turnaround, etc., is 30 seconds. What is its effective cycle time?
- (a) 157 seconds (b) 161 seconds  
(c) 173 seconds (d) 182 seconds

**Ans. (b)**

Speed = 200 m/min.

It operates at 80% of speed.

∴ When loaded, speed =  $0.8 \times 200 = 160$  m/min.

When unloaded speed increases by 25% i.e.,

$$1.25 \times 200 = 250 \text{ m/min.}$$

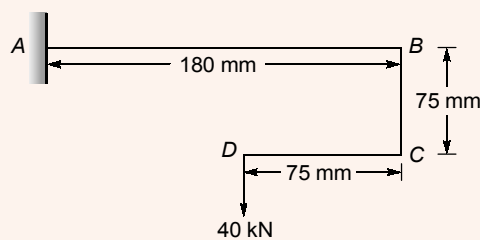
With 80% operating speed, speed after unloading

$$= 0.8 \times 250 = 200 \text{ m/min.}$$

$$\text{Cycle time} = \frac{120}{160}(60) + \frac{120}{200}(60) + 30 + 50 = 161 \text{ seconds}$$

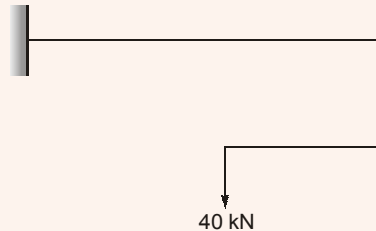
• • • End of Solution

44. The bending moment at A for the beam shown below (not to scale) is



- (a) 3200 kN.mm                      (b) 3600 kN.mm  
(c) 4200 kN.mm                      (d) 4800 kN.mm

Ans. (c)

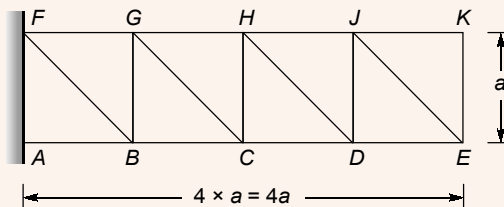


$$M_A = (40) [180 - 75]$$

$$= 4200 \text{ kN-mm}$$

• • • End of Solution

45. In the pin-end cantilever truss shown below, member *FG* had been fabricated 10 mm longer than required. How much will point *E* deflect vertically?



- (a) 10 mm                                      (b) 20 mm  
(c) 30 mm                                      (d) 40 mm



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<b>CS</b> 6 in Top 10	<b>1</b> AIR		<b>AIR-2</b> Debangshu Chatterjee	<b>AIR-4</b> Himanshu Agarwal	<b>AIR-6</b> Jain Ujjwal Omprakash	<b>AIR-9</b> Sreyans Nahata	<b>AIR-10</b> Nilesh Agrawal				
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53 Selections in Top 10

96 Selections in Top 20

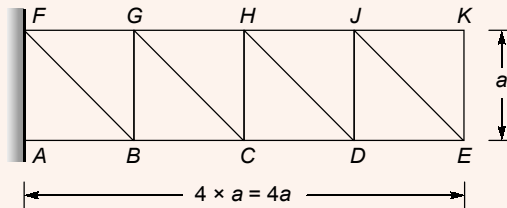
368 Selections in Top 100

ME		CE		EE		EC		CS & PI		IN	
Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100	Top 20	Top 100
17 Selections	68 Selections	16 Selections	65 Selections	19 Selections	76 Selections	10 Selections	45 Selections	17 Selections	53 Selections	17 Selections	61 Selections

Detailed results are available at [www.madeeasy.in](http://www.madeeasy.in)

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Ans. (c)

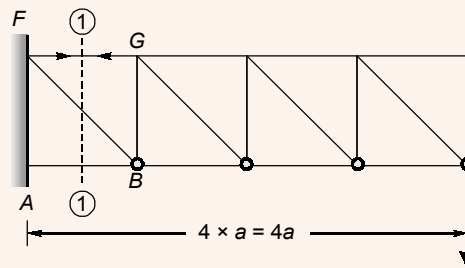


$$\delta V_E = \text{Vertical deflection of joint } E = \sum \frac{PKl}{AE} = \sum k \cdot \delta$$

$$\delta_{FG} = \text{Elongation member } FG = +10 \text{ mm}$$

$$\delta = 0 \text{ for all other member}$$

$k$  for member  $FG$



Using method of sections

Cut F-G by (1) - (1)

Equilibrium of RHS of (1) - (1)

$$\therefore \sum M_B = 0$$

$$= -F_{FG} \times a + 1 \times 3a = 0$$

$$\Rightarrow F_{FG} = 3$$

$$\text{So, } \delta V_E = \sum k\delta = +3 \times (10) = 30 \text{ mm}$$

• • • End of Solution

46. The purpose of lateral ties in a short RC column is to
- Avoid buckling of longitudinal bars
  - Facilitate compaction of concrete
  - Increase the load carrying capacity of the column
  - Facilitate construction

Ans. (a)

• • • End of Solution

47. When a two-hinged parabolic arch is subjected to a rise in ambient temperature, the horizontal thrust at the support will
- Increase
  - Decrease
  - Remain same
  - Increase or decrease depending on the span

Ans. (a)

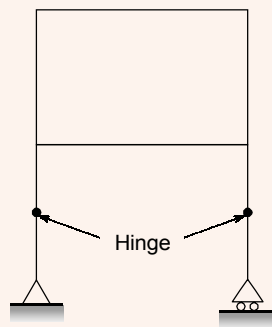
General exterior for horizontal thrust in 2-hinged parabolic arches is

$$A = \frac{\int \frac{M_x y dx}{EI} + \alpha t l}{\int \frac{y^2 dx}{EI_c} + \frac{l}{AE} + k}$$

it ' $\alpha$ ' increases,  $H$  increase

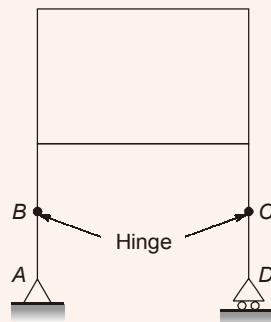
• • • End of Solution

48. The degree of static indeterminacy for a rigid frame as shown below is



- (a) 0
- (b) 1
- (c) 2
- (d) 3

Ans. (b)



$C = 2 =$  No of cuts necessary to get cantilever frame

$$D_s = 3 \times c - \underset{\substack{\text{at A} \\ W}}{1} - \underset{\substack{\text{at B} \\ W}}{1} - \underset{\substack{\text{at C} \\ W}}{1} - \underset{\substack{\text{at D} \\ W}}{2}$$

$$= 1$$

• • • End of Solution

49. In the slope-deflection equations, deformations are considered to be caused by
- (a) Shear forces and bending moments only
  - (b) Axial forces, shear forces and bending moments
  - (c) Axial forces and bending moments only
  - (d) Bending moments only

**Ans. (d)**

In slope-deflection method, axial and shear deformations are neglected.

● ● ● **End of Solution**

50. The maximum bending moment caused by a set of concentrated moving loads is
- (a) Always at the mid-point of span
  - (b) Between the mid-point and concentrated load next to the mid-point' of the span
  - (c) Not definable
  - (d) Always under a load close to the centroid of the set of loads

**Ans. (d)**

To get maximum BM under a chosen wheel load, keep the loads such that the chosen wheel load and resultant are at equal distance from centre. Then, maximum BM occurs under chosen wheel load (but not at centre). The most appropriate answer is D.

● ● ● **End of Solution**

51. Force method of analysis of a structure is particularly preferred when
1. The degrees of freedom of the structure become large
  2. The structure has less numbers of static, and more numbers of kinematic, indeterminacies
  3. The structure has more numbers of static, and less numbers of kinematic, indeterminacies
- (a) 1 only
  - (b) 2 only
  - (c) 3 only
  - (d) 1, 2 and 3

**Ans. (b)**

In force method, forces are taken as unknowns. If  $D_s$  is less it implies less questions. So, it is preferred method.

● ● ● **End of Solution**

52. Stiffness matrix method is in the category of
1. Compatibility method
  2. Displacement method
  3. Force method
  4. Equilibrium method
- (a) 1 and 3 only
  - (b) 1 and 4 only
  - (c) 2 and 3 only
  - (d) 2 and 4 only

**Ans. (d)**

● ● ● **End of Solution**



53. Muller-Breslau Principle for obtaining influence lines is applicable to
1. Statically determinate beams and frame
  2. Statically indeterminate structures, the material of which is elastic, and follows Hooke's law
  3. Any statically indeterminate structure
- (a) 1 and 2 only (b) 1 only  
(c) 2 only (d) 1 and 3 only

Ans. (a)

End of Solution

54. The plastic neutral axis
1. Divides the given section into two equal halves
  2. Divides the given section into two unequal parts
  3. Lies on the centroidal axis of the section
- (a) 1 only (b) 2 only  
(c) 3 only (d) 2 and 3 only

Ans. (a)

End of Solution

55. The plastic moment capacity  $M_p$  is
- (a) Less than the yield moment (b) Equal to the yield moment  
(c) Greater than the yield moment (d) Dependent on section dimensions

Ans. (d)

$$M_p = f_y \cdot \frac{A}{2} (\bar{y}_1 + \bar{y}_2)$$

$M_p$  depends on area and the distribution of area of c/s.

End of Solution

56. Web crippling is caused by
- (a) Excessive bending moment (b) Failure of web under point loads  
(c) Width of flanges (d) Column action of web

Ans. (b)

End of Solution

57. The block shear failure of a bolted joint in tension occurs because of
1. Use of high shear strength bolts
  2. Use of plates with higher bearing strength
- (a) 1 only (b) 2 only  
(c) Both 2 and 2 (d) Neither 1 nor 2

Ans. (a)

End of Solution



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58. As per IS code, the maximum longitudinal pitch allowed in bolted joints of tension members is nominally
- (a) 12 times the thickness of the plate
  - (b) 12 times the diameter of the bolt
  - (c) 16 times the thickness of the plate
  - (d) 16 times the diameter of the bolt

Ans. (c)

● ● ● End of Solution

59. ISMB 100 ( $r_x = 40$  mm,  $r_y = 10$  mm) has been used as a column in an industrial shed. Along the minor axis, the column has restraints in the form of purlins at 1.0 m intervals. Effective length factor along major and minor axes are 1.2 and 1.0, respectively. If the slenderness ratio is restricted to 120, the maximum column height will be
- (a) 1.0 m
  - (b) 2.4 m
  - (c) 4.0 m
  - (d) 4.8 m

Ans. (a)

$\lambda_{xx}$  = Effective slenderness ratio in  $x$ -direction

$$= \frac{1.2 \times l_{xx}}{r_{xx}} = 120$$

$$\Rightarrow \frac{1.2 \times l_{xx}}{40} = 120$$

$$\Rightarrow l_{xx} = \frac{4800}{1.2} = 4000 \text{ mm}$$

$$\lambda_{yy} = \frac{l_{yy}}{r_{yy}} = 120$$

$$\Rightarrow \frac{l_{yy}}{10} = 120$$

$$\Rightarrow l_{yy} = 1200 \text{ mm}$$

So, most appropriate option is (a).

● ● ● End of Solution

60. As per IS 800 : 2007, the permitted slenderness ratio for a bracing member in case of hangers shall be
- (a) 140
  - (b) 145
  - (c) 150
  - (d) 160

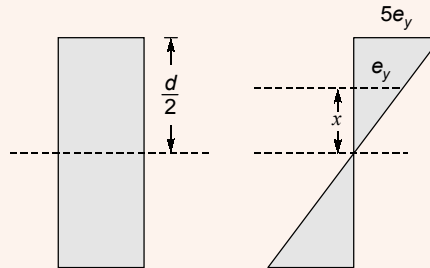
Ans. (d)

As per IS 800 : 2007 Clause : 12.5.2.2, slenderness ratio of bracing member shall not exceed 160 (only hangers).

● ● ● End of Solution

61. A rectangular beam of depth  $d$  is under bending. Load has been gradually increased when the top fibre has obtained five times the strain at the first yield. What depth of the beam will still respond by elastic conditions?
- (a)  $0.16 d$  (b)  $0.20 d$   
(c)  $0.25 d$  (d)  $0.40 d$

Ans. (b)



$$\frac{x}{e_y} = \frac{d/2}{5e_y}$$

⇒

$$x = 0.1d$$

$$\begin{aligned} \text{Depth of beam responding under elastic condition} &= 2x \\ &= 2 \times 0.1d = 0.2d \end{aligned}$$

● ● ● End of Solution

62. The ultimate moment capacity of a mild steel section is usually
- (a) Equal to the plastic moment capacity  
(b) More than the yield moment capacity  
(c) Less than the plastic moment capacity but more than the yield moment capacity  
(d) More than the plastic moment capacity

Ans. (a)

● ● ● End of Solution

63. The portal bracing in a truss-bridge is used to
- (a) Transfer load from top of end posts to bearings  
(b) Maintain the rectangular shape of the bridge cross-section  
(c) Stiffen the structure laterally  
(d) Prevent the buckling of top chord under side sway

Ans. (a)

Ultimate moment capacity and plastic moment capacity are one and the same thing.

● ● ● End of Solution

64. Consider the following cases in the design of reinforced concrete members in flexure:
1. Over-reinforced section
  2. Tension failure
  3. Compression failure
  4. Under-reinforced section

Which of the above cases are considered for safe design of R.C. members in flexure?

- (a) 1 and 2 only (b) 2 and 4 only  
(c) 3 and 4 only (d) 1 and 3 only

**Ans. (b)**

Design of RCC section are based on

- (i) Tension failure of steel is considered safe.  
(ii) Compression failure of concrete should be avoided.  
(iii) Over reinforcement section are subjected to compression failure of concrete thus shall be avoided.  
(iv) Under reinforcement sections are preferred due to tension failure of steel (gradual failure)

• • • **End of Solution**

**65.** The bond between steel and concrete is mainly due to

1. Mechanical resistance  
2. Pure adhesive resistance  
3. Frictional resistance  
(a) 1 and 2 only (b) 1 and 3 only  
(c) 2 and 3 only (d) 1, 2 and 3

**Ans. (d)**

- (i) Mechanical resistance is provided due to gripping of steel bars due to shrinkage of concrete.  
(ii) Pure adhesive resistance is provided by adhesive of chemical (C-S-H gel) produced by concrete during setting.  
(iii) Frictional resistance is when bar has tendency to slip or move.

• • • **End of Solution**

**66.** The carbonation process is demonstrated more by

- (a) Atmospheric corrosion (b) Chloride corrosion  
(c) Stress corrosion (d) Hydrogen embrittlement

**Ans. (a)**

Carbonation occurs in concrete when calcium bearing phases present in concrete are attacked by  $\text{CO}_2$  present in air, and converted to calcium carbonate.

• • • **End of Solution**

**67.** When a spirally reinforced short column is loaded axially, the concrete inside the core is subjected to

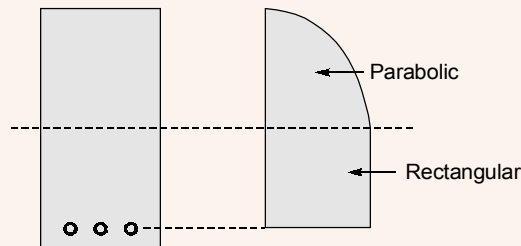
- (a) Bending and compression (b) Biaxial compression  
(c) Triaxial compression (d) Uniaxial compression

**Ans. (c)**

• • • **End of Solution**

68. In a reinforced concrete section, shear stress distribution is diagrammatically
- (a) Wholly Parabolic
  - (b) Wholly Rectangular
  - (c) Parabolic above NA and Rectangular below NA
  - (d) Rectangular above NA and Parabolic below NA

Ans. (c)



● ● ● End of Solution

69. As per IS 456 : 2000, the maximum permissible shear stress,  $\tau_{c,max}$ , is based on
- (a) Diagonal tension failure
  - (b) Diagonal compression failure
  - (c) Flexural tension failure
  - (d) Flexural compression failure

Ans. (b)

$\tau_{c,max}$  is maximum shear strength of concrete with shear reinforcement. When a large quantity of shear reinforcement is provided with main reinforcement, failure will occur due to diagonal compression failure of concrete, based on which  $\tau_{c,max}$  value has been decided.

● ● ● End of Solution

70. Footings shall be designed to sustain the
- 1. Applied loads
  - 2. Moments and forces under relatable loading conditions
  - 3. Induced reactions
- (a) 1 and 2 only
  - (b) 1 and 3 only
  - (c) 2 and 3 only
  - (d) 1, 2 and 3

Ans. (d)

Foundation structure shall be able to sustain the applied loads, moments, forces and induced reactions without exceeding the safe bearing capacity of soil.

● ● ● End of Solution

71. Reinforced concrete slabs are designed for
- 1. Shear
  - 2. Flexure
  - 3. Positive bending moment
  - 4. Negative bending moment
- (a) 1, 2 and 3 only
  - (b) 1 and 4 only
  - (c) 2, 3 and 4 only
  - (d) 1, 2, 3 and 4

Ans. (d)

● ● ● End of Solution



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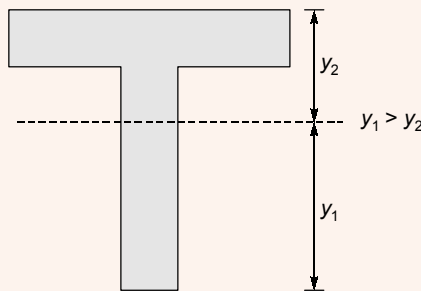
72. As compared to the working stress method of design, the limit state method of design premises that the concrete can admit
- (a) A lower stress level
  - (b) A higher stress level
  - (c) Occasionally higher, but usually lower, stress level
  - (d) Only the same stress level

Ans. (b)

● ● ● End of Solution

73. The bending stress in a T-beam section is maximum
- 1. At top fibre
  - 2. At centroidal fibre
  - 3. At bottom fibre
- (a) 1 only
  - (b) 2 only
  - (c) 3 only
  - (d) At a level which is dependent on the loading condition

Ans. (c)



Since 
$$\frac{\sigma_1}{y_1} = \frac{\sigma_2}{y_2}$$

Maximum bending stress will be at maximum distance from NA so bending stress at bottom fibre will be maximum.

● ● ● End of Solution

74. If the loading on a simply supported prestressed concrete beam is uniformly distributed, the centroid of the prestressing tendon should be as
- (a) A straight profile along the lower edge of the kern
  - (b) A parabolic profile with convexity downward
  - (c) A straight profile along the centroidal axis
  - (d) A circular profile with convexity upward

Ans. (b)

For simply supported beam subjected to UDL, BMD is parabolic. For load balancing shape of cable shall be as per same profile (parabolic) with convexity downward.

● ● ● End of Solution





- (a) 33.2 lps (b) 35.6 lps  
(c) 37.0 lps (d) 38.2 lps

**Ans. (d)**

$$Q_{\text{theo}} = \frac{ALN}{60} = \frac{\pi (0.3)^2 (0.25)(135)}{4 \times 60} = 0.04 \text{ m}^3/\text{sec}$$

$$\% \text{ slip} = \frac{Q_{\text{theo}} - Q_{\text{Act}}}{Q_{\text{theo}}} \times 100$$

$$0.04 = 1 - \frac{Q_{\text{Act}}}{Q_{\text{theo}}}$$

$$\frac{Q_{\text{Act}}}{0.04} = 0.96$$

$$Q_{\text{Act}} = 38.4 \text{ lps}$$

● ● ● **End of Solution**

**80.** In the design of pre-stressed concrete structures, which of the following limit states will qualify as the limit states of serviceability?

- |               |             |
|---------------|-------------|
| 1. Flexural   | 2. Shear    |
| 3. Deflection | 4. Cracking |
- (a) 1 and 2 only (b) 3 and 4 only  
(c) 1 and 4 only (d) 2 and 3 only

**Ans. (b)**

● ● ● **End of Solution**

**81.** Consider the following statements :

1. Pumps used in series are generally of the centrifugal type.
2. Centrifugal pumps, though yielding comparatively smaller discharges than axial flow pumps, yield higher heads (at each stage) compared to axial flow pumps.

Which of the above statements is/are correct?

- (a) 1 only (b) 2 only  
(c) Both 1 and 2 (d) Neither 1 nor 2

**Ans. (a)**

Centrifugal pumps gives greater discharge.

● ● ● **End of Solution**

**82.** When steel reinforcing bars are provided in masonry, the bars shall have an embedment with adequate cover in cement-sand mortar not leaner than

- (a) 1 : 3 (b) 1 : 4  
(c) 1 : 6 (d) 1 : 6

**Ans. (a)**

● ● ● **End of Solution**



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Ans. (c)

$$\frac{H\sqrt{T}}{P} = \text{Constant for IC engines.}$$

• • • End of Solution

89. Manometric head developed  $h_m$  in m, and discharge  $Q$  in lps in respect of two pumps, 1 and 2, are tabulated. The pumps are connected in series against a static head of 100 m.

Total head losses for a discharge of  $\frac{Q^2}{100}$  (m). What is the delivered discharge?

<b>Q (in lps)</b>	15	18	20	22	25
<b><math>h_{m1}</math> (in m)</b>	60.6	61.2	62.0	55.0	48.0
<b><math>h_{m2}</math> (in m)</b>	50.8	51.0	48.8	45.8	40.0

- (a) 20.15 lps  
(c) 21.95 lps

- (b) 21.25 lps  
(d) 22.20 lps

Ans. (\*)

• • • End of Solution

90. A reciprocating pump has a stroke of 30 cm, speed of 100 rpm, and a piston of 22.5 cm diameter. It discharges 18.9 lps. What is the slip of the pump?

- (a) 3.12%  
(c) 4.15%
- (b) 3.54%  
(d) 4.95%

Ans. (d)

$$Q_{\text{theo}} = \frac{ALN}{60} = \frac{\pi (0.225)^2 (0.3)(100)}{4 \times 60} = 19.88 \text{ lps}$$

$$\% \text{slip} = \frac{Q_{\text{theo}} - Q_{\text{Act}}}{Q_{\text{theo}}} \times 100$$

$$= \frac{19.88 - 18.9}{19.88} \times 100 = 4.93\%$$

• • • End of Solution

91. The following data were recorded when a centrifugal pump worked at its maximum efficiency :  $Q = 40$  lps; Manometric head developed = 25 m; Input shaft horse power = 11.9 W. What is the non-dimensional specific speed of the pump if it was running at 1500 rpm? (May adopt the following (all in S.I. units):

$$g^{1/4} = 1.77, g^{1/2} = 3.132, g^{3/4} = 5.544,$$

$$\sqrt{2} = 1.414, \sqrt{5} = 2.236 \text{ and } \sqrt{10} = 3.162$$



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- (a) 165 (b) 155  
(c) 145 (d) 135

Ans. (b)

$$N_s = \frac{N\sqrt{Q}}{(gH)^{3/4}} = \frac{1500\sqrt{40}}{(9.81 \times 25)^{3/4}} = 153.07 \approx 155$$

• • • End of Solution

92. The total head to be developed by a centrifugal pump is expected to be up to 50 m. The normal ratio of radii of impeller rim and impeller eye of 2 is maintained. The design is for a speed of 1300 rpm. What is the nominal diameter of the impeller? Take  $\sqrt{g} = 3.13$

and  $\frac{1}{\pi} = 0.318$ .

- (a) 53 cm (b) 57 cm  
(c) 60 cm (d) 64 cm

Ans. (a)

$$\frac{u_2^2 - u_1^2}{2g} = H_{\text{mano}}$$

$$\frac{1}{2g} \left[ \left( \frac{\pi D_2 N}{60} \right)^2 - \left( \frac{\pi D_1 N}{60} \right)^2 \right] = 50$$

$$\frac{1}{2g} \left[ \left( \frac{\pi N}{60} \right)^2 \times D_1^2 \right] (4 - 1) = 50$$

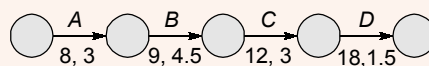
$$D_1 = 0.2656 \text{ m} = 26.56 \text{ cm}$$

So,

$$D_2 = 53.12 \text{ cm}$$

• • • End of Solution

93. Activities A, B, C and D constitute a small project; their interrelationship, expected duration and standard deviation of this expected duration are shown in the figure, respectively.



With a view to improving the speed of implementation, each of B, C and D are split into three equal segments, maintaining appropriate interrelationships between A and each of these nine segments. What will be the standard deviation of the modified project duration after

segmentation (to the nearest  $\frac{1}{10}$  unit)?

- (a) 6.2 (b) 5.6  
(c) 5.2 (d) 4.6







99. Slack time in PERT analysis
- (a) Can never be greater than zero      (b) Is always zero for critical activities  
(c) Can never be less than zero      (d) Is minimum for critical events

Ans. (b)

● ● ● End of Solution

100. A small project consists of 3 activities P, Q and R to be executed in that sequence. The relationship between Time Duration (in 'Units' of time-T) and corresponding total direct cost (C units) for each of the activities, for alternate mutually exclusive possible durations for each activity, are tabulated herewith :

P		Q		R	
T	C	T	C	T	C
8	250	6	340	8	400
9	235	7	320	10	375
10	225	8	295	12	350
11	215	9	275		

For a total duration of 25 units of time, the least total direct cost for the complete project will be

- (a) 965 units      (b) 950 units  
(c) 940 units      (d) 925 units

Ans. (d)

The following combinations are possible for a total duration of 25 units of time.

Combination sequence	P		Q		R		Total Cost
1.	8	250	7	320	10	375	945
2.	8	250	9	275	8	400	925
3.	9	235	6	340	10	375	950
4.	9	235	8	295	8	400	930
5.	10	225	7	320	8	400	945
6.	11	215	6	340	8	400	955

Hence least total direct cost is 925.

● ● ● End of Solution

**Directions:** Each of the next twenty (20) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the codes given below :

**Codes:**

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)  
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **not** the correct explanation of Statement (I)

- (c) Statement (I) is true but Statement (II) is false
- (d) Statement (I) is false but Statement (II) is true

101. **Statement (I):** Splitting of fibres is a type of seasoning defect in wood.  
**Statement (II) :** Seasoning of timber is a general requirement for structural purposes.

Ans. (b)

● ● ● End of Solution

102. **Statement (I) :** Hardwoods are used in special purpose heavy constructions.  
**Statement (II) :** Hardwoods too are porous in nature.

Ans. (b)

● ● ● End of Solution

103. **Statement (I):** In general, bricks cannot be used in industrial foundations.  
**Statement (II):** Heavy duty bricks can withstand higher temperatures.

Ans. (b)

● ● ● End of Solution

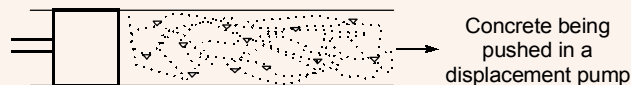
104. **Statement (I):** In multistoried constructions, burnt clay perforated bricks are used to reduce the cost of construction.  
**Statement (II):** Perforated bricks are economical and they also provide thermal insulation.

Ans. (a)

● ● ● End of Solution

105. **Statement (I) :** Positive displacement pumps can be used for pumping of ready-mixed concrete.  
**Statement (II):** The coarse aggregate in the mix is unlikely to be crushed during positive displacement.

Ans. (a)



Aggregates would not be crushed.

● ● ● End of Solution

106. **Statement (I):** Fire resistance of plastering can be achieved by mixing surkhi to the cement mortar.  
**Statement (II) :** Insulation against sound and fire can be achieved by adding sufficient water in-situ just before applying the mortar.

Ans. (c)

● ● ● End of Solution



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107. **Statement (I):** Water containing less than 2000 ppm of dissolved solids can generally be used satisfactorily for making concrete.

**Statement (II):** The presence of any of zinc, manganese, tin, copper or lead reduces the strength of concrete considerably.

Ans. (b)

• • • End of Solution

108. **Statement (I):** Though a non-elastic material, yet concrete exhibits a linear relationship between stress and strain at low values of stress.

**Statement (II):** The modulus of elasticity of concrete is dependent on the elastic properties of aggregate and on curing.

Ans. (b)

• • • End of Solution

109. **Statement (I) :** Finer the cement, greater is the need for water for hydration and workability.

**Statement (II) :** Bleeding of a mix occurs due ' to low water-cement ratio.

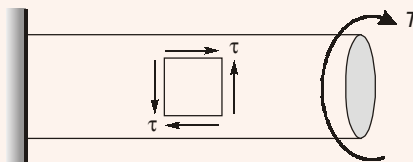
Ans. (c)

• • • End of Solution

110. **Statement (I):** The failure of a mild steel specimen of circular cross-section, subjected to a torque occurs along its cross-section.

**Statement (II):** The failure occurs on a plane of the specimen subjected to maximum shear stress; and mild steel is relatively weak in shear.

Ans. (a)



MS is ductile material which is weakest in shear so fail at  $\tau_{max}$  plane.

Maximum shear stress plane will be longitudinal plane and traverse plane. (Pure shear conditions)

• • • End of Solution

111. **Statement (I):** In elastic analysis of structures, the Neutral Axis is the intersection between the plane of bending and the neutral plane.

**Statement (II):** Neutral Axis in the context of plastic analysis of structures is always the Equal Area Axis of the cross-section.

Ans. (b)

• • • End of Solution

112. **Statement (I):** Whereas shutter vibrators are preferred for use with pre-stressed beams, needle vibrators are preferred in foundation concreting.

**Statement (II):** Needle vibrators are susceptible to get dysfunctional with leaking-in of cement slurry — which is not the case with the shutter vibrator.

Ans. (b)

● ● ● End of Solution

113. **Statement (I):** The forward edge of wheels or outriggers acts as a fulcrum in determining the lifting capacity of a mobile crane.

**Statement (II):** There is in-built security and safety against sudden dropping of load, as well as against abrupt swinging, in the working of a mobile crane.

Ans. (c)

Outriggers are extended legs on which the crane is supported (wheel is off loaded).

● ● ● End of Solution

114. **Statement (I):** Hand-operated chain-hoists include differential screw-gear types within their range.

**Statement (II):** In case of a hoist-winch, the capacity of the hoist is increased by a number of gear reductions.

Ans. (b)

- Differential screw gear is a type of chain hoist.
- Greater the gear reduction, lesser the motor has to work.

● ● ● End of Solution

115. **Statement (I):** When employing weigh-batching for mix preparation, bulking of sand has to be accounted for.

**Statement (II):** Bulked sand will affect the proportional composition of the ingredients to be used in making wet concrete of the desired eventual strength.

Ans. (d)

● ● ● End of Solution

116. **Statement (I):** Critical path(s) through a CPM network can be identified even without working out the backward pass computations by a competent user.

**Statement (II) :** Critical path is the progressive chain of activities from start to finish (not excluding between splitting and merging nodes) through the network where Total Float is absent throughout (including through dummy arrows, if appropriate).

Ans. (d)

● ● ● End of Solution



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3	Amit Kumar Mishra	150	766.46
21	Nishant Kumar	144	712.45
59	Sandeep Singh Olla	144	678.23
11	Raman Kunwar	142	732.88
6	Pawan Jeph	140	745.57
23	Ishan Shrivastava	140	709.24
24	Abhishek Verma	140	705.12
65	Yogendra Singh	140	676.44

Mechanical Engineering			
Rank	Name	Personality Test	Total Marks
36	Rohit Singh	148	659
56	Harmandeep Singh	148	640
29	Anuj Kumar Mishra	146	675
39	Anubhaw Mishra	142	657
7	Sudhir Jain	140	708
13	Kumar Sourav	140	699
31	Saurabh Singh Lodhi	140	665
41	Praseed Sahu	140	653
54	Vedant Darbari	140	642
74	Vinay Kumar	140	598

Electrical Engineering			
Rank	Name	Personality Test	Total Marks
13	Neetesh Agrawal	150	708
12	Pankaj Fauzdar	149	712
11	Ankita Gupta	146	714
22	Umesh Prasad Gupta	146	687
2	Partha Sarathi Tripathy	141	772
20	Apurva Srivastava	140	692
1	Shaik Siddhik Hussain	135	772
3	Nikki Bansal	134	761
31	Akhil Pratap Singh	134	673
9	Sudhakar Kumar	132	718

Electronics & Telecommunication Engg.			
Rank	Name	Personality Test	Total Marks
9	Shruti Kushwaha	144	754.88
1	Ijaz MYousuf	142	801.22
18	Hitesh	142	743.22
2	Saurabh Pratap Singh	140	791.57
13	Dhanesh Goel	140	747.22
60	Harshit Mittal	140	705.36
14	Shyam Sundar Sharma	136	745.57
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117. **Statement (I)** : For implementing weigh-batching, separate compartments are made for storing large quantities of the aggregates. Besides lifting and loading equipments, there must be regular assessment of grading and also of moisture content.

**Statement (II)** : Whereas eventual strength of the mix depends also on the grading of the ingredients, the water needs too must be properly computed and implemented.

**Ans. (b)**

- Moisture correction is done on daily basis.
- Water cement ratio is important parameter of mix design.

● ● ● **End of Solution**

118. **Statement (I)** : Resources Optimization is largely a pre-implementation pursuit whereas Resources Allocation is a through-implementation dynamic process.

**Statement (II)**: Resources Allocation has a larger bearing on Inventory Management than Resources Optimization.

**Ans. (b)**

● ● ● **End of Solution**

119. **Statement (I)**: Crashing of project duration always increases the cost of the project on its completion, no matter what the indirect, or overhead, costs are.

**Statement (II)**: The critical path along the project activities network diagram is compressed in the process of investigating the crashing of the project duration, and not the non-critical activities, up to a certain stage of crashing.

**Ans. (d)**

● ● ● **End of Solution**

120. **Statement (I)** : In the operation of reciprocating pumps, slip can sometimes be negative.

**Statement (II)** : Under conditions of high speed, long suction pipes (without capitation) and short delivery pipes, inertia pressure can be relatively rather high, causing the delivery valve to open before the discharge stroke begins.

**Ans. (a)**

● ● ● **End of Solution**

