Total No. of Questions—12] [Total No. of Printed Pages—4

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S.E. (Civil) EXAMINATION, 2007

BUILDING MATERIALS AND CONSTRUCTION

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Assume suitable data, if necessary.

(*v*) *All* questions are compulsory.

SECTION I

1. (*a*) Describe design considerations for shallow foundations. [6]

(*b*) Explain with neat sketches :

(*i*) Bearing pile;

(*ii*) Framed structure. [6]

(*c*) Write a short note on settlement of foundation. [4]

Or

2. (*a*) Describe cantilever footing with sketch. [6]

(*b*) What is settlement ? Explain the causes of failure of foundation. [6]

(*c*) Write down the circumstances where the following types of foundations are used :

(*i*) Mat foundation;

(*ii*) Combined footing. [4]

P.T.O.

3. (*a*) Describe the following technical terms with sketches :

(*i*) Throating;

(*ii*) Header stone;

(*iii*) Spalls;

(*iv*) Queen closer. [6]

(*b*) Write a short note on cavity wall construction. [6]

(*c*) Compare English Bond and Flemish Bond. [4]

Or

4. (*a*) Illustrate neat sketch of successive courses in plan and elevation to illustrate construction of Brick wall 1½ brick thick in Flemish Bond. [6]

(*b*) Write down the points to be observed while supervising stone masonry in superstructure. [6]

(*c*) Describe the following technical terms with sketches :

(*i*) Cornice;

(*ii*) Coping;

(*iii*) Mitered closer;

(*iv*) Bed joint. [4]

5. (*a*) Define door. Draw neat and labelled sketch of panelled door. [6]

(*b*) Draw the sketch of Arch and show on it :

(*i*) Spring line;

(*ii*) Extradas;

(*iii*) Span;

(*iv*) Haunch. [6]

(*c*) State different market names of paints. Write down defects in plastering. [6]

Or

6. (*a*) Explain with neat sketches different types of hinges used for doors and windows. [6]

(*b*) Write down the methods of construction of Arches. State different types of arches. [6]

(*c*) Describe the method of painting in detail. Explain defects in painting. [6]

SECTION II

7. (*a*) What do you understand by mosaic flooring ? Describe in detail the construction of such a floor. [6]

(*b*) What are the relative advantages and disadvantages of flat roof over other types ? [6]

(*c*) Draw neat and labelled sketch of Queen-post truss. [4]

Or

8. (*a*) State essential requirements of good flooring material. [6]

(*b*) What are the general principles observed in construction of R.C.C. slab ? [4]

(*c*) Name the types of roofing materials available in market. State advantages and limitations of each. [6]

9. (*a*) State briefly the requirements of a good vertical circulation. [6]

(*b*) Explain different methods for vertical circulation. State when they are preferred. [6]

(*c*) Draw a neat sketch showing beam to beam connections in structural steel work. [4]

Or

10. (*a*) State different types of stairs based on materials of construction. Explain any *one* in detail. [6]

(*b*) Explain the following terms :

(*i*) Tread;

(*ii*) Going;

(*iii*) Riser;

(*iv*) Header;

(*v*) Nosing;

(*vi*) Balustrade. [6]

(*c*) What are advantages and disadvantage of steel structures ? [4]

11. (*a*) Enumerate the benefit of safety to employers, employees and customers. [6]

(*b*) Discuss the different factors leading to accidents in construction project. [6]

(*c*) What is seasoning of timber ? Enlist methods of seasoning and explain *one* method in detail. [6]

Or

12. (*a*) What is shoring ? Explain *one* type in detail. [6]

(*b*) Compare thermoplastic materials and thermosetting material. [6]

(*c*) Explain the important measures that are to be adopted for preventing accidents at construction sites. [6]

Total No. of Questions—12] [Total No. of Printed Pages—8+2

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S.E. (Civil) EXAMINATION, 2007

STRENGTH OF MATERIALS

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) A rigid bar ABCD pinned at 'B' and connected to two vertical rods is as shown in Fig. 1.1. Assuming that the bar was initially horizontal and the rods stress free, determine the stress in each rod after load P = 500 N is applied at 'D'.

Take $E_{st} = 200$ GPa, $E_{Al} = 100$ GPa. [8]

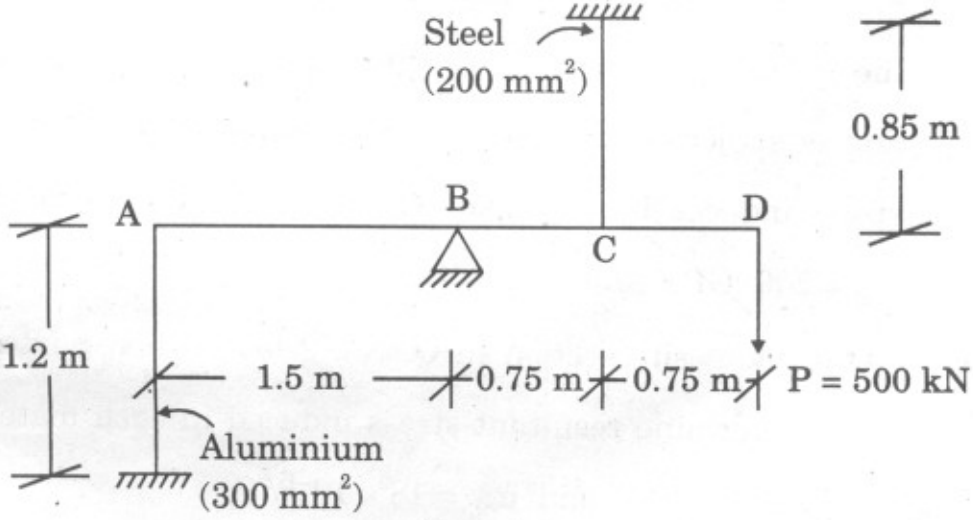

Fig. 1.1

P.T.O.

(*b*) Two cylindrical rods one of steel and other of brass are joined at 'C' and supported rigidly at 'A' and 'E' as shown in Fig. 1.2. Determine the reactions at the ends and displacement of the junction. Take $E_{st} = 200$ GPa, $E_{Al} = 100$ GPa. [8]

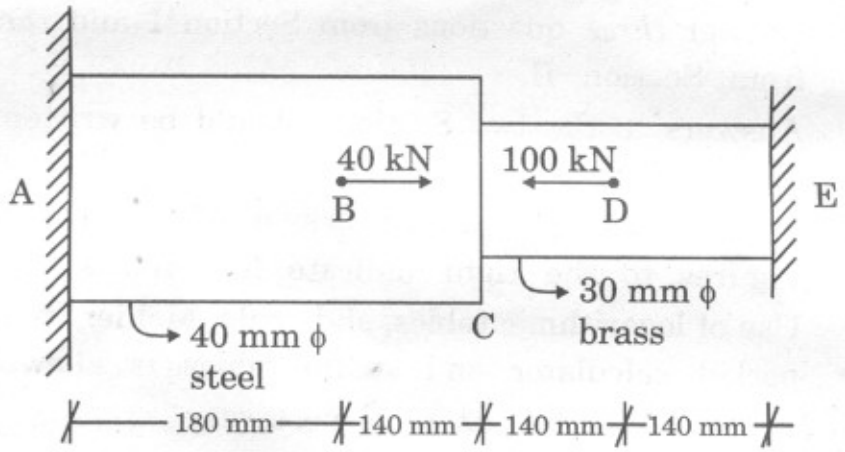

Fig. 1.2

Or

2. (*a*) A composite rod 1800 mm long consists of a steel tube 46 mm external diameter and 40 mm internal diameter. A copper tube of 36 mm diameter is placed coaxially into the steel tube. The assembly is held into the two rigid plates and is subjected to an axial compressive force of 150 kN. Find stress induced in each material and contraction produced. Take $E_{st} = 200$ GPa and $E_{cu} = 100$ GPa. [8]

(*b*) If the composite section in Q. No. 2 (*a*) is then heated through 40°C, determine resultant stress induced in each material. Take $\alpha_{st} = 12 \times 10^{-6}/°C$ and $\alpha_{cu} = 18 \times 10^{-6}/°C$. [8]

3. (*a*) The beam shown in Fig. 3.1 is loaded as shown. Draw S.F.D. and B.M.D. showing all salient values. [10]

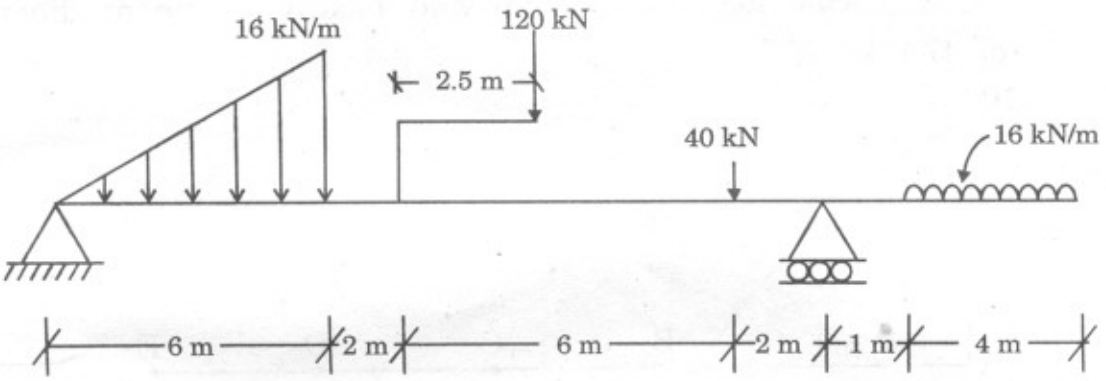

Fig. 3.1

(*b*) A simply supported beam of span 6 m and of cross-section as shown in Fig. 3.2, carries a u.d.l. If the permissible bending stresses are 120 MPa in compression and 45 MPa in tension, find safe u.d.l. the beam can carry. [8]

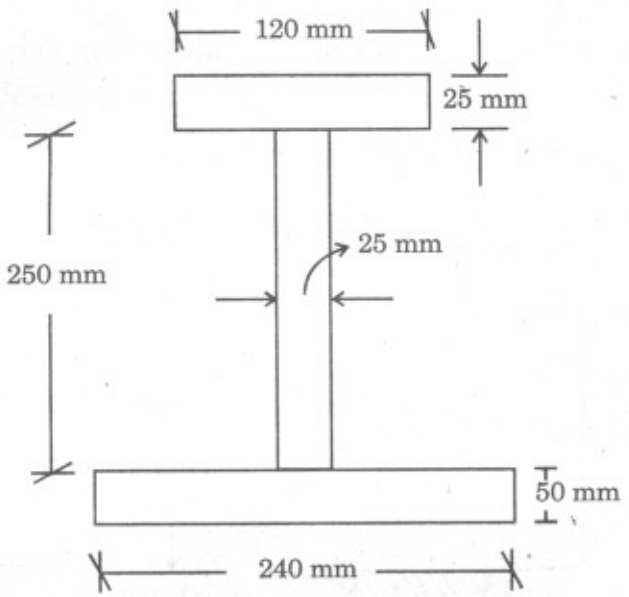

Fig. 3.2

Or

4. (*a*) The Fig. 4.1 shows a shear force diagram of a beam. The curve in portion 'AB' is a second degree curve with zero slope at 'A'. Draw loading diagram and bending moment diagram of the beam. [10]

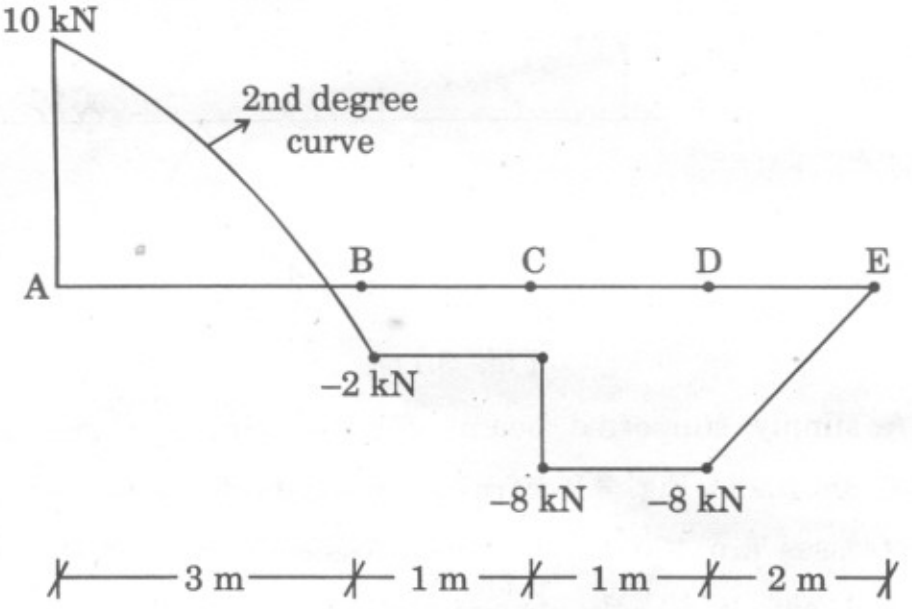

Fig. 4.1

(*b*) A simply supported beam of 6 m span has the c/s as shown in Fig. 4.2. It carries an u.d.l. of intensity 18 kN/m throughout the span. If $m = 15$, calculate maximum stress in timber and steel. [8]

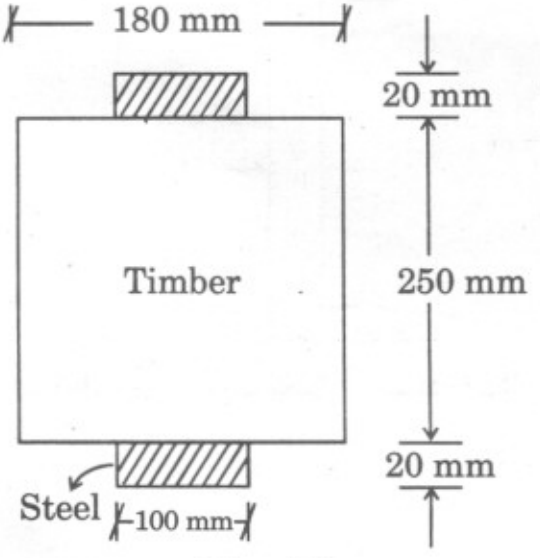

Fig. 4.2

5. (*a*) A beam of T cross-section is formed by nailing together two boards having the dimensions as shown in Fig. 5.1. If total shear force acting on c/s is 1800 N and each nail can carry 800 N in shear, what is the maximum allowable spacing. [8]

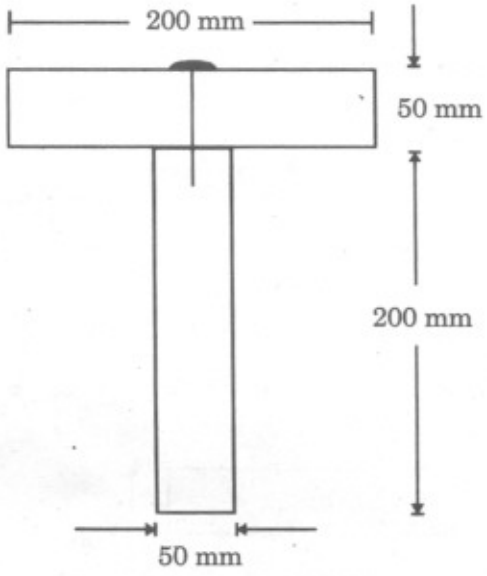

Fig. 5.1

(*b*) A shaft of solid cross-section with two different diameters is as shown in Fig. 5.2. Determine outside diameter of prismatic hollow shaft of the same material, equal length and having

same torsional stiffness if the wall thickness 't' of hollow shaft is to be $d/10$. [8]

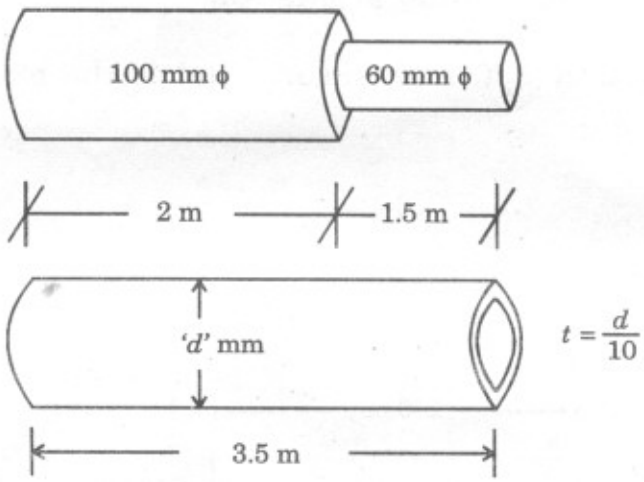

Fig. 5.2

Or

6. (*a*) A cantilever beam carrying u.d.l. 20 kN/m throughout its span has cross-section as shown in Fig. 6.1. At a cross-section 0.85 m from free end, determine the largest shear stress and shearing stress at point 'A'. Assume span of 5 m. [8]

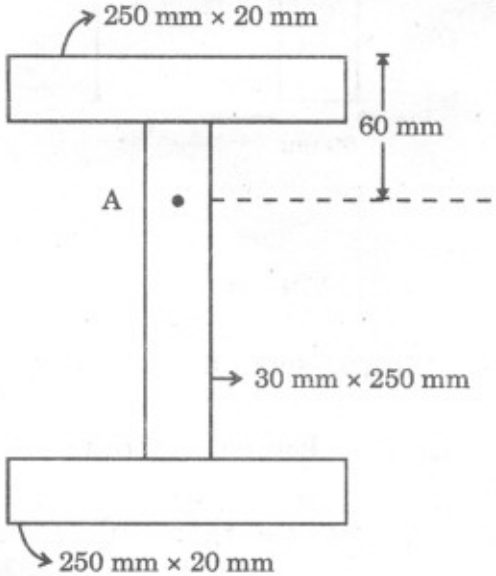

Fig. 6.1

(*b*) A steel shaft, 1.2 m long, has its outer and inner diameters equal to 50 mm and 40 mm respectively. If the shaft transmits 175 kW while rotating at 1800 rev./min., determine :

(*i*) Maximum shearing stress

(*ii*) Angle of twist.

Take G = 80 GPa. [8]

SECTION II

7. (*a*) As shown in Fig. 7.1, the shear stress along the plane 'BE' is zero. Show that $\tau = \sigma_1 \times \sigma_2$ if one of the principal stresses is zero. [8]

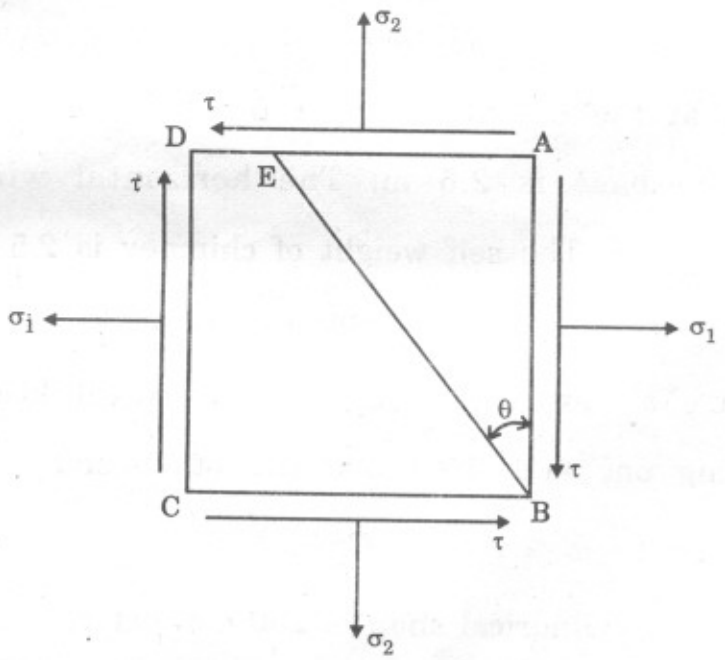

Fig. 7.1

(*b*) Derive an expression for maximum shear stress, if a hollow shaft having external diameter 'D' and internal diameter '*d*' is subjected to torsion 'T' and bending moment 'M'. [8]

Or

8. (*a*) The principal stresses at a point in a strained material are 'σ_1' and 'σ_2'. Prove that the resultant stress on the plane carrying the maximum shear stress is :

$$\frac{\sqrt{\sigma_1^2 + \sigma_2^2}}{2}.$$ [8]

(*b*) Enlist and describe the theories of failure of different civil engineering materials. [8]

9. (*a*) A chimney is 45 m high. Its external diameter tapers from 4 m at the base to 2 m at the top. The internal diameter at the base is 2.5 m. The horizontal wind pressure is 2000 N/m^2. The self weight of chimney is 2.5 MN. Determine the maximum and minimum stresses at the base. [8]

(*b*) Derive an expression for Euler's critical load for a column having one end fixed and the other end hinged. [8]

Or

10. (*a*) A hollow cylindrical shaft of 250 mm external diameter is bored eccentrically, the diameter of bore being 190 mm so that the thickness varies from 20 mm at one end to 40 mm at the

other as shown in Fig. 10.1. If the shaft is subjected to a compressive load of 1000 kN along the axis of the bored hole, calculate maximum and minimum stress in the shaft. [8]

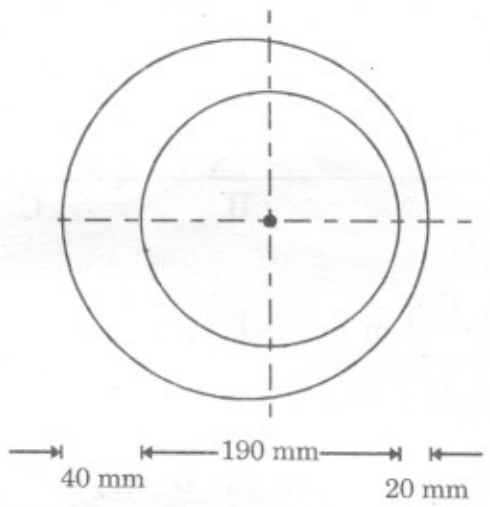

Fig. 10.1

(*b*) Find the percentage saving in the material if an axially loaded solid circular column is replaced by hollow circular column of the same cross-sectional area. The internal diameter of hollow column is $\frac{3}{4}$ of its external diameter. Both columns are of same material having same length and are hinged at one end and fixed at other end. It carries an axial load of 500 kN. Take E = 200 GPa. The length of column is 6 m. [8]

11. (*a*) A uniform beam of length 8 m is simply supported at its ends and carries u.d.l. of 2.5 kN/m between the mid span and a point at distance 2 m from right hand end as shown in Fig. 11.1. Obtain deflection at the mid span. [9]

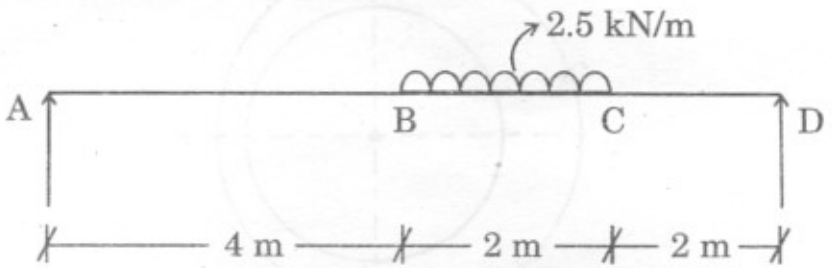

Fig. 11.1

(*b*) A cantilever of length 6 m is subjected to u.d.l. of 3 kN/m over half of its length from free end. The M.I. of cantilever is '2I' from fixed end over half of its length and 'I' over remaining half. Using Conjugate Beam Method, determine the slope and deflection at the free end.
Take $E = 200$ GPa, $I = 2 \times 10^8$ mm^4. [9]

Or

12. (*a*) A simply supported beam of span 5 m and flexural rigidity 4000 kN-m^2 carries a uniformly destributed load of 5 kN/m covering exactly left half of the span. Find maximum deflection and its location. [9]

(*b*) A simply supported beam of length '*l*' is subjected to a central point load 'W'. Using Conjugate Beam Method, determine slope and deflection of a point at a distance *l*/4 from right end of the beam. Take flexural rigidity of beam as EI. [9]

Total No. of Questions—6] [Total No. of Printed Pages—4

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S.E. (Civil) EXAMINATION, 2007

ENGINEERING GEOLOGY

(2003 Course)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) *All* questions are compulsory.

SECTION I

1. (A) Discuss with suitable example. "Igneous rocks show a wide variety of textures and this textural variation is a direct outcome of their mode of origin." [12]

(B) Describe the types of metamorphism. [4]

Or

Write short notes on (any *four*) :

(*i*) Clastic texture [4]

(*ii*) Agents of metamorphism [4]

(*iii*) Organic deposits [4]

(*iv*) Factors controlling weathering [4]

(*v*) Schistose and gneissose. [4]

P.T.O.

A

2. (*a*) How are rocks folded ? What are the different parts of fold and types of folds ? How a fold passes into a fault ? [12]

(*b*) Write a note on Block faulting. [4]

Or

Write notes on (any *four*) :

(*i*) Sill and dykes [4]

(*ii*) Unconformity [4]

(*iii*) Earthquake waves [4]

(*iv*) Dip and strike [4]

(*v*) Overthrust. [4]

3. (A) Define landslide. Give its causes and preventive measures. [8]

(B) What are earthquakes ? How are they caused ? Describe with a neat figures, focus, epicentre and iso-seismal lines of an earthquake. [10]

Or

(A) Give an account of Deccan trap basalt with reference to :

(*a*) Distribution [2]

(*b*) Types. [6]

(B) Describe any *one* feature resulting from river deposition. [3]

(C) Write short notes on :

(*i*) Relict Mountain [1½]

(*ii*) Vindhyan Building Stone [2]

(*iii*) The crust [1½]

(*iv*) Solid products of volcanoes. [2]

SECTION II

4. (*a*) Describe with suitable examples, various geological conditions in Deccan Trap leading to tail channel erosion. [9]

(*b*) Write a note on Geological Survey of reservoir area. [7]

Or

Write notes on :

(*a*) Durability of building stones [4]

(*b*) Causes leading to Land-slides [6]

(*c*) Use of Remote Sensing and G.I.S. in Civil Engineering Projects. [6]

5. (*a*) Discuss in detail drilling as a method of subsurface geological exploration. Give its limitations. [10]

(*b*) Write a note on hot springs and geysers. [6]

Or

Write notes on :

(*a*) Artesian wells [4]

(*b*) Contact springs [3]

(*c*) Depth zones [3]

(*d*) Preservation of core of tachylytic basalt [3]

(*e*) Core recovery. [3]

6. (*a*) Write in detail with suitable examples about influence of divisional planes on tunnelling. [10]

(*b*) Write a note on treatment to be given to a dyke and a fracture crossing dam alignment. [8]

Or

Write notes on :

(*a*) Importance of angle holes [3]

(*b*) Lengths and number of core pieces [3]

(*c*) Occurrence of Limestone in reservoir of dam [3]

(*d*) Mechanical fracture of drill core [3]

(*e*) Preventive measures against land-sliding. [6]

Total No. of Questions—**12**] [Total No. of Printed Pages—**4**

[3162]-105

S.E. (Civil) EXAMINATION, 2007

ENGINEERING ECONOMICS AND MANAGEMENT

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (A) Enlist different types of demand. Explain in short any *one*. [2+2]

(B) Explain Law of Substitution. [4]

(C) Explain Law of Diminishing Marginal Utility. [4]

(D) Discuss applications of economics to civil engineering. [4]

Or

2. (A) Explain Law of Supply. [4]

(B) Define the following terms :

(1) Asset

(2) Inventory

(3) Revenue

(4) Market. [4]

P.T.O.

(C) What is elasticity of supply ? Explain in short with the help of a sketch. [4]

(D) Explain indifference curve analysis. [4]

3. (A) State and explain "Law of Returns". [6]

(B) Give classification of market and explain any *one* in short. [6]

(C) Explain process of capital formation. [4]

Or

4. (A) Explain law of increasing returns. [6]

(B) What do you understand by term Gross Domestic Product G.D.P. Explain in brief. [4]

(C) What is division of labour ? State its advantages and disadvantages. [6]

5. (A) Define the term Money. What are its functions ? [4]

(B) Define Annuities. Enlist kind of annuities. [4]

(C) Define depreciation. Enlist various methods to calculate depreciation. Explain any *one* in brief. [6]

(D) Discuss the role of S.E.B.I. in capital market. [4]

Or

6. (A) Define the term capital. Enlist its different types and explain each in short. [6]

(B) Write a short note on B.O.T. [4]

(C) Define cost and give its classification. [4]

(D) Discuss important function of RBI. [4]

SECTION II

7. (A) Define management and explain its importance. [4]

(B) Discuss military organisation. [6]

(C) Enumerate contributions of Henry Fayol to management. [6]

Or

8. (A) What is Joint Stock Company ? Discuss its advantages and disadvantages. [8]

(B) Discuss line and staff organisation. [4]

(C) Write a note on Partnership. [4]

9. (A) Discuss various sources of recruitment. Explain each of it in short. [8]

(B) Differentiate between programmed and non-programmed decisions. [4]

(C) Define motivation. Give its importance. [4]

Or

10. (A) Explain in short concept of Decision Tree. [4]

(B) Explain the importance of Training. Briefly explain various training methods. [8]

(C) Define Leadership. Briefly explain styles of leadership. [4]

11. (A) What are Trade Unions ? Discuss their functions and objectives. [6]

(B) What is work study ? Explain method study and time study. [6]

(C) Write a note on T.Q.M. [6]

Or

12. (A) What are quality circles ? Discuss in brief. [4]

(B) Discuss in brief M.I.S. [4]

(C) Write a short note on KAIZEN. [4]

(D) What are aims and objectives of Industrial Psychology ? [6]

Total No. of Questions—**12**] [Total No. of Printed Pages—**8+1**

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S.E. (Civil) EXAMINATION, 2007

FLUID MECHANICS—I

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

Unit I

1. (*a*) A liquid has a specific gravity of 1.6. Find its mass density, specific weight, specific volume and kinematic viscosity if its dynamic viscosity is 1.2 Ns/m^2. [4]

(*b*) The pressure outside the droplet of water of diameter 0.06 mm is 10.62 N/mm^2. Calculate the pressure within the droplet, if surface tension is 0.0725 N/m of water. [4]

P.T.O.

(*c*) Using method of dimensional analysis, obtain an expression for the discharge Q over a rectangular weir. The discharge Q depends on the head 'H' over a rectangular weir, acceleration due to gravity '*g*', length of weir crest 'L', height of weir crest over the channel bottom 'Z' and the kinematic viscosity 'ν' of the liquid.

$$\therefore Q = g^{1/2}\, H^{5/2}\, f\left[\frac{\nu}{g^{1/2}\, H^{3/2}}, \frac{L}{H}, \frac{Z}{H}\right]. \qquad [8]$$

Or

2. (*a*) A cylindrical shaft of 90 mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm and internal diameter 95 mm. If the space between the tube and the shaft is filled by a lubricant of dynamic viscosity of 2 poise, determine the power required to overcome viscous resistance. The shaft rotates at a speed of 240 r.p.m. [8]

(*b*) Derive the expression for the following dimensionless numbers :

(*i*) Reynolds Number

(*ii*) Froude Number. [4]

(*c*) Define similitude and write uses of model analysis. [4]

Unit II

3. (*a*) Explain with diagram the stable, unstable and neutral equilibrium of floating body. [8]

(*b*) A U-tube containing mercury has its right limb open to atmosphere and left limb connected to a pipe conveying water under pressure, the difference in the levels of mercury in the two limbs being 200 mm (mercury level up on right side). If the mercury level in the left limb is 400 mm below the centre line of the pipe, find absolute pressure in the pipeline in kPa.

Also, find the new difference in the levels of mercury in the U-tube if the pressure in the pipe falls by 2.0 kN/m^2. [6]

(*c*) A rectangular tank 1.5 m wide, 3 m long and 1.8 m deep contains water to a depth of 1.2 m. Find the horizontal acceleration which may be imparted to the tank in the direction of its length so that :

(*i*) There is no spilling of water from the tank, and

(*ii*) The front bottom corner of tank is just exposed.

Also, calculate the volume of water that would spill out from tank in case (*ii*). [4]

Or

4. (*a*) Derive expression for the total pressure and centre of pressure for a plane inclined surface submerged in a liquid. [8]

(*b*) A solid cylinder of diameter 4 m has a height of 4 m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. Comment on the stability of the cylinder. [6]

(*c*) An open circular cylinder of 15 cm diameter and 100 cm length contains water upto a height of 80 cm. Find maximum speed in r.p.m. at which the cylinder is to be rotated about its vertical axis so that no water spills out. [4]

Unit III

5. (*a*) A stream function is given as $\psi = Uxy$. Determine :

(*i*) Whether the flow is possible.

(*ii*) Whether flow is rotational or irrotational.

(*iii*) The velocity potential ϕ

(*iv*) Acceleration component at point (1, 1). [8]

(*b*) Prove that streamlines and equipotential lines are orthogonal to each other. [4]

(*c*) Define Hydraulic gradient and total energy line. Draw H.G.L. and T.E.L. for flow of ideal fluid in a pipeline. [4]

Or

6. (*a*) A tappering pipe has a diameter of 30 cm at section 1 at elevation of 50 m and diameter of 50 cm at section 2 at elevation of 40 m. If the pressure at section 1 is 125 kPa, calculate pressure

at section 2 for a discharge of 0.5 m^3/sec of water. The kinetic energy correction factor at section 1 and 2 are 1.1 and 1.3 respectively. Assume head loss through pipe is h_f and

$$h_f = \frac{1.30\,(V_1 - V_2)^2}{2g}.$$ [8]

(*b*) What is velocity potential and stream function ? What are Cauchy-Rieman equations ? What are its uses ? [8]

SECTION II

Unit IV

7. (*a*) A venturimeter of throat diameter 5 cm is fitted into a 12.5 cm diameter pipeline. Determine the flow in the pipeline when the reading of differential U-tube manometer is 20 cm. If the energy loss in downstream part of divergent cone is 10 times the velocity head in pipe, calculate the total head loss. Take $C_d = 0.96$. [8]

(*b*) A rectangular channel 1.5 m wide has a discharge of 0.2 m^3/sec which is measured by a right angled triangle V notch. Find the position of apex of notch from the bed of channel if the maximum depth of water is not to exceed 1 m.

Assume : $C_d = 0.62$. [6]

(*c*) Explain how coefficient of velocity of orifice is determined experimentally. [4]

Or

8. (*a*) Derive an expression for the time required to empty a tank with :

(*i*) Rectangular notch

(*ii*) Triangular notch.

Assume suitable data. [6]

(*b*) Petroleum oil (specific gravity = 0.93 and viscosity = 0.013 N-s/m^2 flows isothermally through a horizontal pipe of diameter of 5 cm. A Pitot tube is inserted at the centre of the pipe and it is attached to a U-tube manometer. The water is used as manometric liquid in U-tube manometer. The reading of manometer is 10 cm. Calculate the flow of oil.

Assume coefficient of Pitot tube = 0.98. [6]

(*c*) A 40 m long weir is divided into 12 equal bays by vertical posts each of 0.6 m wide. Calculate the discharge over the weir if the head over the crest is 1.20 m and the velocity of approach is 2 m/s. [6]

Unit V

9. (*a*) Derive an expression for velocity distribution for viscous flow through a circular pipe. Also, sketch the distribution of velocity and shear stress across a section of pipe. [6]

(*b*) Glycerine (Viscosity = 1.50 P_a – S and ρ = 1260 kg/m^3) flows at a velocity of 5 m/s in a 10 cm diameter pipe.

Determine :

(*i*) The boundary shear stress in the pipe due to the flow.

(*ii*) Head loss in length of 12 m of pipe.

(*iii*) Power needed by the flow for the distance of travel = 12 m. [6]

(*c*) Show that the value of coefficient of friction for viscous flow through a circular pipe is

$$F = \frac{16}{R_e}$$

where R_e is Reynolds No. [4]

Or

10. (*a*) Prove that the momentum thickness and energy thickness for boundary layer flow are given by :

$$\theta = \int_0^{\delta} \frac{u}{U}\left(1 - \frac{u}{U}\right) dy$$

and

$$\delta_e = \int_0^{\delta} \frac{u}{V}\left(1 - \frac{u^2}{V^2}\right) dy. \quad [6]$$

(*b*) A flat plate 1.5 wide and length 'L' *m* is kept parallel to a uniform stream of air flow of velocity of 3.0 m/sec in a wind tunnel. If it is desired to have laminar boundary layer along the plate, what

is maximum length 'L' of the plate is required ? For this maximum length of the plate, determine the drag for on one side of plate.

Take : ρ_{air} = 1.2 kg/m^3, ν_{air} = 1.45 × 10^{-5} m^2/sec. [6]

(*c*) What is meant by average drag coefficient, C_d ? How does it differ from local drag coefficient, C_D* ? [4]

Unit VI

11. (*a*) A fire engine supplies water to a hosepipe 75 m long and 0.075 m in diameter at a pressure of 294 kN/m^2 (Gauge). The discharge end of the hosepipe has a nozzle of diameter '*d*' fixed at its end.

Determine the diameter of nozzle so that the momentum of the issuing jet would be maximum.

Take friction factor = 0.032. [4]

(*b*) A farmer wishes to connect two pipes of different lengths and diameter to a common header supplied with 10 × 10^{-3} m^3/sec of water from a pump. One pipe is 110 m long and 6 cm in diameter. The other pipe is 950 m long. Determine the diameter of the second pipe such that both pipes have the same flow rate.

Assume that the pipe are to be laid at levelled ground and friction coefficient for both pipes is 0.02.

Also, determine the head loss in meters of water in the pipes. [6]

(*c*) Define the terms major energy losses and minor energy losses in pipe. Enlist various types of minor losses in pipe flow. [6]

Or

12. (*a*) State any *four* characteristics of turbulent flow. [4]

(*b*) Derive an expression for shear stress on the basis of 'Prandtl Mixing Length Theory'. [6]

(*c*) Water is flowing through a rough pipe of 0.5 m diameter and 800 m length at the rate of 0.5 m^3/sec. Assuming average height of roughness as 0.015 mm. Determine :

(*i*) Coefficient of friction

(*ii*) Wall shear stress

(*iii*) Centre line velocity and velocity at a distance of 200 mm from pipe wall. [6]

Total No. of Questions—**11**] [Total No. of Printed Pages—**4+2**

[3162]-107

S.E. (Civil) EXAMINATION, 2007

BUILDING PLANNING AND BUILT ENVIRONMENT

(2003 COURSE)

Time : Four Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

(*vii*) Section II should be written only on drawing sheets.

SECTION I

1. (*a*) Explain any *two* principles of planning with respect to an educational building. [6]

(*b*) Explain how a building acts as an environmental filter. [4]

(*c*) State different zones for the purpose of development of a city and explain any *one*. [6]

P.T.O.

Or

2. (*a*) Explain the importance of landscaping pertaining to institutional buildings. [6]

(*b*) Discuss the importance of built up area, plinth area and carpet area. [6]

(*c*) Explain how utility of living room can be enhanced by proper interior decoration and planning. [4]

3. (*a*) Write a short note on heat exchange of buildings. [6]

(*b*) Explain how climatic factors affect the design of buildings. [6]

(*c*) Describe :

(*i*) Sky component

(*ii*) ERC. [6]

Or

4. (*a*) Explain the principles of lighting and define day light factor. [6]

(*b*) Explain in brief the working principles of comfort air-conditioning. [6]

(*c*) Write short notes on :

(*i*) Wind effect

(*ii*) Stack effect. [6]

5. (*a*) A studio has dimensions 10 × 7 × 5 m. Ceiling is provided with acoustical tiles with absorption coefficient 0.4 and curtains with heavy folds on one of short walls with coefficient 0.5.

Absorption power of other surfaces of studio may be taken as 8.5 m^2 sabines. Calculate extra absorption units required for reverberation time of 1 sec. [6]

(*b*) Discuss important considerations in fire protection. [4]

(*c*) State and discuss briefly the necessary building services. [6]

Or

6. (*a*) Discuss various measures to be taken during construction for noise control and sound insulation for hospital buildings. [6]

(*b*) State the various fire resistant materials that can be used for walls and floors. [4]

(*c*) What is reverberation time ? Why are echoes formed ? [6]

SECTION II

7. (*a*) Draw a detailed plan to a scale of 1 : 50 of a residential building for the given line plan in Fig. 1. Use the following data : [12]

(*i*) The structure is load bearing.

(*ii*) All dimensions are in mm.

(*iii*) The given dimensions indicate the internal sizes of the respective units.

(*iv*) All walls are one brick thick walls.

(*v*) It has only ground floor.

(*vi*) Stair-case is provided to have access to terrace.

(*vii*) Assume suitable sizes of doors and windows.

(*viii*) Take plinth height = 900 mm

(*ix*) R.C.C. slab is provided on all rooms.

(*x*) Locate doors and windows at suitable locations.

(*xi*) Give the detailed dimensions.

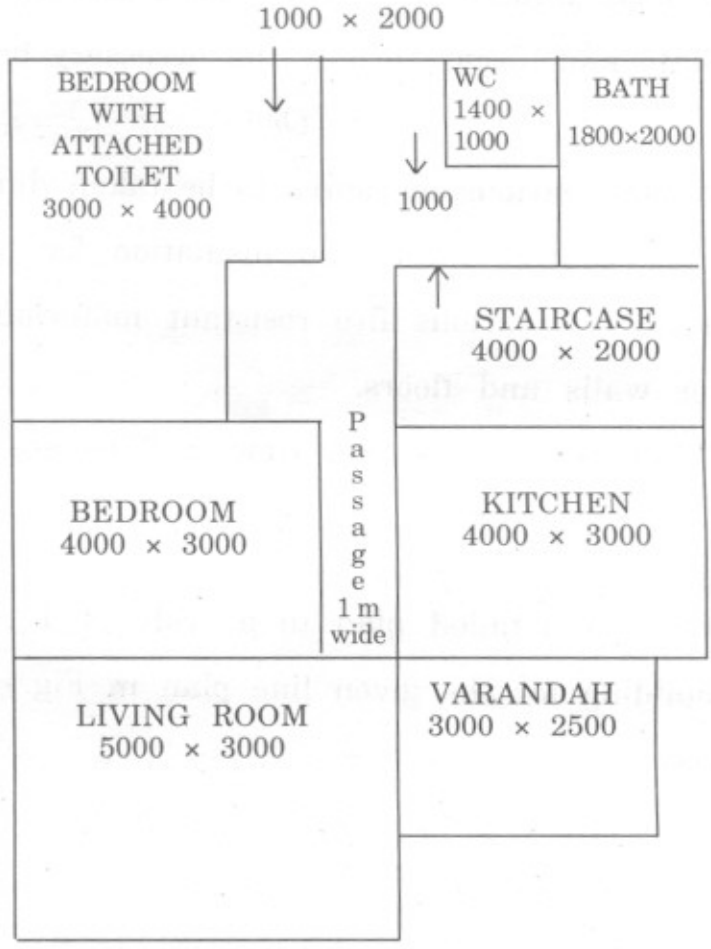

Fig. 1. : **Line Plan**

(*b*) For the above drawn plan of a building show cross-section of foundation and plinth filling. Assume the following data :

(*i*) Depth of foundation below ground level = 1.2 m.

(*ii*) It is spread footing. Use UCR masonry for foundation.

[8]

Or

8. Draw a detailed plan of a residential building with suitable scale. The building has ground floor and first floor. It is framed structure. It should satisfy the following requirements :

Sr. No.	Name of Unit	Internal Area of Unit in m^2	No. of Units
1.	Living room	20	01
2.	Bed-rooms	15 each	02
3.	Master bed with attached toilet & bath.	20	01
4.	Kitchen	12	01
5.	Verandah	10	01
6.	W.C.	1.8 each	02
7.	Bath	2.8	01
8.	Stair-case	Use suitable dimensions	01

Draw the separate plans for ground floor and first floor. [12+8]

9. It is proposed to plan a lodge in a city with a accommodation capacity of 60 passengers. It does not have any food cooking or serving facility. Few rooms can be planned to accommodate single bed and few rooms as double bed. Use additional rooms for supporting facilities required in a Lodge. Plan the structure as G+1 framed structure.

Draw line plan only for both the floors. Use the norms and standard guide-lines to decide the sizes of different rooms.

Draw north direction. [15]

Locate the positions of openings. [3]

Or

10. Draw a line plan for primary health centre. It should be ground floor only.

Show all necessary units. Show North Direction. Use standard norms to finalise the dimensions of each unit. [15]

Locate the positions of all openings for doors and windows. [3]

11. Draw to scale 1 : 100 or any suitable, a two point perspective view for the sketch shown in Fig. 2.

Select station point vertically below the plan from the point where the inclined plan touches the picture plane. Take station point 6.0 m below picture plane.

Select eye level = 1.85 above G.L.

Retain all construction lines. [12]

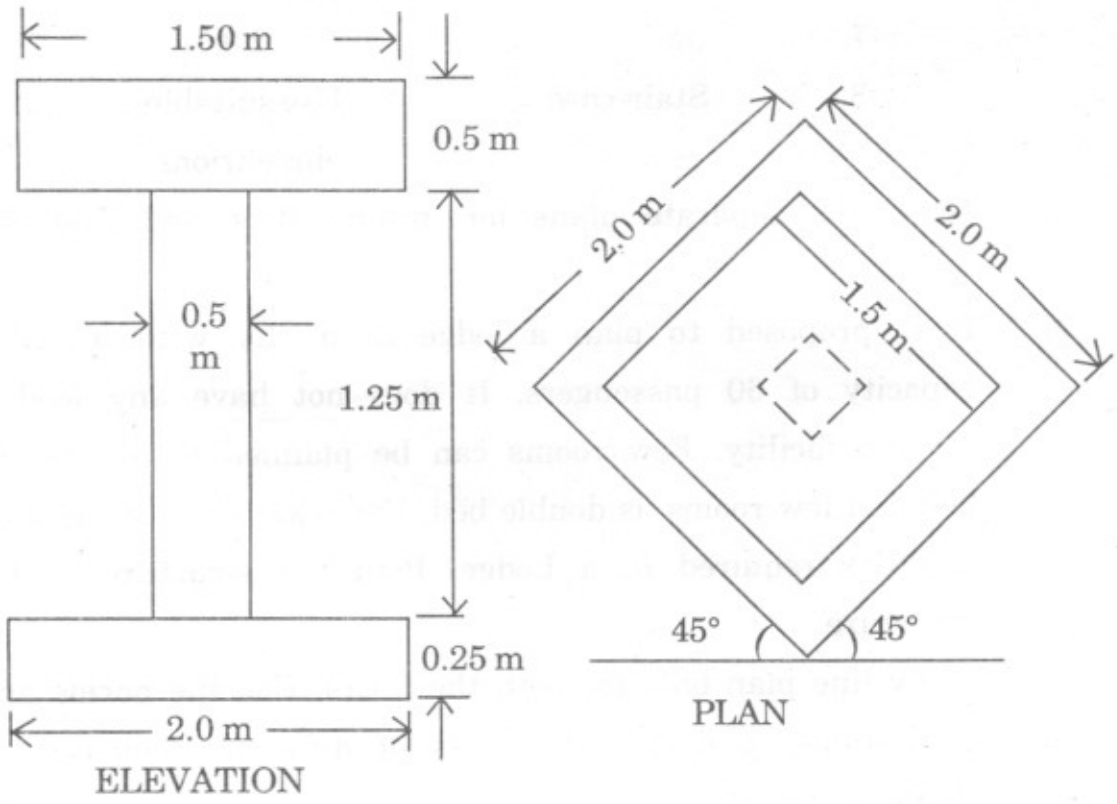

Fig. 2

Total No. of Questions—12] [Total No. of Printed Pages—7

[3162]-108

S.E. (Civil) EXAMINATION, 2007

SURVEYING—I

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (*a*) What are the sources of errors in levelling ? What precautions are necessary to avoid them ? [5]

(*b*) A dumpy level was set up exactly midway between two pegs A and B 100 m apart. The reading on the staff at the two pegs A and B were 2.785 m and 3.925 m respectively. The instrument was then moved to station 'C', 10 m beyond A on the line BA produced the respective staff readings were 2.115 m and 3.325 m.

P.T.O.

Calculate the staff readings on the two pegs A and B to provide horizontal line of sight. [6]

(*c*) Explain with a neat sketch how would you measure total vertical angle between top and bottom of ranging rod. [5]

Or

2. (*a*) Define the following terms :

(1) Telescope normal

(2) Telescope inverted

(3) Horizontal axis

(4) Swinging the telescope

(5) Vertical axis. [5]

(*b*) Explain with a neat sketch two peg method to make the line of collimation parallel to the bubble tube axis. [6]

(*c*) Write a note on degree of precision in levelling works. [5]

3. (*a*) The following are the particulars of closed traverse :

Line	**Length** (m)	**Latitude**	**Departure**
AB	200	+171.80	–102.40
BC	300	+70.10	+287.50
CA	300	–241.50	–185.40

Find :

(1) Closing error and relative error of closure.

(2) Corrected independent co-ordinates of all stations, if the total latitude and total departure of A 500 each. Use Bowditch Rule. [6]

(*b*) What is Gale's traverse table ? Discuss the procedure for recording the various entries in the table. [6]

(*c*) Explain in detail the procedure of measurement of deflection angle using transit theodolite. [5]

Or

4. (*a*) The length and bearing of a line XY cannot be observed directly and the following set of observations were obtained from stations P and Q :

Line	**Length** (m)	**Bearing**
PQ	156	92° 30′
QY	206	8° 45′
PX	184	4° 15′

Calculate the length and bearing of line XY. [6]

(*b*) Discuss how the omitted measurements are determined in case the length of one line and bearing of an adjacent line is omitted. [6]

(c) Explain the procedure of locating the object by angles from two stations. [5]

5. (a) With a sight horizontal reading on a staff held vertical were 2.840 and 1.645 corresponding to the top and bottom stadia wires. The distance between the instrument station and the staff station is 120 m. The focal length of the object glass is 20 cm and the distance from the object glass to the trunnion axis is 15 cm. Calculate the stadia interval. [6]

(b) Define contour. What do you understand by contour interval and on what factors does it depend ? [5]

(c) Explain in detail the procedure of carrying out direct method of contouring. [6]

Or

6. (a) The following observations were made for two stations A and B to determine the gradient of the line AB. A tacheometer was set up at station C and the staff at A and B was held vertically :

Staff Station	**Vertical Angle**	**Staff Readings**
A	+3° 50′	1.250, 1.720, 2.190
B	+0° 12′	1.095, 1.520, 1.945

Horizontal angle ACB = 40° 50′, Tacheometer is fitted with anallatic lens. Calculate the gradient of line AB. [6]

(*b*) Write a short note on profile levelling. [5]

(*c*) What do you mean by interpolation of contours ? Discuss the various methods of interpolation in brief. [6]

SECTION II

7. (*a*) Describe the method of setting out a simple circular curve by Rankine method of deflection angles using two theodolites. [6]

(*b*) What are the various types of vertical curves ? Discuss each with neat sketch. [5]

(*c*) Calculate the necessary data for setting out a simple circular curve of 350 m radius to connect the two tangents intersecting at the chainage 1238 m, the deflection angle being 36°. Take the peg interval equal to 30 m. Use Rankine method of deflection angles. [6]

Or

8. (*a*) The chainage of the intersection point of two straights is 2105.59 m and the deflection angle is 45° 20′. A circular curve of 250.00 m radius is to be set out to connect the two straights. Calculate the necessary data for setting out a curve by method of offset from the chord produced. [6]

(*b*) Write a short note on obstacles in setting out a curve. [5]

(*c*) Two straights meets at an angle of 138° are to be connected by a simple curve of 264 m length. Find the radius of the curve and the value of versed sine for a unit chord of 30 m. [6]

9. (*a*) What are the methods of determining the length of a transition curve ? Explain any *one* in detail. [4]

(*b*) Write a short note on use of reverse curves in highways. [4]

(*c*) A compound curve consisting of two simple circular curves of radia 350 m and 500 m is to be laid out between two straights. The angle of intersection between the tangents and the two straights are 25° and 55°. Calculate :

(1) Length of common tangent

(2) Length of tangents. [8]

Or

10. (*a*) A road 8 metres wide is to deflect through an angle of 60° with the centre line radius of 300 m. A transition curve is to be used at each end of the circular curve of such a length that the rate of gain of radial acc^{n} is 0.5 m/sec^{2}, when the speed is 50 kmph.

Find out :

(1) Length of transition curve

(2) Superelevation

(3) Shift. [8]

(*b*) Explain the functions of transition curve. [4]

(*c*) Write a short note on use of reverse curves in highways. [4]

11. (*a*) Enumerate the different methods of plane table surveying. Describe *one* of them in detail with a neat sketch. [6]

(*b*) What are the types of errors in plane tabling ? How are they minimized ? [5]

(*c*) In plane table survey at one plane table station it was found that the table was not accurately centered over the ground station. If the displacement was 25 cm in a direction right angle to the ray, calculate the displacement of point from its true position on the plane table sheet, if the scale of the plotting is :

(*i*) $\frac{1}{50}$

(*ii*) $\frac{1}{500}$

(*iii*) $\frac{1}{5000}$. [6]

Or

12. Write short notes on : [17]

(*a*) Two point problem

(*b*) Lehman's Rule

(*c*) Temporary adjustment of plane table.

Total No. of Questions—12] [Total No. of Printed Pages—8+2

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S.E. (Civil) EXAMINATION, 2007

THEORY OF STRUCTURES–I

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

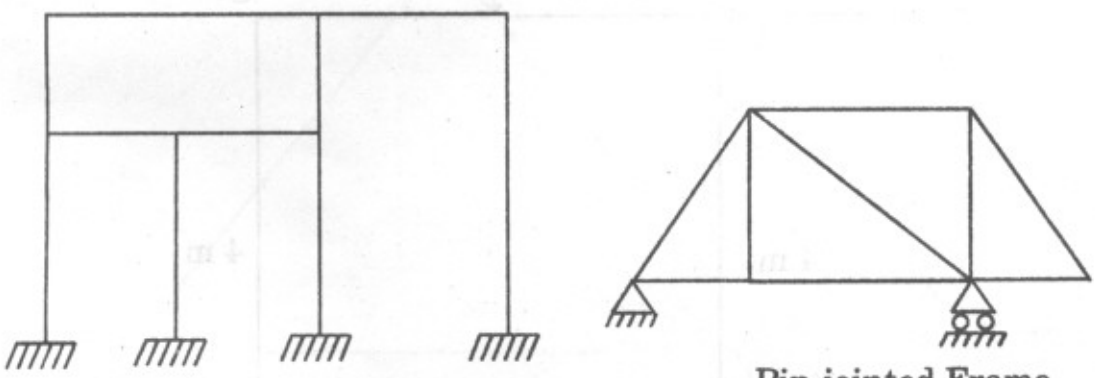
(*iii*) Figures to the right indicate full marks.

(*iv*) Use of electronic pocket calculator is allowed.

(*v*) Assume suitable data, if necessary.

SECTION I

1. (A) Determine static and kinematic degree of indeterminacy for the structures as shown in Fig. 1. [6]



Stiff-jointed Frame

Pin-jointed Frame

Fig. 1

P.T.O.

(B) Determine the strain energies of the three bars shown in Fig. 2, having same length, same material and same axial force. [6]

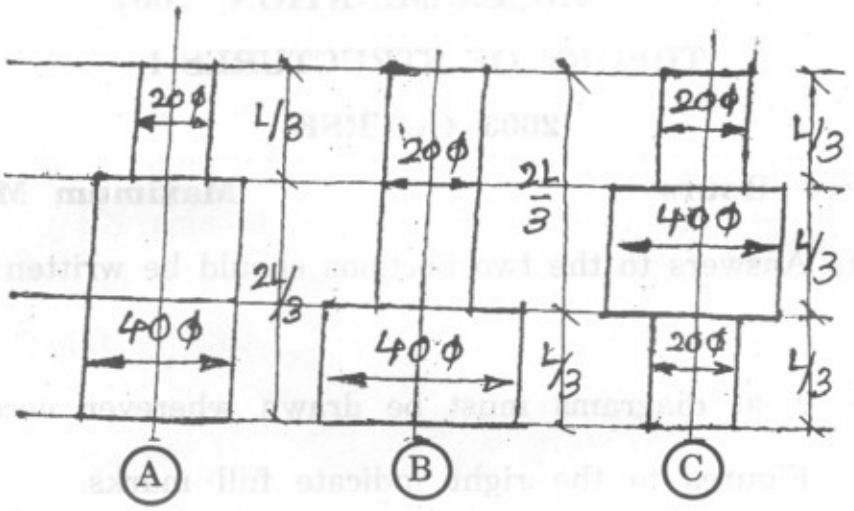


Fig. 2

(C) A portal frame ABCD is hinged at A and has a roller support at D. It is subjected to loads as shown in Fig. 3. Find the horizontal displacement at D. Take EI = 35×10^3 kNm^2. [6]

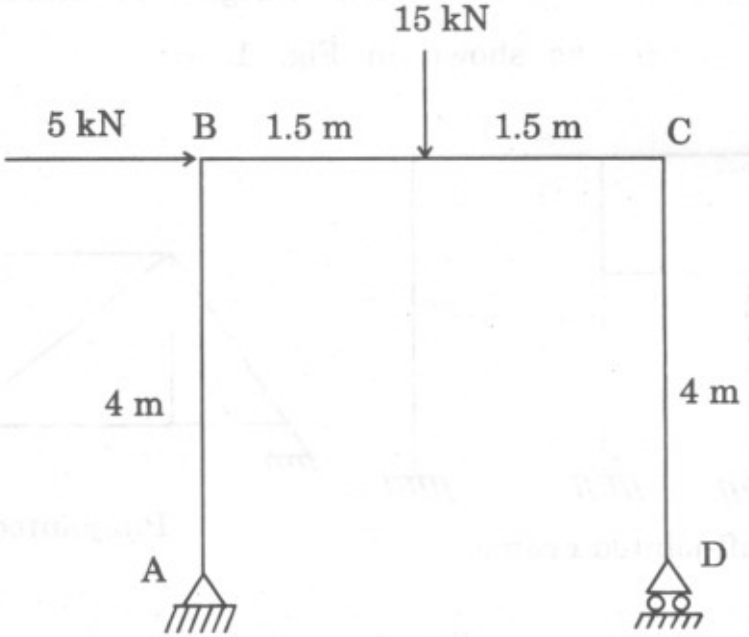


Fig. 3

Or

2. (A) Explain in brief static and kinematic indeterminacies of a structure. Find these for a plane frame shown in Fig. 4. [5]

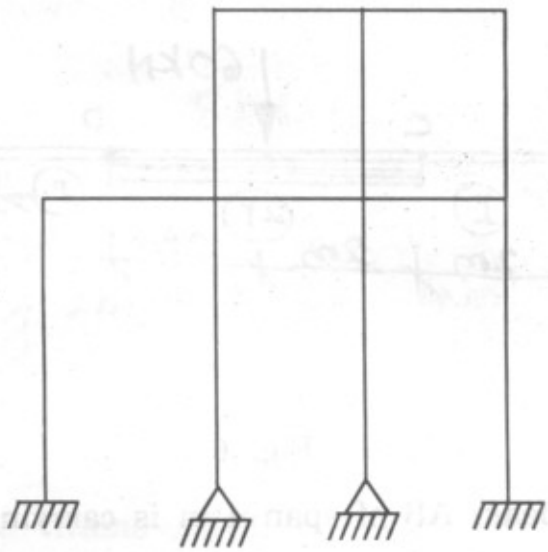


Fig. 4

(B) For the truss shown in Fig. 5, calculate the total strain energy and deflection at point C. Take cross-sectional area of tension members = 60 mm^2, compression members = 200 mm^2 and modulus of elasticity 'E' = 200 GPa. [6]

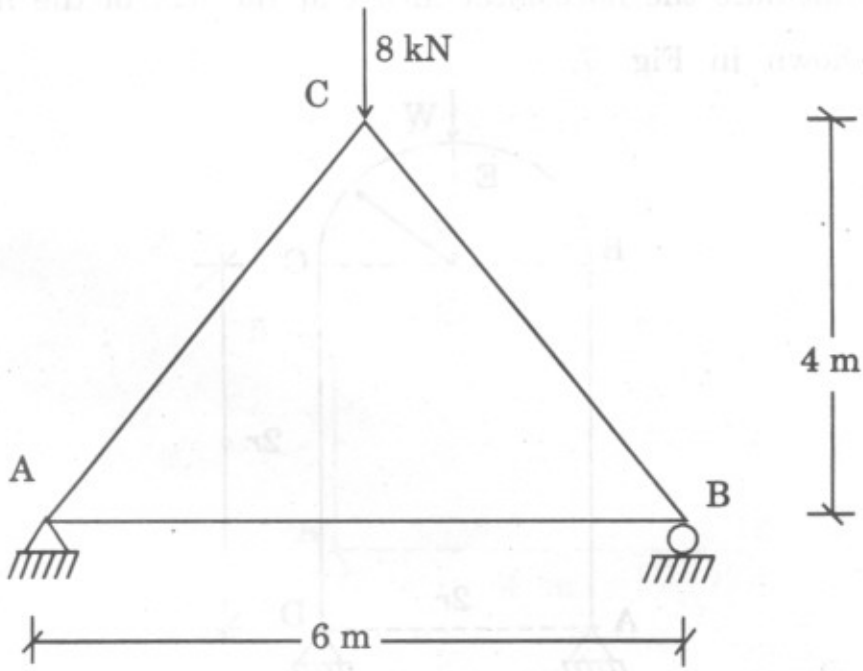


Fig. 5

(C) Determine the central deflection for the beam shown in Fig. 6. Take E = 200 GPa, I = 4×10^7 mm^4. [7]

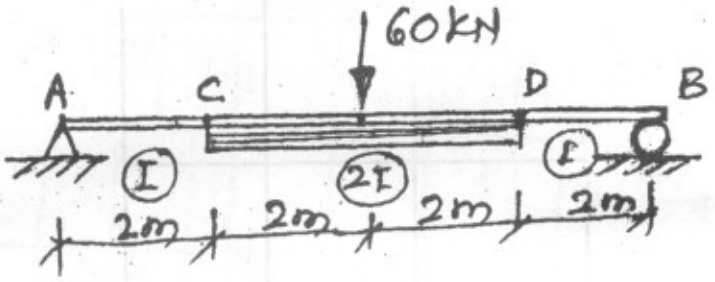


Fig. 6

3. (A) A fixed beam AB of span 4 m is carrying a u.d.l. of 15 kN/m over the whole span. The support B sinks down by 10 mm. If E = 200 GPa, I = 8×10^7 mm^4 then calculate the fixed end moments and draw the Bending Moment Diagram. [8]

(B) Calculate the horizontal thrust at the feet of the frame ABCD shown in Fig. 7. [8]

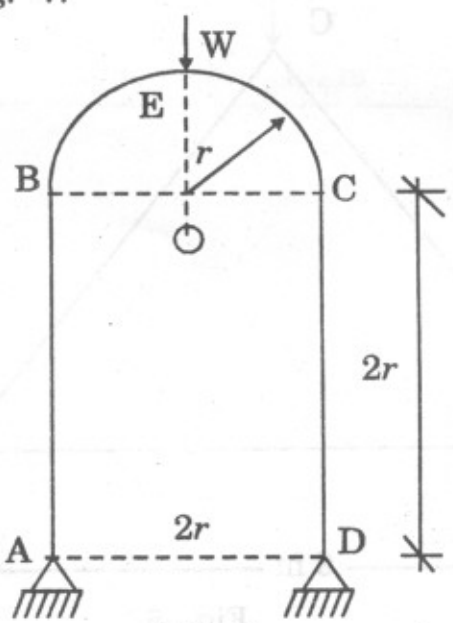


Fig. 7

Or

4. (A) Determine the fixed end moments at A and D for the beam ACD shown in Fig. 8 and draw B.M.D. [8]

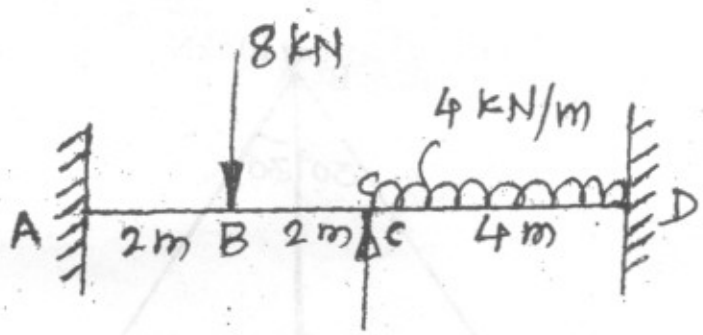


Fig. 8

(B) A portal frame ABCD is hinged at its feet A and D with stiff joints at B and C. Calculate the horizontal thrust at the hinges, using the method of minimum-strain energy. EI = constant. Neglect the effect of shear and axial thrust in the columns. Refer Fig. 9. [8]

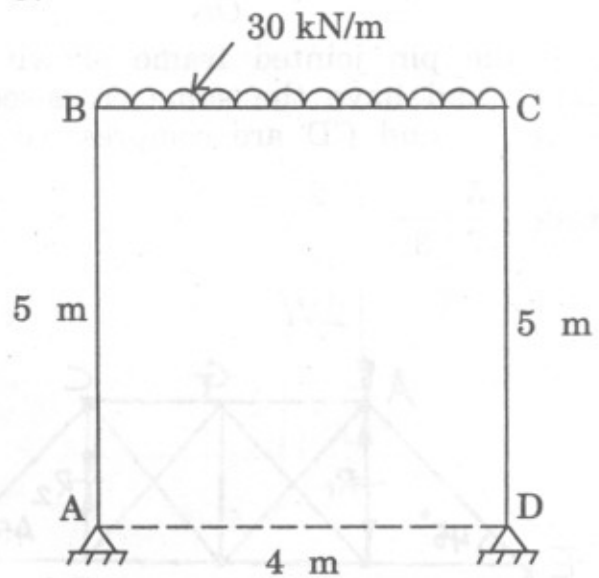


Fig. 9

5. A truss is loaded as shown in Fig. 10. Determine the horizontal deflection of roller C. Take E = 200 GPa cross-sectional area of members AB and BC is 1000 mm^2 and members AD, BC, CD is 500 mm^2. [16]

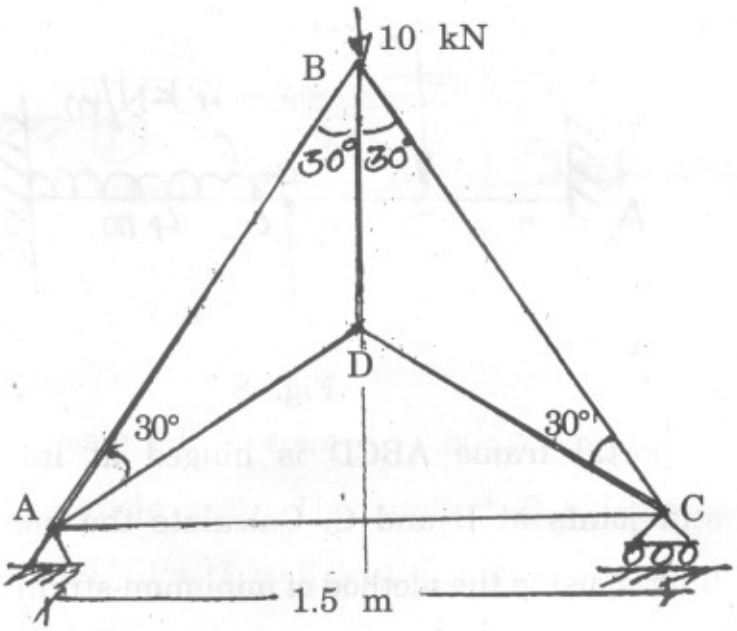


Fig. 10

Or

6. The bars of the pin jointed frame shown in Fig. 11 are of the same material and have the same cross-sectional area. Show that the forces in AB and CD are compressive and tensile respectively of magnitude $\frac{W}{2}\left[\frac{1+2\sqrt{2}}{3+4\sqrt{2}}\right]$. [16]

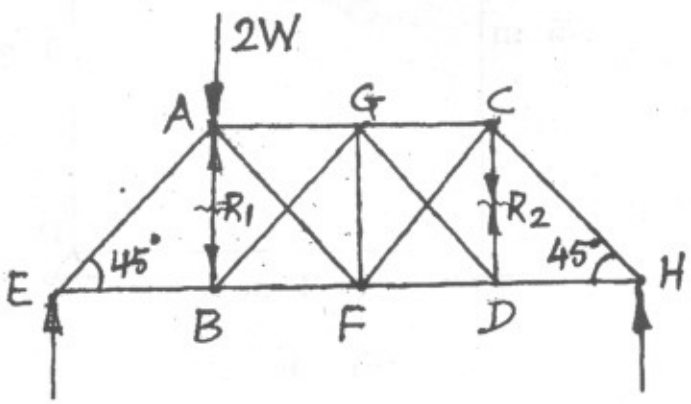


Fig. 11

SECTION II

7. Analyse the rigid frame shown in Fig. 12 by slope-deflection method. Draw B.M.D. [16]

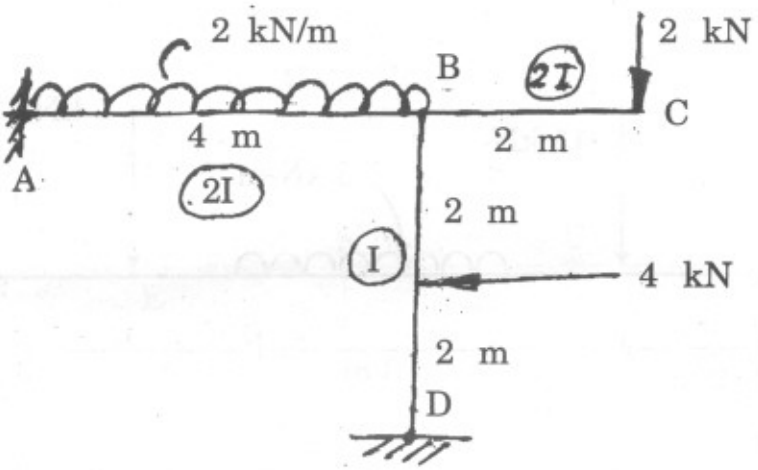


Fig. 12

Or

8. Analyse the frame shown in Fig. 13 by using Moment Distribution Method. Draw bending moment diagram and the deflected shape of the Frame. [16]

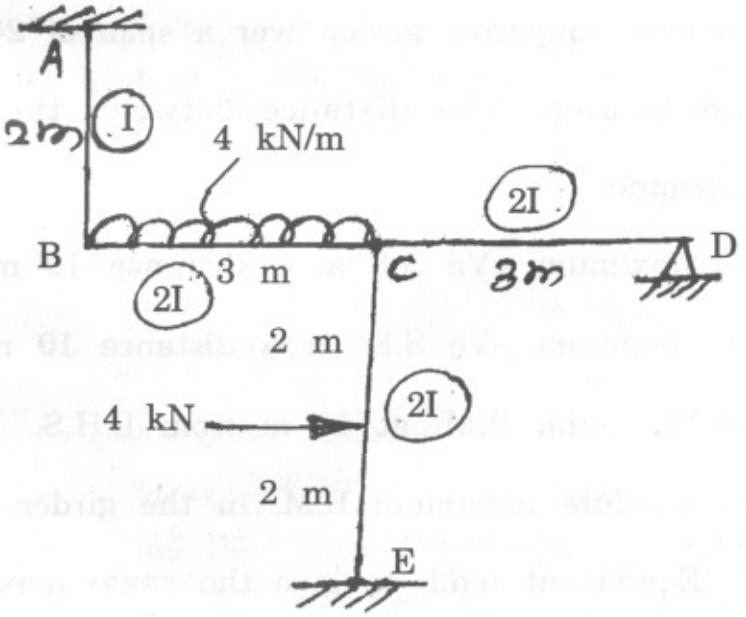


Fig. 13

9. (A) Find the support reactions of a simply supported beam loaded as shown in Fig. 14. Also determine the Bending moment at the centre of the beam, using the influence lines method. [8]

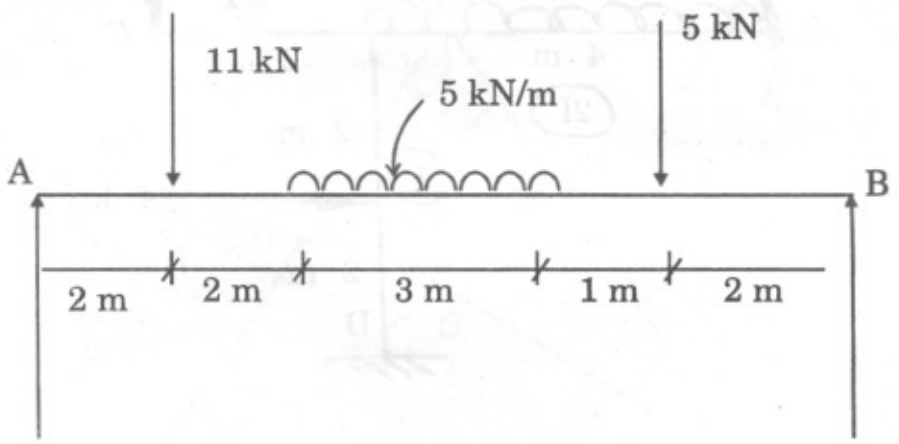


Fig. 14

(B) Four wheel loads 25 kN, 50 kN, 75 kN and 75 kN cross a simply supported girder over a span of 24 m with 25 kN load leading. The distance between the loads is 3 m, determine

(*i*) Maximum +Ve S.F at a distance 10 m from L.H.S.

(*ii*) Maximum –Ve S.F. at a distance 10 m from L.H.S.

(*iii*) Maximum B.M. at 10 m from L.H.S.

(*iv*) Absolute maximum B.M. in the girder.

(*v*) Equivalent u.d.l. to give the same maximum B.M. [8]

Or

10. (A) A compound beam ABC has simple supports at A, B and C and internal hinge at D. Draw influence lines diagrams for reaction at A, reaction at B, reaction at C and S.F. and B.M. at E. Refer Fig. 15. [8]

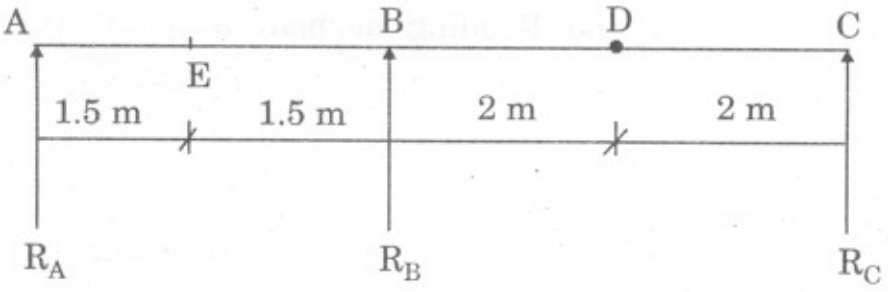


Fig. 15

(B) A girder of span 18 m is supported at its ends. Four wheel loads 150 kN, 150 kN, 250 kN and 100 kN traverse the girder from left to right with 100 kN load leading. The distance between the wheel load is 3 m. Determine :

(*i*) Maximum S.F. at 6 m from L.H.S.

(*ii*) Maximum B.M. at 6 m from L.H.S.

(*iii*) Absolute maximum B.M.

(*iv*) Equivalent u.d.l. to give the same maximum B.M. [8]

11. (A) A three hinged circular arch of 20 m span and 3 m rise is carrying a point load of 100 kN at a section 7.5 m from the left support. Find the value of horizontal thrust and B.M. at a point 7.5 m from the right support. [8]

(B) A two hinged semi-circular arch of radius r, carries a point load of W at the crown. Find the horizontal thrust and draw B.M.D. [8]

Or

12. (A) A three hinged parabolic arch with hinges at springings A and B and at crown C is loaded as shown in Fig. 16. The load of 40 kN acts at the centre of AC. Calculate the reactions at A and B and Bending moment at point D which is the midpoint of CB. [8]

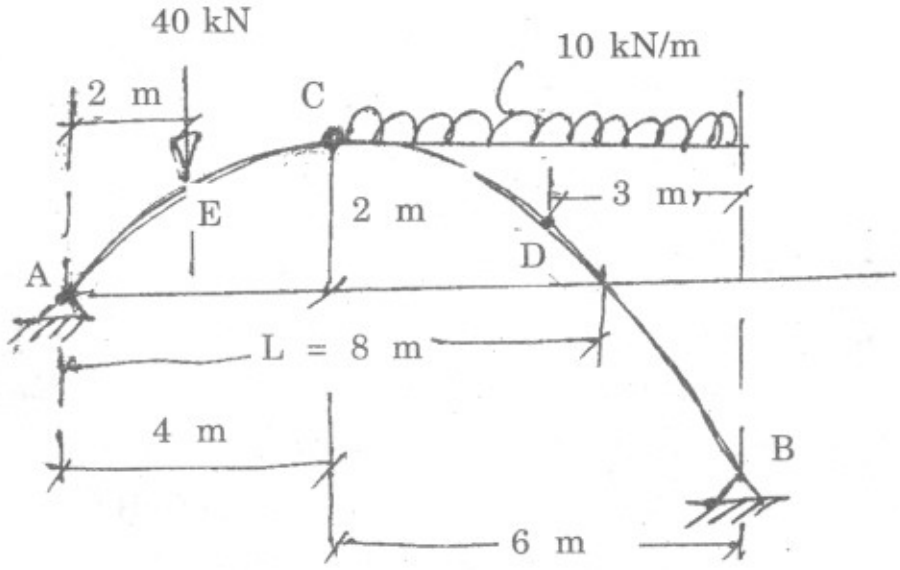


Fig. 16

(B) A two hinged semi-circular arch of radius R carries a u.d.l. of W kN/m over whole span. Determine the horizontal thrust at the supports. [8]

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[3162]-101

S.E. (Civil) EXAMINATION, 2007

ENGINEERING MATHEMATICS—III

122

(2003 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) In Section I, attempt Q. No. **1** *or* Q. No. **2**, Q. No. **3** *or* Q. No. **4**, Q. No. **5** *or* Q. No. **6**.

In Section II, attempt Q. No. **7** *or* Q. No. **8**, Q. No. **9** *or* Q. No. **10**, Q. No. **11** *or* Q. No. **12**.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of non-programmable electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Solve (any *three*) : [12]

(*i*) $\dfrac{d^2y}{dx^2} - 3\dfrac{dy}{dx} + 2y = xe^{3x} + \sin 2x$

(*ii*) $\left(D^2 - 1\right)y = e^{-x}\sin\left(e^{-x}\right) + \cos\left(e^{-x}\right)$

P.T.O.

(iii) $\left(D^3 - D^2 + 3D + 5\right)y = e^x \cos 3x$

(iv) $\left(D^2 + 4\right)y = 4 \sec^2 2x$ (Method of Variation of Parameters)

(v) $x^3 \frac{d^2y}{dx^2} + 3x^2 \frac{dy}{dx} + xy = \sin(\log x)$.

(b) Solve :

$$\frac{dx}{x^2 + y^2} = \frac{dy}{2xy} = \frac{dz}{(x + y)^3 z}.$$ [5]

Or

2. (a) Solve (any *three*) : [12]

(i) $\left(D^2 - 1\right)y = x\left(\sin x + e^x\right)$

(ii) $\left(D^2 + 5D + 6\right)y = e^{-2x} \sec^2 x(1 + 2\tan x)$

(iii) $\operatorname{cosec} x \frac{d^4y}{dx^4} + y \operatorname{cosec} x = \sin 2x$

(iv) $\left(D^2 + 4\right)y = \frac{1}{1 + \cos 2x}$ (Method of Variation of Parameters)

(v) $(2x + 1)^2 \frac{d^2y}{dx^2} - 6(2x + 1) \frac{dy}{dx} + 16y = 8(2x + 1)^2$.

(*b*) Solve :

$$\frac{du}{dx} + v = \sin x$$

$$\frac{dv}{dx} + u = \cos x,$$

given that when $x = 0$, $u = 1$ and $v = 0$. [5]

3. (*a*) The differential equation satisfied by a beam uniformly loaded with one end fixed and second subjected to a tensile force P is given by :

$$EI\frac{d^2y}{dx^2} - P_y = -\frac{W}{2}x^2.$$

Show that the elastic curve for the beam under conditions $y = 0$, $\frac{dy}{dx} = 0$, when $x = 0$, is given by :

$$y = \frac{W}{2P}\left[x^2 + \frac{2}{n^2} - \frac{e^{nx}}{n^2} - \frac{e^{-nx}}{n^2}\right],$$

where $EI = \frac{P}{n^2}$. [8]

(*b*) The temperature at any point of the insulated metal rod of one metre length is governed by the equation :

$$\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}.$$

Find $u(x, t)$ subject to the following conditions :

(*i*) $u(0, t) = 0°C$

(*ii*) $u(1, t) = 0°C$

(*iii*) $u(x, 0) = 50°C$, and hence find the temperature in the middle of the rod at any subsequent time. [9]

Or

4. (*a*) A 2 kgs. weight suspended from a string stretches it 8 cms. The weight is pulled 15 cms below equilibrium position and released. Assume that the weight is acted upon by a damping force which in kgs is numerically equal to IV, where V is the instantaneous velocity in met./sec. Determine the position of the spring at any time after the weight is released. [8]

(*b*) A string is stretched and fastened to two points, distance '*l*' apart, is displaced into the form $y(x, 0) = K(lx - x^2)$, from which it is released at $t = 0$. Find the displacement of the string at a distance x from one end. [9]

5. (*a*) Solve the following system of equations by Gauss-Seidel method :

$$27x_1 + 6x_2 - x_3 = 85$$

$$6x_1 + 15x_2 + 2x_3 = 72$$

$$x_1 + x_2 + 54x_3 = 110.$$

Carry out four iterations. [8]

(*b*) Using fourth order Runge-Kutta method, evaluate the value of y for $x = 0.1$ and $x = 0.2$, given the differential equation :

$$\frac{dy}{dx} = xy + y^2, \; y(0) = 1. \qquad [8]$$

Or

6. (*a*) Solve the following system of equations by Cholesky's method :

$$4x_1 + 2x_2 + 4x_3 = 10$$

$$2x_1 + 2x_2 + 3x_3 + 2x_4 = 18$$

$$4x_1 + 2x_2 + 6x_3 + 3x_4 = 30$$

$$2x_2 + 3x_3 + 9x_4 = 61. \qquad [8]$$

(*b*) Using Adam's Bashforth method, determine $y(1.4)$, given that :

$$\frac{dy}{dx} = x^2(1 + y), \; y(1) = 1.$$

Obtain the starting values from Euler's method, taking $h = 0.1$. [8]

SECTION II

7. (*a*) An unbiased coin is thrown 10 times. Find the probability of getting exactly 6 heads, at least 6 heads. [5]

(*b*) From a group of 10 students marks obtained by each in papers of Mathematics and Applied Mechanics are given as :

x	y
23	25
28	22
42	38
17	21
26	27
35	39
29	24
37	32
16	18
46	44

Calculate Karl Pearson's coefficient of correlation. [6]

(*c*) Calculate standard deviation for the following distribution. Decide whether A.M. is good average :

Class Interval	**Frequency**
0—10	5
10—20	9
20—30	15
30—40	12
40—50	10
50—60	3

[5]

Or

8. (*a*) In a certain examination test, 2,000 students appeared in the subject of Statistics. Average marks obtained were 50% and S.D. 5%. How many do you expect to obtain more than 60% supposing that marks distributed normally. (Area corresponding to $z = 2$ is 0.4772) [6]

(*b*) Determine the equation of regression lines for the following data and obtain an estimate of y for $x = 4.5$:

x	y
1	9
2	8
3	10
4	12
5	11
6	13
7	14
8	16
9	15

[5]

(*c*) Calculate the first four moments about the mean of given distribution. Also find β_1 and β_2.

x	f
2.0	4
2.5	36
3.0	60
3.5	90
4.0	70
4.5	40
5.0	10

[5]

9. (*a*) A particle describes the curve $r = 2a \cos \theta$ with constant angular speed ω, find the radial and transverse components of velocity and acceleration. [5]

(*b*) Find the directional derivative of $\phi = e^{2x} \cos yz$ at (0, 0, 0) in the direction of tangent to the curve $x = a \sin t$, $y = a \cos t$, $z = at$, at $t = \pi/4$. [5]

(*c*) Prove that (any *two*) : [6]

(*i*) $\nabla \cdot \left(\dfrac{\bar{a} \times \bar{r}}{r} \right) = 0$

(*ii*) $\nabla \cdot \left[r \nabla \left(\dfrac{1}{r} n \right) \right] = \dfrac{n(n-2)}{r^{n+1}}$

(*iii*) $\bar{b} \times \nabla [\bar{a} \cdot \nabla \log r] = \dfrac{\bar{b} \times \bar{a}}{r^2} - \dfrac{2(\bar{a} \cdot \bar{r})}{r^4} (\bar{b} \times \bar{r})$.

Or

10. (*a*) A particle describes the curve $r^2 = a^2 \cos 2\theta$ under the action of a force directed towards the pole. Find the law of force. [5]

(*b*) Show that :

$$\bar{F} = \left(6xy + z^3\right) \bar{i} + \left(3x^2 - z\right) \bar{j} + \left(3xz^2 - y\right) \bar{k}$$

is irrotational. Find scalar ϕ such that $\bar{F} = \nabla \phi$. [5]

(*c*) Prove that (any *two*) : [6]

(*i*) $\nabla^2 f(r) = f''(r) + \frac{2}{r} f'(r)$

(*ii*) $\nabla \times \left(\frac{\bar{a} \times \bar{r}}{r^3} \right) = \frac{-\bar{a}}{r^3} + \frac{3(\bar{a} \cdot \bar{r})}{r^5} \bar{r}$

(*iii*) $\nabla^2 \left[\nabla \cdot \left(\frac{\bar{r}}{r^2} \right) \right] = \frac{2}{r^4}$.

11. (*a*) Find the work done in moving a particle from (0, 1, –1) to $\left(\frac{\pi}{2}, -1, 2 \right)$ in a force of field :

$$\bar{F} = \left(y^2 \cos x + z^3 \right) \bar{i} + (2y \sin x - 4) \bar{j} + \left(3xz^2 + 2 \right) \bar{k}$$

is the field conservative ? [6]

(*b*) Verify Divergence theorem for :

$$\bar{F} = 2xy^2 \bar{i} + (xz^2 - y^3) \bar{j} + z^3 \bar{k}$$

over the volume of cube with edges of unit length parallel to co-ordinate axes. [7]

(*c*) Evaluate :

$$\iint_S \bar{r} \cdot n^n \, ds$$

over the surface of sphere of a radius 2 with centre at origin. [5]

Or

12. (*a*) If

$$\bar{F} = \left(2xy + 3z^2\right) \bar{i} + \left(x^2 + 4yz\right) \bar{j} + \left(2y^2 + 6xz\right) \bar{k}$$

Evaluate :

$$\int_C \bar{F} \cdot d\bar{r}$$

where C is the curve $x = t$, $y = t^2$, $z = t^3$ joining the points (0, 0, 0) and (1, 1, 1). [5]

(*b*) Verify Stokes' theorem for :

$$\bar{F} = xy^2 \bar{i} + y \bar{j} + xz^2 \bar{k}$$

for the surface of a square $x = 0$, $y = 0$, $x = 2$, $y = 2$ in the plane $z = 0$. [7]

(*c*) Evaluate :

$$\iint_S \left(\nabla \times \bar{F}\right) \cdot d\bar{S}$$

where

$$\bar{F} = \left(x^3 - y^3\right) \bar{i} - xyz \bar{j} + y^3 \bar{k}$$

and S is the surface

$$x^2 + 4y^2 + z^2 - 2x - 4 = 0$$

above the plane $x = 0$. [6]