006062

2007

CIVIL ENGINEERING (Paper I)

Time allowed : 3 Hours } **{ Maximum Marks : 200**

Note :
(i) Solve one question from each section.
(ii) If more than one questions are attempted in a section, the excess will be ignored.
(iii) Figures to the right indicate the number of marks for the question / sub-question.
(iv) Make suitable assumptions, if necessary and state the same.
(v) Use of log-tables, non-programmable calculators is permitted.
(vi) Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.
(vii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he will be penalised.

SECTION - A

1. (A) A uniform rod AB (length 1.6m and wt. 150N) rests in equilibrium. On the inner surface of a smooth semicircular channel, 1m in radius, when carrying two point loads, 100N and 400N as in Figure 1.A. **16**

Determine its configuration as defined by angle ϕ.

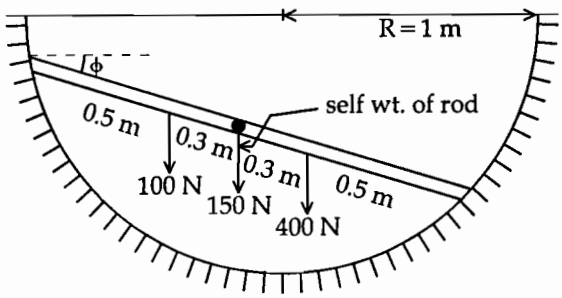

Figure 1. A

(B) A tensile load of 40KN is acting on a rod of diameter 40mm and of length 4m. A bore of diameter 20mm is made centrally on the rod. To what length the rod should be bored so that the total extension will increase by 30% under the same tensile load. **09**

Take $E = 2 \times 10^5$ N/mm^2.

P.T.O.

(C) The steel truss shown in Figure 1.C is anchored at A and supported on rollers at B. If the truss is so designed that, under the given loading, all tension members are stressed to 100 N/mm^2 and all compression members, to 80 N/mm^2, find vertical deflection of point C. **09**
Take E = 2×10^5 N/mm^2.
Also find the lateral displacement of end B.

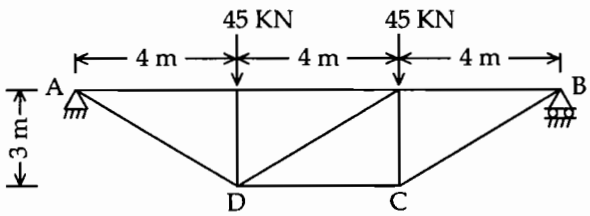

Figure 1. C

2. (A) A system of three identical, homogeneous cylinders (equal in wt.) as shown in Figure 2.A is in equilibrium. If coefficient of friction 'μ' is same for all surfaces where sliding is possible, what should be its minimum value ? **16**

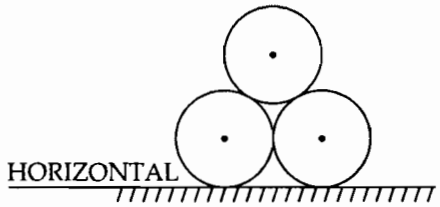

Figure 2. A

(B) The bar shown in Figure 2.B is subjected to a tensile force of 160KN. If the stress in the middle portion is limited to 150 N/mm^2, determine the diameter of the middle portion. Find also length of middle portion if the total elongation of bar is to be 0.2mm. **09**
Given : E = 2.1×10^5 N/mm^2.

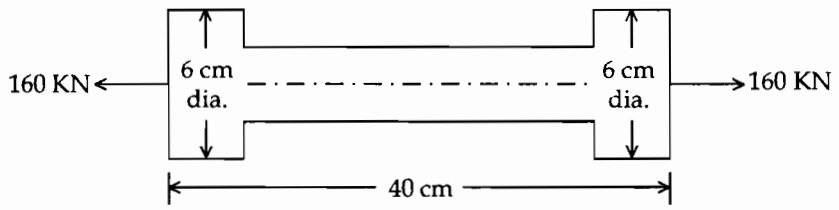

Figure 2. B

(C) At a point in a strained material, the principal stresses are 100 N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of major principal stress. What is the maximum intensity of shear stress in the material at that point ? **09**

SECTION - B

3. (A) Analyse the frame shown in Figure 3.A using moment distribution method. Draw bending moment diagram. **16**

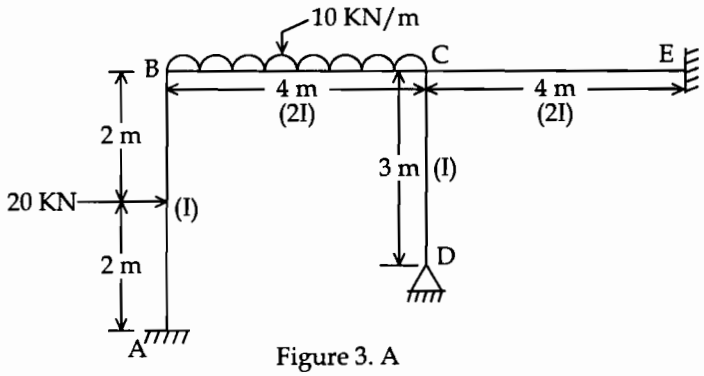

Figure 3. A

(B) For the pratt truss shown in Figure 3.B construct the influence line diagrams for forces in members L_0U_1, L_0L_1, L_1U_1, U_1L_2 and U_1U_2. **10**

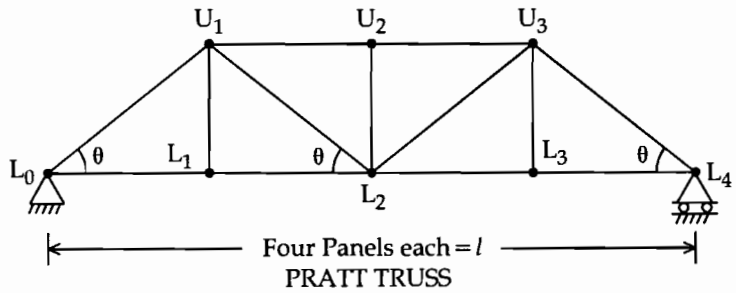

Figure 3. B

(C) Determine the horizontal thrust and the bending moment at the crown in parabolic two hinged arch shown in Figure 3.C assuming that $I = I_C \sec\theta$. The outward horizontal displacements at A and B due to yielding of supports are $40/EI_C$ and $60/EI_C$ respectively. **08**

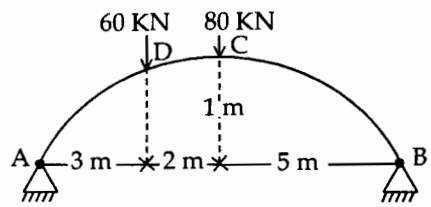

Figure 3. C

P.T.O.

4. (A) Analyse the continuous beam with a spring at the joint C as shown in Figure 4.A by slope deflection method. **16**

Draw bending moment diagram.

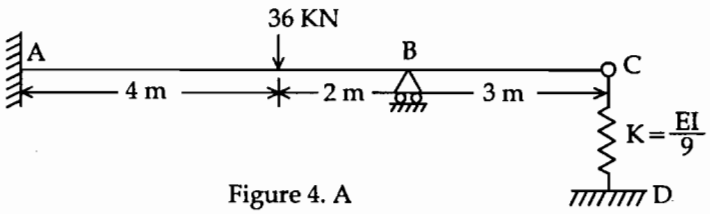

Figure 4. A

(B) Using flexibility method, find out reactions at the supports for a continuous beam ABCD with spans AB = BC = CD subjected to uniformly distributed load of intensity ω KN/m over entire span. **10**

Assume EI uniform.

(C) A cable is suspended between two points A and B located at 60m apart horizontally. B is lower than A by 15m. At the point G located at a horizontal distance of 15m from A, the cable is 12.875m below the point A. The cable carries a uniform load of 24 KN/m of span. **08**

Determine the position and sag of the lowest point and the horizontal tension 'H' in the cable.

Also determine the curved length of the cable.

SECTION - C

5. (A) A 200mm × 150mm × 10mm angle, carrying a load of 200 KN is to be welded to a steel plate by fillet welds as shown in Figure 5.A. Find the length of the weld at the top and bottom if the allowable shear stress in the weld is 102.5 N/mm^2. **08**

Given : Distances between the neutral axis and the edges of the angle section from top and bottom are 144.7mm and 55.3mm respectively.

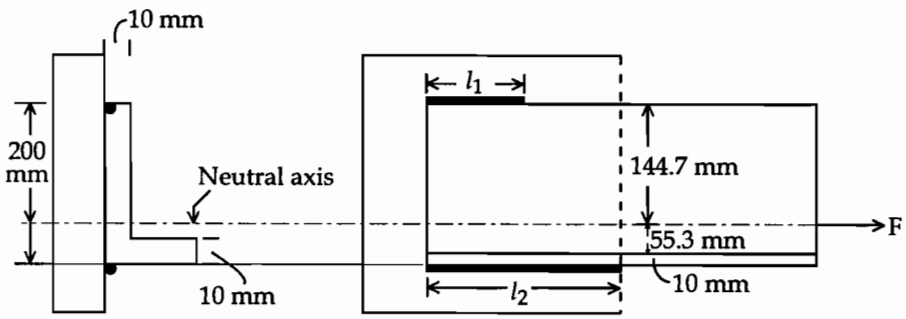

Figure 5. A

OVERALL DIMENSION OF ANGLE = 200 × 150 × 10 mm

(B) With the help of neat sketches explain : **10**

(i) Design of stiffners used in plate girder.

(ii) Design of splicing used in plate girder.

(C) An isolated T beam simply supported over a span of 6m has a flange width of 1500mm. The thickness of the flange is 80mm and the beam has an effective depth of 500mm upto the centre of tensile reinforcement. Which consists of 4 Nos. of 25mm diameter bars. **15**

Calculate the moment of resistance of the section neglecting compressive resistance of the area of web above the neutral axis. The width of web is 250mm. Use M20 grade concrete and HYSD steel of grade Fe415.

6. (A) Plates have been connected with flanges of 'I' section by applying 8mm fillet weld as shown in Figure 6.A. Compute the maximum load which may be placed at a distance of 100mm from the flanges. **15**

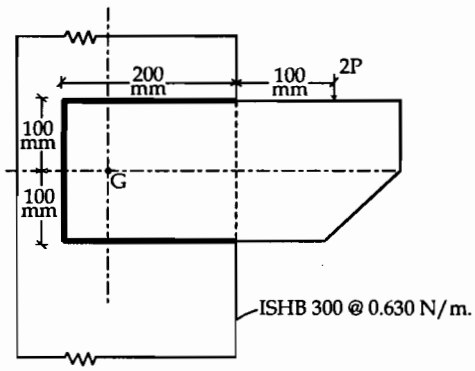

Figure 6. A

(B) Design a reinforced concrete column section to support an axial load of 500KN at the service state. One side of the column section is restricted to 250mm. The effective length of the column is 4.0m. The materials used are M15 grade concrete and HYSD steel of grade Fe415. **08**

Given : $\sigma cc = 4$ N/mm^2 and $\sigma sc = 190$ N/mm^2.

(C) Explain with the help of neat sketches : **10**

(i) Limit state of collapse : Flexure, for singly reinforced rectangular beam.

(ii) Wind load calculations for the design of steel roof truss.

P.T.O.

SECTION - D

7. (A) Design a circular water tank of 2,00,000 litres capacity. The joint between base slab and side wall is to be rigid. Good foundation for the tank is available at a depth of 0.6m below the ground level. σcbc for concrete = 7 N/mm^2, σst for steel = 115 N/mm^2, m = 13. **17**

(B) With the help of neat sketches explain : **08**

(i) Designing of cantilever retaining wall and counterfort retaining wall showing reinforcement details in each part.

(ii) Different forms of shear reinforcement and their share in resisting shear force.

(C) Write notes on : **08**

(i) Methods of concrete mix design.

(ii) Effects of materials, mix proportions, time and temperature on workability of concrete.

8. (A) Design the dog legged reinforced concrete stair case for a multistorey building in which the storey height (floor to floor distance) is 3.0m. The stair hall measures 2.8m × 4.3m (internal). The width of the stair is 1.25m. The staircase is not liable for overcrowding. The weight of finishes may be considered as 0.125 KN/m^2 of the finished surface of the step. **17**

Concrete MIS grade and HYSD steel of grade Fe415 is to be used.

(B) Design a concrete mix from following data : **10**

(i) Characteristic strength at 28 days = 25 N/mm^2.

(ii) Type of cement = rapid hardening, port-land cement.

(iii) Slump required = 30−60mm; exposure−moderate.

(iv) Aggregate available = Gravel 20mm to 40mm (max.)

(v) Fine aggregate = Natural sand is available.

(vi) Specific gravity of coarse aggregate = 2.7

(vii) Specific gravity of fine aggregate = 2.65

(viii) The fine aggregate corresponds to grading zone II giving fine aggregate percentage between 29% to 37%.

(ix) Water cement ratio corresponding to 28 days strength = 0.56

(x) Water cement ratio corresponding to durability consideration = 0.55

(xi) Approximate water contents corresponding to given type of aggregate and workability = 160 kg/m^3.

(xii) Wet density of concrete = 2480 kg/m^3.

(C) Write notes on : 06

(i) Factors affecting strength of concrete.

(ii) Admixtures used in concrete.

(iii) Tests on workability of concrete.

SECTION - E

9. (A) A rectangular beam 175mm × 350mm has an effective span of 10m. The prestressing cable has a triangular profile with zero eccentricity at ends and 60mm at the mid span. The effective prestress is 750 KN after all losses. 08

Determine the point load the beam can carry at mid span, if the pressure line passes through the upper kern of the section.

(B) The end block of a post tensioned beam is 100mm × 150mm. A prestressing cable consists of 7 wires of 6mm dia. strand and stressed to 800 MPa has to be anchored at the centre of the end block. 17

The anchorage plate is 75mm × 75mm having permissible bending stress = 165 MPa.

Using M45 grade concrete, design thickness of anchorage plate.

(C) Write notes on : 08

(i) Erection techniques adopted in modern days, with reference to precast construction.

(ii) Design considerations for transportation and erection of precast units.

10. (A) A prestressed concrete beam 150mm × 300mm in cross section supports a live load of 5 KN/m over a simply supported span of 8m. It has parabolic cable having an eccentricity of 75mm at the mid span and zero at the ends. 08

Determine the force of prestress if the net resultant stress at the bottom fibre at mid span is zero under the action of dead load, live load and prestress force.

(B) A section of a prestressed concrete beam 150mm × 300mm carries a factored shear force of 110 KN and a factored bending moment of 25KNm. The prestressing steel index is 0.4 and the effective prestress after all losses is 600 MPa. Compressive stress at centroidal axis due to prestress is 6.5 N/mm^2. 17

Design suitable shear reinforcement assuming $\sigma ck = 35\ N/mm^2$, $\sigma p = 1600 N/mm^2$, $Ap = 150mm^2$ and cover to reinforcement = 60mm.

(C) Write notes on : 08

(i) Precast and cast at site advantages and disadvantages for concrete structures.

(ii) Modern techniques used in precast construction.

P.T.O.

SECTION - F

11. (A) Write algorithm and flow chart for finding roots of the equation by Newton Raphson Method. **18**

(B) Find smallest positive root of $x^3-5x+3=0$ using Newton Raphson Method. **08**

(C) For the system of equations : **07**

$$6x_1-x_2-x_3=11.33$$
$$-x_1+6x_2-x_3=32$$
$$-x_1-x_2+6x_3=42$$

Approximate values of $x_1=4.67$, $x_2=7.62$ and $x_3=9.05$, use Gaussian method to find values upto three decimal.

12. (A) Write algorithm and flow chart for finding roots of the equation by Bi-section method. **18**

(B) Find the roots correct to two decimals using Bi-section method for equation $x^3-x-4=0$. How many iterations are required if permissible error is 0.02. **09**

(C) Apply Newton Raphson Method to solve the equation $x^3+2x-5=0$ for finding out real root at the end of fifth iteration. **06**

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2007

CIVIL ENGINEERING (Paper II)

006312

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :
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SECTION - A

1. (a) The following are the lengths and bearings of the sides of a closed traverse ABCD. Compute the length and bearing of line DA : **15**

Line	Length in meter	Bearings
AB	76.80	140° 12′
BC	195.60	36° 24′
CD	37.20	338° 48′
DA	?	?

(b) Explain clearly the two point problem and how it is solved ? **11**

(c) What are the characteristics of contour lines ? **8**

P.T.O.

2. (a) The following is the data relative to observations made on a vertically held staff with a tachometer fitted with an anallatic lens. The constant of the instrument was 100. Calculate the distance 'AB' and the reduced levels of 'A' and 'B' : **12**

Instrument Station	Height of axis	Staff Station	WCB	Vertical Angle	Hair Readings	Remark
O	1.56	A	12° 25 ′	0° 0 ′	1.88, 2.25, 2.62	R.L. of "O" 130.25
		B	60° 45 ′	+15° 10 ′	1.83, 2.15, 2.47	

(b) What is transition curve ? Why it is used ? Define shift of a curve. **10**

(c) What is meant by a satellite station and reduction to centre ? How would you correct the observation when made upon an eccentric signal ? **12**

SECTION - B

3. (a) What are the common defects in paintings, their causes and remedial measures ? **10**

(b) What are the methods of Artificial seasoning ? **10**

(c) Explain setting time test of cement and its importance. **14**

4. (a) Describe various types of fire protection systems. **12**

(b) What are the factors affecting ventilation of building ? **10**

(c) Mention the various aspects and prospects to be considered under Regulations and Byelaws, by the Architect while planning and designing the layout of a building. **12**

SECTION - C

5. (a) What is meant by safe bearing capacity of soil ? Explain plate loading test for determination of bearing capacity ? **10**

(b) What are the general principles in bricks masonry construction ? What are the rules for bricks bonding ? **11**

(c) What are the advantages of constructing steel roof trusses over timber trusses ? Explain any one method of Damp proofing of flat RCC roofs. **12**

(b) Define the following terms with reference to CPM/PERT network. **10**

(i) Dummy activity

(ii) Critical Path

(iii) Float

(iv) Dangling Error

(v) Event

(c) Enumerate the factors in selecting the pump. Differentiate clearly between a reciprocating pump and a centrifugal pump. **11**

SECTION - F

11. (a) Describe 'Needle beam method' of tunnelling and state the soil condition suitable for this. **12**

(b) Explain the different methods of ventilation during construction of tunnels. **10**

(c) What are the factors influencing the shape of tunnels ? **11**

12. (a) What are faults ? How are faults recognized in the field ? **10**

(b) What are the main geological problems associated with Dam sites ? Explain **11**

(c) What is Sedimentary Rock ? Classify Sedimentary rocks into various classes and give a brief description of each class. **12**

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SECTION - D

7. (a) Compute the intensity of active and passive earth pressure at depth 8 meter in dry cohesionless sand with an angle of internal friction of 30° and unit weight of 18 kN/m^3. Also calculate the total earth pressure and its line of action. What will be the intensity of active pressure if the water level rises to the ground level ? Take saturated unit weight of sand as 22 kN/m^3. **11**

(b) Define : **12**

(i) Shear strength

(ii) Cohesion

(iii) Angle of internal friction of soil

(iv) Optimum moisture content

(c) What is Coffer dam ? Explain its type with sketches. **10**

8. (a) What are the different methods of soil stabilization ? **11**

(b) What is a flow net ? What are its uses ? **10**

(c) What are the different types of shallow foundation ? Discuss with sketches. **12**

SECTION - E

9. (a) What is A-B-C control policy of inventory ? What are the objectives and functions of store management ? **11**

(b) What is control chart ? Explain any two control charts of sampling plan. **12**

(c) What is scientific management ? Explain principles of scientific management. **10**

10. (a) What safety measures will you adopt in the following situations : **12**

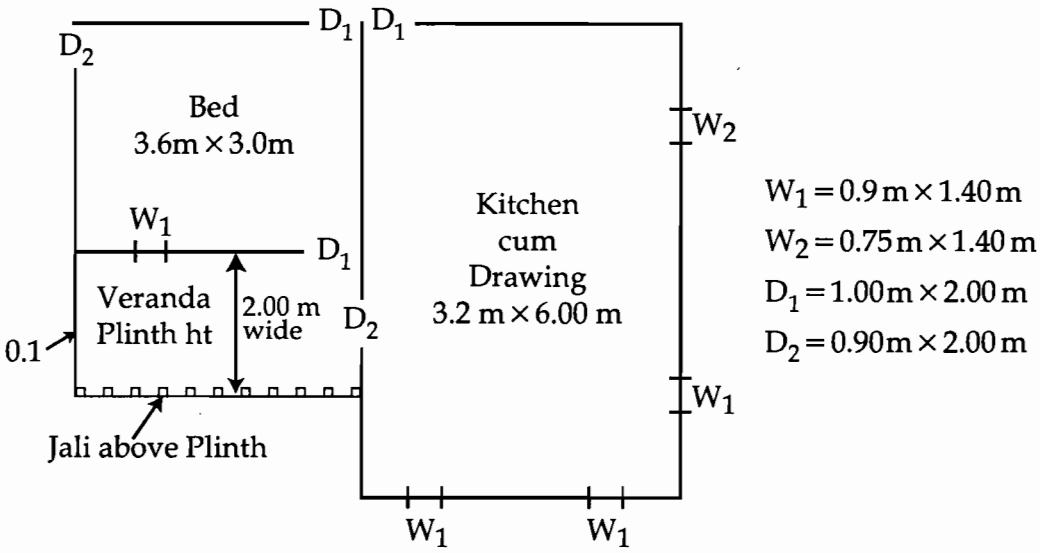
(i) Storage and handling of building materials.

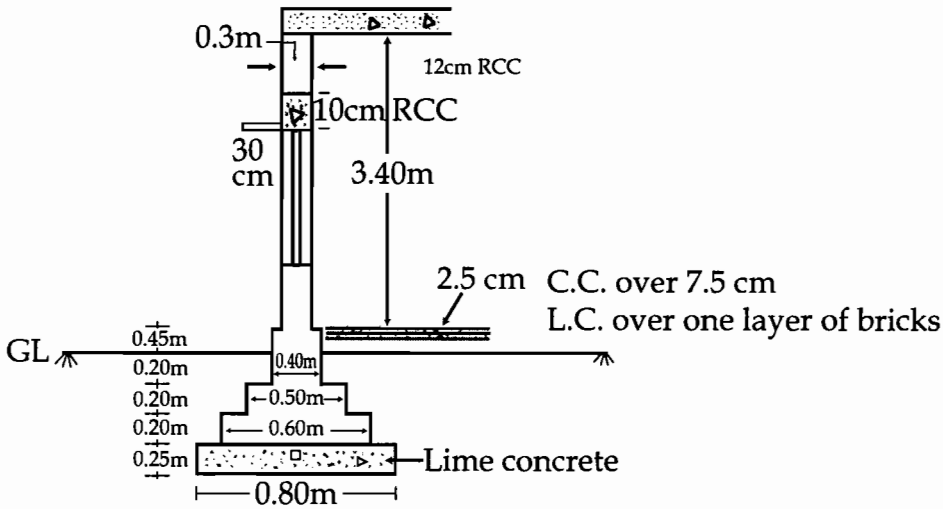
(ii) Demolition of a building

P.T.O.

6. (a) The line plan of a residential building is given in figure No. 1. **20**

Figure 1. Not to scale.





Section of Main Wall

Estimate the quantities of the following items of work in measurement sheet.

(i) Excavation

(ii) 2.5 cm. thick D.P.C. at plinth

(iii) Ist class brick work in foundation and plinth in lime mortar

(iv) Inside plastering

(b) What is unbalanced tender ? Explain with example. **8**

(c) What are the factors to be considered in Rate analysis ? **5**

PET

2007

CIVIL ENGINEERING (Paper III) 006532

Time allowed : 3 Hours } **{ Maximum Marks : 200**

Note :

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SECTION - A

1. (a) Define 'Viscosity' of fluid. A cylindrical shaft of 90 mm diameter rotates about a vertical axis inside a fixed cylindrical tube of length 50 cm. and 92 mm internal diameter. If the space between the tube and the shaft is filled by an oil of dynamic viscosity 1.8 poise, calculate the power required to overcome the viscous resistance when the shaft is rotated at a speed of 240 rpm. **12**

(b) A solid cone of diameter 24 cm and height 20 cm floats with its vertex downwards in water. Find the metacentric height of the cone and comment on its equilibrium. Assume the specific gravity of cone = 0.80. **11**

(c) Define streamline and equipotential line. A closed tank, kept on ground level, containing water is partly filled with water and the air space above it is under pressure. A 5 cm hose, connected to the tank, discharges water to atmosphere on to the roof of a building 3m above the level of water in the tank. If frictional losses are 1.5 m of water, what air pressure must be maintained in the tank to deliver 15 *l/s* to the roof ? Neglect minor losses except the velocity head at exit. Assume specific weight of water as 9.79 kN/m^3. **11**

P.T.O.

2. (a) In an open channel flow define the specific energy of flow. In a hydraulic jump occuring in a horizontal, rectangular, frictionless channel the energy loss and Froude number after the jump are 9.0m and 0.12 respectively. Calculate the discharge intensity and initial depth of the jump. **12**

(b) A straight 25cm diameter pipeline, 5km long, is laid between two reservoirs having a difference in water levels of 40m. To increase the capacity of the system, an additional 25cm diameter pipe, 2.5km long, is laid parallel from the first reservoir to the midpoint of the original pipeline. Assuming $f = 0.025$ for both the pipes find the increase in discharge due to installation of the new pipe. Assume $hf = flv^2/2gD$. **11**

(c) State Buckingham *pi* theorem. A pipe of diameter 1.5m is required to transport an oil of relative density 0.9 and kinematic viscosity 0.03 stoke at a rate of 3.0 m^3/s. If a 15cm diameter pipe with water having kinematic viscosity of 0.01 stoke is used to model the above flow, calculate the velocity and discharge in the model. **11**

SECTION - B

3. (a) What is hydrologic cycle ? Describe, briefly, with a neat sketch, the different processes involved in it. Explain briefly the man's interference in various parts of this cycle. **12**

(b) A catchment has six raingauge stations. In a year, the annual rainfall recorded by the gauges are as follows :

Station	A	B	C	D	E	F
Rainfall (cm)	82.6	102.9	180.3	110.3	98.8	136.7

For a 10% error in the estimation of the mean rainfall, calculate the optimum number of stations in the catchment. **11**

(c) Discuss the importance of evaporation control of reservoirs and possible methods of achieving the same. **11**

SECTION - D

7. (a) Explain with sketches any five factors controlling the alignment of roads. **11**

(b) What is the need of providing superelevation on horizontal curves ? **11**

Under the mixed traffic condition a highway horizontal curve has a radius of 250 m. in plain terrain. Design the superelevation with the design speed of 100 km/h. Calculate the restricted speed, if any.

(c) State four objects of carrying out traffic volume studies. Briefly explain the methods of traffic volume counts. **11**

8. (a) Explain the relationship between speed, travel time, volume, density and capacity. Support your answer with sketches. **11**

(b) Define stopping sight distance as per IRC norms. **11**

Calculate the stopping sight distance for a design speed of 60 km/h for :

(i) Two way traffic on a two lane road,

(ii) Two way traffic on a single lane road.

(c) Draw a sketch of flexible pavement cross section and show the component parts. Briefly explain the functions and importance of any four important components of the pavement. **11**

SECTION - E

9. (a) State five ideal characteristics of a bridge site. **11**

Define the following :

(i) Effective linear waterway

(ii) Afflux

(iii) Economic span

(iv) Scour

(b) Explain briefly the rational method for the determination of flood discharge. **11**

Calculate the peak runoff from following data :

Catchment area : Sandy soil with thick vegetation cover and area is 12000 ha. Length and fall : Length of catchment = 23 km

Fall = 175 m.

Severmost storm recovered : 24 cm in 3 hrs.

(c) Enumerate the various forces, loads and stresses considered in the design of bridges. Explain in brief the forces due to water currents. **11**

P.T.O.

(c) Details of a non-overflow section of a concrete gravity dam are given below : **11**

(i) R.L. of deepest foundation level = 100 m.

(ii) R.L. of roadway at top of dam = 160 m.

(iii) Maximum water level = 157 m.

(iv) Roadway width at top = 8 m.

(v) Downstream face vertical upto R.L. = 152 m.

(vi) Upstream face vertical upto R.L. = 140 m.

(vii) Slope of downstream face = 0.85 H : 1 V

(viii) Slope of upstream face = 0.1 H : 1 V

(ix) Horizontal seismic coefficient, αH = 0.15

Calculate the hydrodynamic pressure force due to earthquake and its moment about toe of dam. There is no tail water.

6. (a) Design an Ogee spillway (downstream profile of crest of spillway only) of a gravity dam by USWES method using following data : **11**

(i) Maximum discharge = 3500 m^3/s

(ii) Net length of spillway = 170 m.

(iii) R.L. of maximum water level = 526 m.

(iv) R.L. of bed of river at spillway = 465 m.

(v) Slope of downstream face = 0.75 H : 1V

(vi) Upstream face is vertical

(vii) Coefficient of discharge of spillway, C = 2.21

Neglect end contractions and velocity of approach. Also state the crest level of spillway. Spillway is ungated spillway.

(b) Design a trapezoidal shaped concrete lined channel to carry a discharge of 200 cumec at a slope of 30 cm/km. Assume side slope of 1.5 H : 1 V, Manning's $n = 0.017$, limiting velocity in the channel as 2.0 m/s. **11**

(c) What is meant by river training ? What are the objectives of river training ? State the various methods adopted for river training. **11**

P.T.O.

4. (a) The peak of a flood hydrograph due to a 3-hour duration isolated storm in a catchment is 270m^3/s . The total depth of rainfall is 5.9cm. Assuming an average infiltration loss of 0.3cm/h and a constant baseflow of 20 m^3/s estimate the peak flow of the 3-hour unit hydrograph of this catchment. If the area of the catchment is 567 km^2, determine the base width of the 3-hour unit hydrograph by assuming it to be triangular in shape. **12**

(b) Give the detailed list of various methods of estimating flood peak from a catchment and explain the rational method and its use. **11**

(c) A 30cm diameter well completely penetrates an unconfined aquifer of saturated depth 40m. After a long period of pumping at a steady rate of 500 *lpm*, the drawdown in two observation wells, 25m and 75m from the pumping well were found to be 3.5m and 2m respectively. Determine the transmissivity of the aquifer. Also calculate the drawdown at the pumping well. **11**

SECTION - C

5. (a) Following table gives the necessary data about the crops, duty and area under each crop commanded by a canal taking off from a storage reservoir. Assuming a time factor for the canal to be (12/20), calculate the discharge required at the head of the canal. If the capacity factor is 0.80, determine the design discharge. **11**

	Crop	Base period (days)	Area (ha.)	Duty of water at the head of the canal (ha/cumec)
(1)	Sugarcane	320	900	580
(2)	Overlap for sugarcane in hot weather	90	150	580
(3)	Wheat (Rabi)	120	750	1600
(4)	Bajra (Kharif)	120	600	2000
(5)	Vegetables (Hot weather)	120	320	600

(b) Define duty of irrigation water and mention any six methods of improving duty. **11**

10. (a) Explain the various techniques adopted to strengthen the bridge substructure and superstructure. **11**

(b) Write short notes on the following : **11**

(i) Classification of bridges.

(ii) Erection of supension bridges.

(c) Discuss in brief any four methods of erection of steel bridges. State the conditions under which each type is used. **11**

SECTION - F

11. (a) State the various types of water demands of a city. **11**

Compute the population of the year 2010 and 2016 for a city whose population in the year 1940 was 25,000, and in the year 1980 was 47,000. Use geometric increase method.

(b) The BOD_5 of a waste is 600 mg/l. The deoxygenation constant, $K_1 = 0.23$/day(base e.). Find the ultimate BOD_4 of the waste. What proportion of the BOD_4 would remain unoxidised after 20 days ? **11**

(c) Define ecosystem. Give an account of the structure and function of an ecosystem. **11**

12. (a) A settling basin is designed to have a surface overflow rate of 32.6 m/day. Find the overall removal obtained for a suspension with size distribution given below. **11**

Particle size(mm)	:	0.10	0.08	0.07	0.06	0.04	0.02	0.01
Weight fraction greater than size (percent)	:	10	15	40	70	93	99	100

The specific gravity of particles is 1.2 and the water temperature is 20°C at which, the dynamic viscosity is 1.027 centipoise and density is 0.997 gm/cm^3.

(b) What is meant by activated sludge ? **11**

Explain briefly the activated sludge process. Describe briefly the types of aeration systems in an activated sludge process.

(c) Define air pollution. What are the sources of air pollutants ? State any ten pollutants generally found in air. **11**

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Civil
Mah. Engineering Services Main Examination - 2009

ASP

2009

CIVIL ENGINEERING (Paper I) 106277

Time allowed : 3 Hours | | **Maximum Marks : 200**

Note :

(i) *Solve one question from each section.*

(ii) *If more than one question are attempted in a section, the excess will be ignored.*

(iii) *Figures to the right indicate the number of marks for the question / sub-question.*

(iv) *Make suitable assumptions, if necessary and state the same.*

(v) *Use of log-tables, non-programmable calculators is permitted.*

(vi) *Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.*

(vii) *Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.*

SECTION - A

1. (A) What should be the value of 'θ' of the inclined plane shown in Figure 1, which will make the motion of 900 N block down the plane to impend ? The coefficient of friction for all contact surfaces is $\frac{1}{3}$. **12**

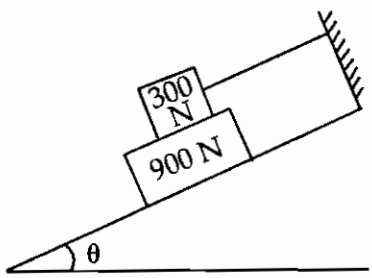


Figure 1 [Q. No. 1 (A)]

(B) A man wishes to move a wooden box of 1 m cube to a distance of 5 m with the least amount of work. If the block weighs 1 kN and the coefficient of friction is 0.3, determine whether he should tip the box or slide it. **11**

P.T.O.

(C) A cord ACB, 5 m long is attached at points A and B to two vertical walls 3 m apart as shown in Figure 2. A pulley C of negligible weight and size carries a suspended load of 200 N and is free to roll without friction along the cord. Determine the position of the load as defined by its horizontal distance from one of the walls so that the system is in equilibrium. For this position determine tension in the cord. **11**

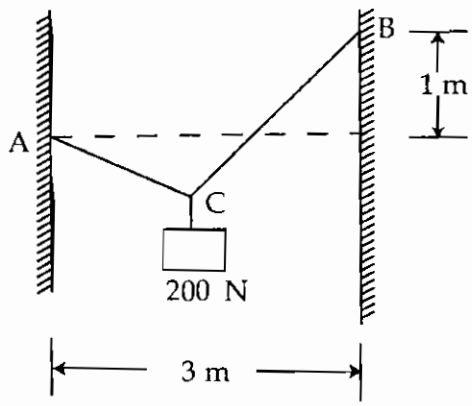
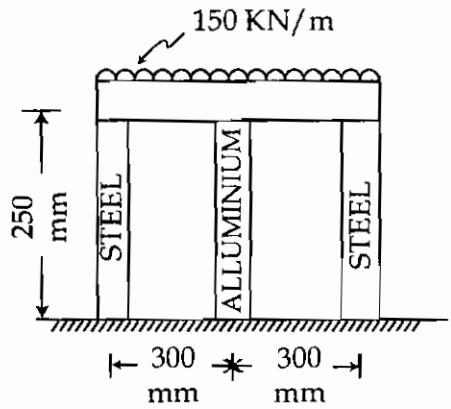


Figure 2 [Q. No. 1 (C)]

2. (A) A rigid bar is fixed to the top of three posts made of steel and aluminium as shown in Figure 3. The length of all the posts is 250 mm when no load is applied and the temperature is 20 °C. Determine the reaction offered by each of the posts if the horizontal bar is subjected to a uniformly distributed load of 150 KN/m and the temperature is raised to 80 °C. The coefficients of thermal expansion of the materials are $\alpha_{steel} = 12 \times 10^{-6}/°C$ and $\alpha_{alluminium} = 23 \times 10^{-6}/°C$. **12**



Diameter of steel bars = 40 mm

Diameter of alluminium bar = 60mm

Figure 3 [Q. No. 2 (A)]

(B) Draw the BMD and SFD for the compound beam shown in Figure 4. Showing salient values. **10**

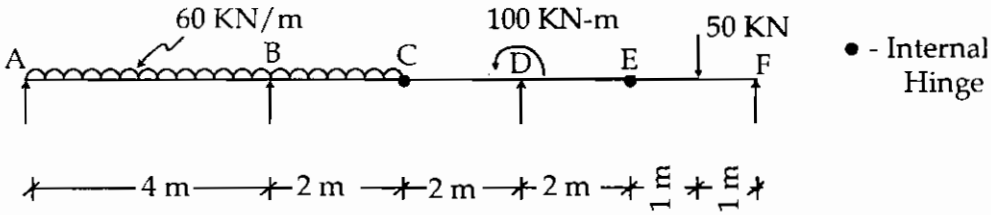


Figure 4 [Q. No. 2 (B)]

(C) Determine the equation of the elastic curve for the cantilever beam shown in Figure 5. Also find the deflection at B and C. Assume EI constant. **12**

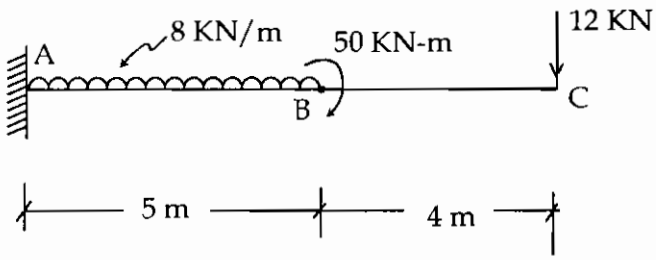


Figure 5 [Q. No. 2 (C)]

SECTION - B

3. (A) A fixed beam ACB of length 2L is fixed at A and B, AC = CB = L. While portion AC has a moment of inertia of 2 I, portion CB has a moment of inertia of I. If the beam is subjected to a uniformly distributed load of 'ω' per unit length over the entire span, determine the fixed-end moments at A and B using slope-deflection method. **12**

(B) A rigid portal frame ABCD has two unequal vertical legs, AB = 4m and CD = 6m with member BC horizontal and 8m long. The supports A and D are fixed and all the members have same moment of inertia I. The member BC carried a uniformly distributed load of 40 KN/m and a horizontal force 'H' acts at joint C. Find the magnitude and sense of the force 'H' such that the frame does not sway under the given loading. Use moment - distribution method. **13**

(C) A two-span continuous beam ABC has simple supports at A and C and AB = BC = L. Span AB carries a central concentrated load of 'P'. Compute the redundant reaction at the central continuous support B if it settles by 'Δ'. Use consistency of deformation method. **9**

P.T.O.

4. (A) A cable is suspended between two points A and B located 50m apart horizontally. B is higher than A by 12.5 m. At the midpoint of the span AB, the cable is 9.375 m below the point A. The cable carries a uniformly distributed load over the span. Determine the position and sag of the lowest point and curved length of the cable. **11**

(B) Using the Muller-Breslau principle draw the influence line diagrams for the following actions for the compound beam shown in Figure. 6 and show the salient values. **10**

(i) Moment at A (ii) Reaction at C (iii) Shear force at D

(iv) Moment at E (v) Vertical reaction at H

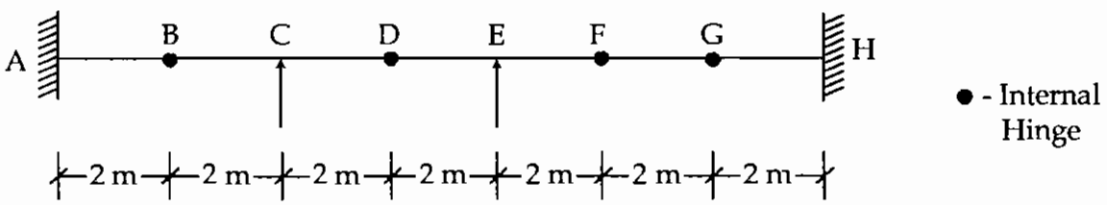


Figure 6 [Q. No. 4 (B)]

(C) Using the stiffness approach of analysis, analyse the pin-jointed truss shown in Figure 7. Axial rigidity of all the members is same. **13**

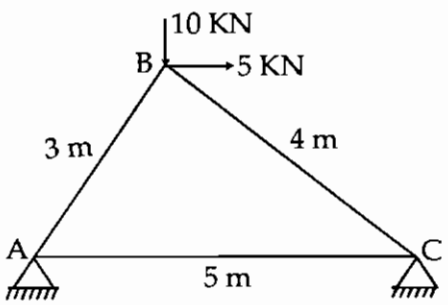
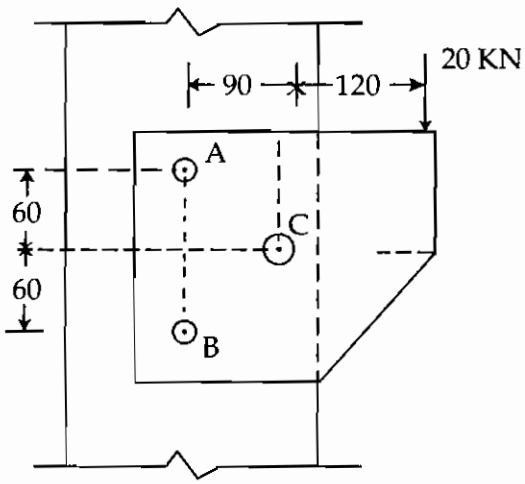


Figure 7 [Q. No. 4 (C)]

SECTION - C

5. (A) Calculate the shearing stress in the rivets B and C for the connection shown in Figure 8. Rivets A and B are 14 mm in diameter, while rivet C has a diameter of 22 mm. **10**



All dimensions in mm.

Figure 8 [Q. No. 5 (A)]

(B) A built-up column consists of ISHB 400 @ 77.4 kg/m with one 300 mm x 12mm flange plate on each side. The column carries an axial load of 2400 KN. Design a gussetted base for the column, if it is supported on a concrete pedestal with a bearing capacity of 4 N/mm^2. Relevant properties of the sections are as given below : **13**

ISHB 400 @ 77.4 kg/m : h = 400 mm, b = 250 mm

ISA 150 × 115 × 15 mm : Root radius = 11 mm

ISA 150 × 115 × 10 mm : Root radius = 11 mm

(C) A literally supported beam having an effective span of 8 m consists of ISMB 550 @ 103.7 kg/m and cover plate of 250 mm × 16 mm connected to each flange by 20 mm diameter rivets. Determine the safe uniformly distributed load which the beam can carry in addition to its own weight. Properties of ISMB 550 @ 103.7 kg/m are as given below : **10**

$Ixx = 64893.6 \times 10^4$ mm^4, $Iyy = 1833.8 \times 10^4$ mm^4,

$Zxx = 2359.8 \times 10^3$ mm^3, $Zyy = 193 \times 10^3$ mm^3,

$h = 550$ mm, $b = 190$ mm, $t_f = 19.3$ mm, $t_w = 11.2$ mm,

$a = 13211$ mm^2

P.T.O.

6. (A) A RC beam of span 3 m carries a uniformly distributed featured load of 120 KN/m over the span. The beam has a uniform width of 300 mm with overall depth varying from 650 mm at support to 400 mm at the free end. The beam is reinforced with 2 – 20 mm diameter bars on compression side and 5 – 28 mm diameter bars on tension side at an effective cover of 50 mm. Two of the tensile bars are curtailed at a distance of 1 m from the support. Design the shear reinforcement assuming M20 concrete and Fe 415 steel. Design shear strength of M20 concrete for different tensile steel are as given below. **13**

100 As/bd	1.00	1.25	1.50	1.75
τ_c (N/mm^2)	0.62	0.67	0.72	0.75

(B) Design a circular RC column 390 mm in diameter having spiral reinforcement subjected to a factored axial load of 1750 KN. The column is braced against sidesway and has an unsupported length of 3.3 m. Use M 25 concrete and Fe 415 steel. **10**

(C) Design an isolated footing for a RC column of size 300 mm × 350 mm carrying an axial load of 750 KN. The safe bearing capacity of soil is 175 KN/m^2. The unit weight of soil is 19.5 KN/m^3. Use M20 concrete and Fe 415 steel. **10**

SECTION - D

7. (A) A retaining wall is to be designed to retain soil upto a height of 5.0 m above ground level. Using limit state approach, design the stem assuming **20**

(i) a cantilever type retaining wall and

(ii) counterfort type retaining wall. Comment on the suitability of each one of them based on your design. Assume the following data.

Unit weight of horizontal backfill	–	18 KN/m^3
Angle of internal friction	–	30°
Depth of foundation	–	1.5 m below GL.
Grade of concrete	–	M 20
Grade of steel	–	Fe 415

C/C distance of counterforts when provided - 3 m.

(B) Design a 3 - span continuous beam of a typical interior idealised plane frame of a building. The frames are spaced 5.5 m apart and in a typical floor 140 mm continuous slab is cast monolithically with the beams. The thickness of floor finish is 40 mm. The beam has three equal spans of 6.1 m each. The floor is to support an imposed load of 5 KN/m^2. at the service state. The unit weight of finishing material is 20 KN/m^3. Materials to be used are M 20 grade concrete and Fe 415 steel. Restrict the design to flexural design only. **13**

8. (A) An open rectangular tank of size 3 m × 5 m in plan and 3.5 m high, resting on firm ground is to be used for storing water. Design the side walls of the tank using M 20 concrete and Fe 415 steel. **13**

(B) What do you understand by workability of concrete ? Discuss any three methods of determining workability of concrete and state the conditions under which each of the methods are suitable. **10**

(C) Write notes on **10**

(i) creep and shrinkage of concrete

(ii) Alkali-aggregate reaction.

SECTION - E

9. (A) A simply supported pre-stressed concrete beam 400 mm wide and 600 mm deep is loaded with a uniformly distributed load of 60 KN/m over a span of 6 m. The beam is pre-stressed with a parabolic tendon with an eccentricity of 100 mm at the ends and 200 mm at midspan. The tendon is pre-stressed with a force of 1920 KN. Using the load balancing concept determine the extreme fibre stresses. **11**

(B) A post tensioned PSC beam of 30 m span is subjected to a pre-stressing force of 2500 KN. The cable profile is parabolic with a maximum eccentricity of 200 mm at midspan and zero eccentricity at the ends. The beam has a cross - section of 500 mm × 800 mm and is pre-stressed with 9 cables, one at a time, each cable consisting of 12 wires of 5 mm diameter. Taking $E_S = 2.1 \times 10^5$ N/mm^2, $Ec = 3.5 \times 10^4$ N/mm^2, $\mu = 0.3$, coefficient of wave effect $K = 15 \times 10^{-4}$ per metre determine the prestress loss due to **14**

(i) Elastic shortening

(ii) Friction.

(C) Write notes on : **8**

(i) Anchorage stresses

(ii) Concepts of pre-stressing

10. (A) Explain with neat sketches different types of pre-cast slab panels which are used in pre-cast construction. **12**

(B) Write notes on : **12**

(i) Modern erection techniques of pre-cast member.

(ii) Design criteria for pre-cast slab panels.

(iii) Quality control in pre-cast construction.

(C) Discuss the design procedure of a rectangular pre-stressed concrete beam. **9**

P.T.O.

SECTION - F

11. (A) Explain the Newton Raphson Method for solution of non-linear algebraic equations. Solve the following equation using this method. **12**

$x^3 - 2x^2 - 5x + 6 = 0$

(B) Write an algorithm and flow-chart for solving a set of three simultaneous equations using Guass-elimination method. **14**

(C) What do you understand by "Banded Matrix" ? Give examples from structural analysis where you come across with such matrices. **7**

12. (A) Explain Gauss-seidel iterative method. Solve the following set of equations using Gauss-seidel method. **12**

$$3x_1 + 4x_2 - 6x_3 = 10$$
$$6x_1 - 3x_2 + 4x_3 = 15$$
$$8x_1 + 6x_2 - 7x_3 = 25$$

(B) An overhanging beam ABC has supports at A and B and portion BC is overhanging. AB = 5 m and BC = 2 m. Portion AB is subjected to a uniformly distributed load of 20 KN/m and portion BC is subjected to uniformly distributed load of 25 KN/m. Find the bending moment values at an equal intervals of 1 m and determine the area under the BMD using Simpson's rule. **12**

(C) Draw flow chart and write a computer programme for designing a simply supported reinforced concrete beam. Use Fortran or C language. **9**

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Mah Civil Engineering Services Main Examination-2009

ASD

2009

106328

CIVIL ENGINEERING (Paper II)

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :

(i) Solve one question from each section.

(ii) If more than one questions are attempted in a section, the excess will be ignored.

(iii) Figures to the right indicate the number of marks for the question/sub-question.

(iv) Make suitable assumptions, if necessary and state the same.

(v) Use of log-tables, non-programmable calculators is permitted.

(vi) Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.

(vii) Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.

SECTION - A

1. (a) State the advantages and disadvantages of plane tabling. **10**

(Minimum five points for each)

(b) State and explain the applications of aerial photo interpretation. **10**

(c) Due to some problems with the equipment, the bearings and two sides were not taken for a closed traverse ABCDEA. From the available data compute the bearings of the two sides. **14**

Line	AB	BC	CD	DE	EA
Length (m)	230.5	250.2	210.8	240.3	265.4
Bearing	N 36°45′E	S 82° 48′E	S 10°10′E	Missing	Missing

2. (a) What are reverse curves ? What is the necessity of providing reverse curves ? What are the disadvantages of a reverse curve ? **10**

(b) Explain the principle of triangulation. What are the purposes of triangulation surveys ? **10**

P.T.O.

(c) A 50 metre long tape has been standardised at 25°C under a pull of 100 N. During the field measurements the tape was supported at two points A and B. The elevations of A and B were 110.385 m and 110.120 m with respect to a local bench mark. Elevation of A above mean sea level is 1163. 853 m. The temperature and pull during the measurement were 42°C and 150 N respectively. Find the corrected length of a tape length reduced to mean sea level. **14**

[Consider radius of earth = 6370 KM,
Coefficient of linear thermal expansion = 11×10^{-6}/°C
Elasticity modulus of tape = 2×10^{11} N/m^2]

SECTION - B

3. (a) What are the various ingredients of Portland cement ? Discuss the function played by each in imparting specific properties to it. **14**

(b) What are the characteristics of good brick earth ? **10**

(c) What is plastering ? What are the objectives of plastering ? **10**

4. (a) Inside dimensions of a stair in a residential structure are 2.5 m × 5.0 m and height of the room is 3.6 m. Design a dog-legged staircase with a rise of 15 centimeter. **14**

(b) Write short note on acoustical defects. **10**

(c) What are traps ? Draw neat sketches for P-trap, Q-trap and S-trap. **10**

SECTION - C

5. (a) Differentiate between load bearing structure and frame structure. **13**

(b) State the advantages of steel trusses over timber trusses. **10**

(c) State various methods used for dewatering of foundation trenches. Explain with a sketch, the well-point system. **10**

6. (a) Prepare an approximate estimate of a residential building with following details. **13**

- RCC frame (G + 4 Storeys)
- Plinth area (on each floor) = 500 m^2
- Plinth area rate_____ = Rs. 1,00,000 per m^2
- Cost of electrification, plumbing etc., 15% of building cost.
- Provide 5% for contingencies and 2% for work-charged establishment of total cost.

(b) What is an estimate ? Explain the difference between revised estimate and supplementary estimate. **10**

(c) What do you mean by depreciation ? Differentiate between depreciation and obsolescence. **10**

SECTION - D

7. (a) What do you mean by consistency of soils ? State the uses of consistency limits. **10**

(b) A load of 1200 kN acts as a point load at the surface of a soil mass. Determine the stress at a point 4 m below and 3 m away from the point of action of load by Boussinesq's formula. Compare the value with that obtained from Westergaard's theory, considering poisson ratio = 0. **10**

(c) Under certain loading, a layer of clay is expected to undergo full settlement of 18 centimeters. Also, it is expected to settle by 5 centimeters in the period of 2 months of loading. Find the time required for the clay layer to settle by 10 centimeters. **13**

$$\left[\text{for } U<60\%, \text{ time factor} = \frac{\pi}{4}\left(\frac{U}{100}\right)^2\right]$$

8. (a) Distinguish between consolidation and compaction. Also calculate the compactive energy applied to soil during stand Proctor test. **10**

(b) What are the limiting values of lateral earth pressure at a depth of 3 m in a uniform sand fill with unit weight of 18 kN/m^3 and $\phi = 32°$. The ground surface is level. **10**

If a retaining wall with a smooth and vertical back is interposed, determine the total active and passive thrusts which will act on the wall.

(c) Distinguish between : **13**

(i) General shear and punching shear failures.

(ii) Deep foundation and shallow foundation.

(iii) Finite and infinite slopes and causes of failure of slopes.

SECTION - E

9. (a) What are the objectives of construction management ? State and describe the functions (like planning, organising...) of construction management. 10

(b) Describe the importance of safety in construction. What are the various safety measures adopted at the time of demolition of a building ? 10

(c) Write detailed note on quality control of following construction items : 13

(i) Concrete (ii) Steel

(iii) Form-work (iv) Sanitary and water supply

10. (a) What are the principles normally adopted in storing materials ? 10

(b) Define and explain the following : 10

(i) Event (ii) Activity

(iii) Dummy (iv) Float

(c) State the different methods of estimating depreciation of construction equipment. 13

Explain double decline balance method of depreciation with the help of following example.

Cost of equipment = Rs. 12 lakhs.

Estimated life of equipment = 5 years.

Estimated salvage value = Rs. 2 lakhs.

Calculate depreciation and book value for each of the five years life.

SECTION - F

11. (a) What is fold ? With the help of neat sketches describe various parts of a fold. 10

(b) What are the factors of metamorphism ? Write five structures of the metamorphic rock with neat sketches. 10

(c) What is a dam ? Describe the types of dam and suitable rock types of site in their selection. 13

P.T.O.

12. (a) State the advantages of circular section and horse-shoe section of tunnels. Explain the various parameters considered to arrive at dimensions to be given to a tunnel section. 10

(b) Explain with the help of neat sketch the central drift method of tunnelling in rock. State the advantages and disadvantages of this method. 10

(c) What are the requirements of ventilating system in a tunnel ? Explain the natural and mechanical methods of ventilation. 13

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Mah. Civil Engineering services Main Exam - 2009

ASV

2009

106352

CIVIL ENGINEERING (Paper III)

Time allowed : 3 Hours } { **Maximum Marks : 200**

Note :

(i) *Solve one question from each section.*

(ii) *If more than one question are attempted in a section, the excess will be ignored.*

(iii) *Figures to the right indicate the number of marks for the question / sub-question.*

(iv) *Make suitable assumptions, if necessary and state the same.*

(v) *Use of log-tables, non-programmable calculators is permitted.*

(vi) *Use of any kind of I.S. Codes and Steel Table Codes is NOT permitted.*

(vii) *Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he/she will be penalised.*

SECTION - A

1. (a) Briefly explain classification of fluids based on viscosity. **12**
Calculate the capillary effect in mm in a glass tube 1 mm in diameter when it is immersed in water. Take surface tension of water as 0.08 N/m and angle of contact as zero. If the same tube is immersed in mercury of specific gravity 13.6 and surface tension of 0.5 N/m, angle of contact between glass and mercury 140°, what will be rise/depression in the level in the tube ?

(b) What is meant by stability of a floating body ? Explain with reference to its metacentric height. **11**
A vertical sluice gate 4 m wide and 2 m deep is hinged at the top. Liquid of specific gravity 1.5 stands to a height of 2 m above the top of the gate on the upstream side. On the downstream side water stands to a height of 1m above the top of the gate. Find resultant force acting on the gate and point at which the resultant force acts.

(c) Determine the stream function if the velocity components of a two dimensional incompressible fluid flow are given as : **11**

$$u = \frac{y^3}{3} + 2x - x^2y$$

$$\vartheta = xy^2 - 2y - \frac{x^3}{3}$$

P.T.O.

2. (a) Explain the energy variation in a short hydraulic jump using specific energy equation. For a constant specific energy of 1.8 N-m/N calculate the maximum discharge that may occur in a rectangular channel 5.0 m wide. **12**

(b) What are repeating variables ? What points are important while selecting repeating variables ? A pipe 50 mm diameter is 6 m long and the velocity of flow of water in the pipe is 2.4 m/s. What loss of head and corresponding power would be saved if the central 2 m length of pipe is replaced by 75 mm diameter pipe ? The change of section is sudden. Take $f = 0.04$ for pipes of both diameters. **11**

(c) What are different types of hydraulic jump. Mention uses of hydraulic jump. **11**

A Hydraulic type of energy dissipater is designed to have energy loss of 8.5 m. The froude number upstream of the jump is 7.2. Find the sequent depths of flow. What is efficiency of jump ?

SECTION - B

3. (a) Describe the principle of working of a tipping bucket type raingauge with a neat sketch. What are its advantages and disadvantages ? **12**

(b) Define rainguage density. Explain various methods available for the estimation of missing precipitation records. **11**

Rainguage station X did not function for a part of a month during which a storm occurred. The storm produced rainfall of 84, 70 and 96 mm at three surrounding stations A, B, and C respectively. The normal annual rainfalls at the stations X, A, B and C are 770, 882, 736 and 944 mm respectively. Estimate the missing storm rainfall at station X.

(c) Discuss various factors affecting evapo transpiration. Explain the use of lysimeter in measuring evapo transpiration. **11**

4. (a) List the various methods of estimating flood. Describe the velocity area method used for stream gauging. What return period you would adopt in the design of a culvert on a drain if you are allowed to accept only 5% risk of flooding in the 25 years of expected life of the culvert. **12**

(b) What is Unit Hydrograph. List the assumptions involved in the theory of Unit Hydrograph ? What are the uses and limitations ? **11**

(c) Why is recharging of ground water necessary ? Design a tube well for the following data. **11**

Yield required = 0.08 cumec, thickness of confined aquifer = 30 m, radius of circle of influence = 300 m permeability coefficient = 60 m/day, drawdown = 5 m.

SECTION - C

5. (a) Define irrigation and explain its necessity in a tropical country like India. What are the advantages and ill effects of assured irrigation ? **11**

(b) What is meant by Bandhara irrigation ? Give briefly the advantages and disadvantages of Bandhara irrigation. **11**

(c) A stream of 125 lit/s was diverted from a canal and 100 lit/s were delivered to the field. An area of 1.6 Hect was irrigated in 8 hours. Effective depth of root zone was 1.7 m. The runoff loss in the field was 420 cum. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.3 m at the tail end. Available moisture holding capacity of the soil is 20 cm per metre depth of soil. Determine water conveyance water application, water storage and water distribution efficiencies. The irrigation was started at a moisture extraction level of 50% of the available moisture. **11**

6. (a) List various causes of failures of earth dams. Explain the Swedish circle method of slope stability analysis. **11**

(b) What is the necessity of river training works ? What is meandering of rivers ? What are its causes ? Explain the role of cut-off in the meandering of rivers. **11**

(c) Differentiate between low gravity dam and a high gravity dam. How does the practical profile of a low gravity dam differs from that of the theoretical profile and why ? Discuss step by step the analytical procedure adopted for stability analysis of gravity dams. **11**

SECTION - D

7. (a) State the objects of widening pavements on horizontal curves ? Explain the factors on which the design of widening depends. **11**

Calculate the extra widening required for a pavement of width 7.0 m on a horizontal curve of radius 250 m, if the longest wheel base of vehicle expected on the road is 7.0 m. Design speed is 70 kmph.

(b) Explain the engineering surveys needed for locating a new highway. Discuss the special care to be taken while aligning hill roads. **11**

(c) Discuss briefly the different causes of traffic accidents. Explain various measures that may be taken to prevent accidents. **11**

8. (a) Calculate the stresses at interior, edge and corner regions of a cement concrete pavement using Westergaard's stress equation using the following data. **11**

Wheel load P = 4100 kg.

Modulus of elasticity of cement concrete = 3.0×10^5 kg/cm^2.

Pavement thickness = 15 cm.

Poissons ratio for concrete = 0.15

Modulus of subgrade reaction = 3.0 kg/cm^3.

Radius of contact area = 15 cm.

(b) Specify the material required for the construction of WBM roads. Write down the construction steps for water bound macadam road. **11**

(c) What are the advantages and disadvantages of traffic signals ? What are various types of signals ? Explain the various traffic signal systems used for co-ordination of signals in a road network. **11**

SECTION - E

9. (a) What factors are taken into consideration for deciding the location of a bridge. List various methods of subsurface investigations. Give the data needed for the design of a bridge. **11**

(b) Draw the sketch (plan and elevation) of a bridge showing its component parts ? Give function of each component. Give classification of permanent bridges. **11**

(c) What is a cofferdam ? What are the requirements of a cofferdam ? What are the types of cofferdam ? **11**

10. (a) Explain the various problems encountered and their remedial measures to be taken during the well sinking. **11**

(b) Describe with sketches the construction of superstructures of steel suspension bridge. List the items you will inspect for the maintainance of bridges. **11**

(c) Write short notes on : **11**

(i) IRC Bridge loading.

(ii) Pope culvert, High level causeway.

P.T.O.

SECTION - F

11. (a) Explain three different methods of forecasting the future population of a town. Explain the factors affecting the water demand. **11**

(b) Give advantages and disadvantages of pressure filter. **11**

Design set of three rapid gravity filters for treating water at a water works, which has to supply the water to a town of population 1,00,000. The per capita demand of the town is 270 lit/day. The rate of filtration of the rapid gravity filters may be taken as 4500 lit/hour/sq. m.

(c) Explain the characteristics of following air pollutants. **11**

Natural contaminant, Aerosols, Dust, Smoke, Mist.

12. (a) What are the various methods of disinfecting water ? What are the requirements of good infectants ? **11**

(b) Write short notes on : **11**

(i) Drop manhole.

(ii) Layout of sewage treatment plant.

(c) What is air pollution ? What are effects of air pollution ? Explain in brief air pollution control methods. **11**

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Maharashtra Engineering (Civil) services Main Examination - 2011

GRM

2011

101200

CIVIL ENGINEERING (Paper - I)

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :

(i) *Solve any one question from each section.*

(ii) *Do not reproduce any question. Write only question number against the answer.*

(iii) *Number of optional questions up to the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.*

(iv) *Figures to the right indicate the number of marks for the questions.*

(v) *Assume suitable data if necessary and state-it clearly.*

(vi) *Use of Non-programmable calculators is permitted.*

(vii) *Use of I.S. Codes and Steel Table, is **not** permitted.*

(viii) *Candidate should not write roll number, any name (including his/her own), signature, address or any indication of his/her identity any where inside the answer book otherwise the candidate will be penalised.*

SECTION - A

1. (a) A beam ABCD supported at B and C has over hangs AB and CD. The shear force diagram for the beam is shown in Figure 1. Determine the loading diagram with couple at pt. F and the bending moment diagram. **10**

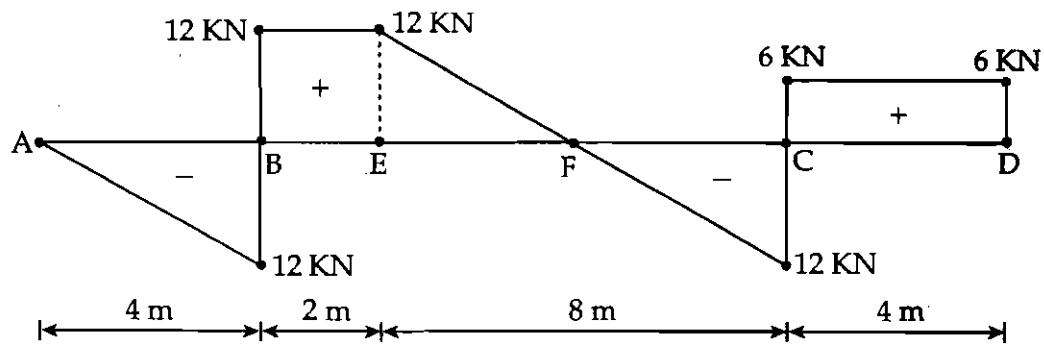


Figure 1

P.T.O.

(b) A circular steel bar ABCD, rigidly fixed at A and D is subjected to loads of 50 KN and 100 KN at B and C as shown in Figure 2, Find the loads shared by each part of the bar and displacements of the points B and C. Take E for steel as 200 GPa. **10**

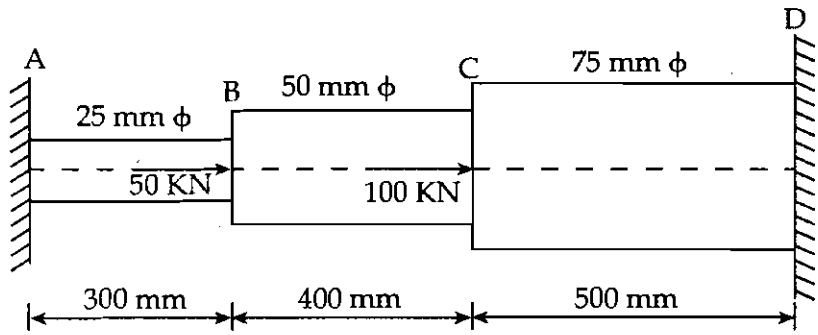


Figure 2

(c) Analyse the continous beam loaded as shown in Figure 3, by the slope deflection method. Support B sinks by 10 mm. Take $E = 2 \times 10^5$ N/mm^2, $I = 16 \times 10^7$ mm^4. Sketch the bending moment and shear force diagrams. **10**

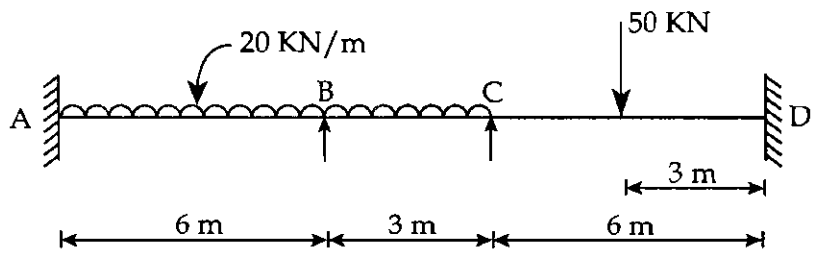


Figure 3

(d) Draw the shear force and bending moment diagrams for the continuous beam shown in Figure 4. Using theorem of three moments. **10**

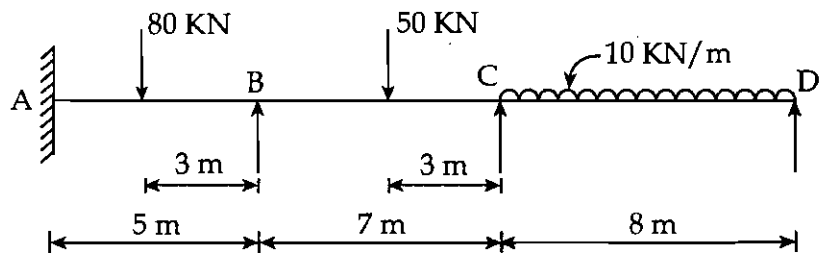


Figure 4

2. (a) The cross-section of cast iron beam is shown in Figure 5. The top flange is in compression and bottom flange is in tension. Permissible stress in tension is 30 N/mm^2 and it's value in compression is 90 N/mm^2. Determine how much concentrated load beam can carry at center of 5 m span. Given ends of beam are simply supported. 10

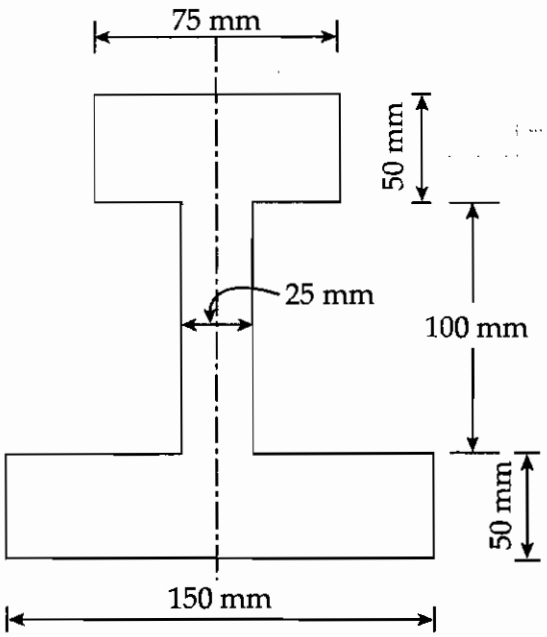


Figure 5

(b) A shaft composed of segments AC, CD and DB is fastened to rigid supports and loaded as shown in Figure 6, for bronze G = 35 GPa, Aluminium G = 28 GPa and for steel G = 83 GPa. Determine the maximum shearing stress developed in each segment. T_C = 300 N.M and T_D = 700 N.M. 10

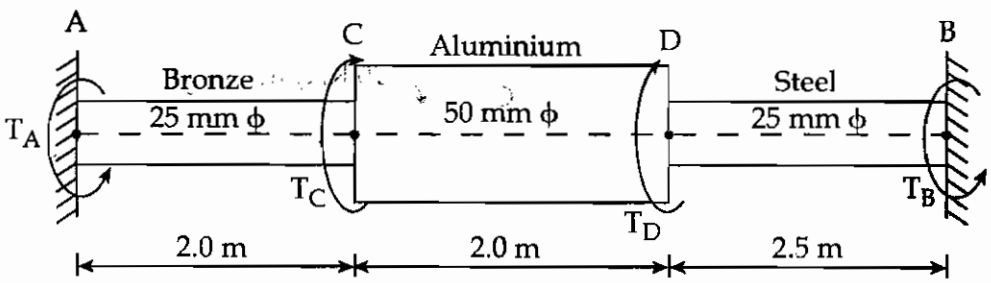


Figure 6

P.T.O.

(c) Analyse the loaded frame shown in Figure 7, by moment distribution method and draw the bending moment diagram. **10**

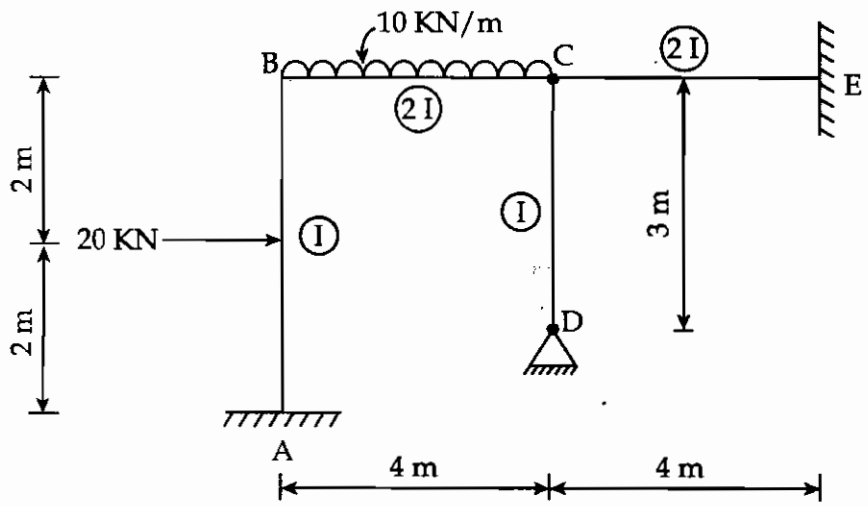


Figure 7

(d) Find the vertical deflection of point 'C' of the loaded truss shown in figure 8. The cross-sectional area of members CD and DE are each 2500 mm^2 and those of other members are each 1250 mm^2. Take E = 200 KN/mm^2. **10**

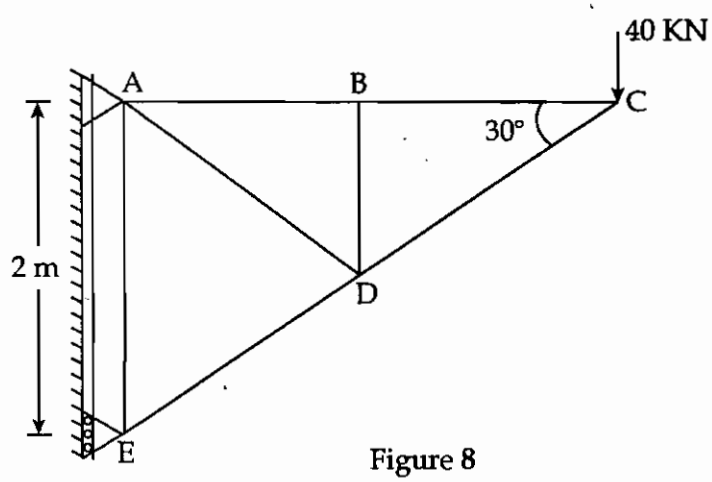
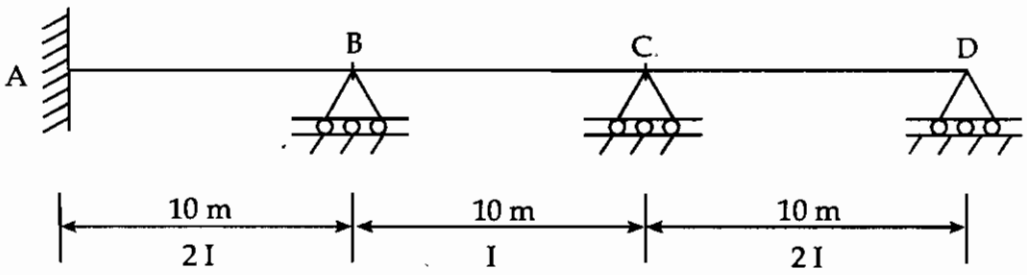


Figure 8

SECTION - B

3. (a) Calculate the flexural stiffness at point D of the three - span continuous beam ABCD shown in figure. **10**



(b) A suspension cable hangs between two points A and B separated horizontally by 90 m and with point B 15 m above A. The lowest point of the cable is 3 m below A. The cable supports a stiffening girder weighing 7.5 KN/m which is hinged vertically below A, B and the lowest point of the cable. Calculate the maximum tension which occurs in the cable when 200 KN wheel load crosses the girder from A to B. **10**

(c) An ISMB 500 @ 852.5 N/m transmits an end reaction of 300 KN and bending moment of 150 KN^{-m}, under factored loads, to the flange of a column ISHB 300 @ 576.8 N/m. Design a welded connection. **10**

(d) A column ISHB 350 @ 661.2 N/m carries an axial compressive factored load of 1700 KN. Design a suitable bolted gusset base. The base rests on M15 grade concrete pedestal. Use 24 mm diameter bolts of grade 4.6 for making the connections. **10**

4. (a) A bean ABC is supported at A, B and C and has an internal hinge at D at a distance of 4 m from A. AB = 8 m, and BC = 12 m. Draw the influence lines for : **10**

(i) Reaction at A R_a

(ii) Reaction at B R_b

(iii) Reaction at C R_c

(b) A parabolic arched rib, 30 m span, is hinged at the crown and springings and has a central rise of 5 m. A moving load of 15 KN/m longer than the span, rolls over the arch from left to right. Calculate the maximum positive and negative bending moment at the section 9 m from the left hand hinge. **10**

(c) Design a welded plate girder of 20 m span using the tension field action for the following factored forces : **10**

(i) Maximum moment - 5000 KN^{-m}.

(ii) Maximum shear force - 900 KN.

The girder is laterally restrained connections need not be designed.

(d) Design a column of effective length 5.90 m. It is subjected to a factored axial compressive load of 2000 KN. Provide two channels back to back connected with battens by site welded connection. Use steel of grade Fe 410. **10**

P.T.O.

SECTION - C

5. (a) A singly Reinforced Concrete beam 230 mm wide and 400 mm effective depth. Using M20 and Fe 415 and using L.S.M. **10**
   (i) Calculate Mumax and Astmax for balanced design
   (ii) If depth of N.A. is limited to 0.35d. What will be values of Mu and Ast
   (iii) If the section is reinforced with 0.4% steel, determine the depth of N.A. and calculate Mu.

   (b) A R.C. beam section of size 230 mm wide × 500 mm deep has 4 Nos 20 mm bars in tension zone and 2 Nos 16 mm bars in compression zone. The effective span of beam is 5.5 m and clear cover to both reinforcement is 30 mm. Find safe working load the beam can carry by W.S.M. Use M20 and Fe415 take $\sigma_{abc} = 7$ N/mm^2 and $m = 13.33$. **10**

   (c) A Reinforced Concrete beam has a support section with a width of 300 mm and effective depth 600 mm. The support section is reinforced with 3 Nos of 20 mm dia. bars at an effective depth of 600 mm. 8 mm dia. 2 legged stirrups are provided at spacing of 200 mm as a shear Reinforcement near support. Estimate the shear strength of support section. Using M20 and Fe500 steel. Assuming $\tau_c = 0.48$ N/mm^2. Using L.S.M. **10**

   (d) Design a slab of size 3m × 7.8m using M20 and Fe 415 for flexture. Assuming M.F = 1.5 and $\tau_c = 0.36$ N/mm^2 K = 1.3, LL = 3.5 KN/m^2 and F.F = 1.0 KN/m^2. Take all necessary checks as per L.S.M. using $\tau_{bd} = 1.2$ N/mm^2. **10**

6. (a) Check the stability of Retaining wall to retain the earth 4m high. The top surface is horizontal behind the wall. The soil has unit weight of 17 KN/m^3 and Angle of internal friction $\phi = 30°$. The material under the wall base is same as above with S.B.C of soil = 150 KN/m^2 and $\mu = 0.55$ use M20 and Fe 415. **10**

   (b) Design a open React. water tank fixed at base on firm ground with capacity 1.5 lakh liters. Assuming depth of water in tank as 3.5m provide free board of 0.2m. Use M25 and Fe 415 steel. Use Approximate Method of design. Design long wall, short wall and base slab. **10**

   (c) Design one of the flight of stair of a school building spanning between landing beams to suit the following data : **10**
   (i) Type of stair case – Waist slab type
   (ii) No. of steps in a flight = 12
   (iii) Tread = 300 mm
   (iv) Riser = 160 mm
   (v) Width of landing beam = 400 mm
   (vi) Material – M20 and Fe 415

   (d) A Reinforced Concrete beam ABC of rectangular section is simply supported at A and C and continuous over support B. Span AB = 5m and BC = 4m. The beam carries a D.L. of 20 KN/m including self weight and L.L = 12 KN/m. Design the continuous beam by L.S.M. with 10% redistribution of moment. Use M20 and Fe 415. Draw B.M.D. envelops. **10**

SECTION - D

7. (a) Discuss the various properties of concrete in both fresh and hardened state, which affect the strength of concrete. **10**

(b) Explain : **10**

(i) Characteristic strength of concrete

(ii) Stress-strain behaviour of concrete. How the stress-strain behaviour is idealised to define the design strength of concrete ?

(c) Explain the three basic concepts of pre-stressing. Discuss why high-strength materials are required to be used in pre-stressed concrete. **10**

(d) A post-tensioned pre-stressed concrete beam of span 30 m is subjected to a pre-stressing force of 2500 KN at transfer. The profile of the cable is parabolic with zero eccentricity at supports and 200 mm at mid-span. The beam has a cross-section of 500 mm × 800 mm and is prestressed with 9 cables, one at a time, each cable consisting of 12 wires of 5 mm diameter. Determine the loss of prestress due to : **10**

(i) elastic shortening (ii) friction

Assume $Es = 2.1 \times 10^5$ N/mm^2, $Ec = 3.5 \times 10^4$ N/mm^2, Coefficient of friction = 0.3, Coefficient for length effect = 15×10^{-4} per metre.

8. (a) List at least four methods of mix design of concrete. Explain in detail the IS code method of mix design. **10**

(b) Explain the following with neat sketches : **10**

(i) Shuttering for a rectangular column

(ii) Shuttering for beam and slab floor

(c) Explain different types of post-tensioning systems with the help of neat sketches. **10**

(d) A pretensioned unsymmetrical I-section has a top flange of 300 mm × 150 mm and a bottom flange of 250 mm × 200 mm. The rib is 150 mm thick and 350 mm deep. The beam is prestressed by a straight cable with an eccentricity of 150 mm and carries a prestressing force of 400 KN. The beam is simply supported over a span of 10 m, and is subjected to a live load of 5 KN/m. Draw the stress distribution diagram at mid-span section for : **10**

(i) self weight and prestressing force

(ii) self weight, prestressing force and live load.

P.T.O.

SECTION - E

9. (a) Using Newton-Raphson method, find root of the following non-linear equation with trial value of 5. **10**

$$x^2 - 5x + 4 = 0$$

(b) Evaluate $\int_1^7 \frac{1}{x}\,dx$ by Simpson's three - eighths rule and compare the value with the exact value of $\log_e 7$ of the integral. **10**

(c) Find the positive root of the equation $\cos x - 1.3x = 0$ correct to four decimal places using bi-section method. **10**

(d) Solve the following set of equations by using Gauss - Jordon method. **10**

$$0.732x_1 - 5.421x_2 + 1.013x_3 = 4.256$$
$$3.491x_1 + 2.203x_2 + 0.782x_3 = -7.113$$
$$0.961x_1 - 1.523x_2 + 4.265x_3 = 3.727.$$

10. (a) Solve the following quadratic equation by accelerated iteration method starting with any convenient initial value. **10**

$$x^2 + 2x - 2 = 0$$

(b) Write computer program for designing of laterally supported beam as per IS : 800. The program should be useful to handle the following load types : **10**

(i) Point load

(ii) Uniformly varying load

(iii) Uniformly distributed load

(iv) Combinations of above three

Use Fortran or C-language.

(c) Develop an algorithm and flowchart to design R.C.C. column subjected to axial load and uniaxial bending moment. **10**

(d) Write computer program in Fortran or C-language for designing flanged beam as per IS : 456. Data such as flange thickness, Web Width, overall depth and area of steel is to be given for particular B.M. and S.F. value. **10**

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Maharashtra Engineering (civil) Services Main Examination - 2011

HRM

2011

1052

CIVIL ENGINEERING (Paper - II)

Time allowed : 3 Hours } **{ Maximum Marks : 200**

Note :

(i) *Solve any one question from each section.*

(ii) *Do not reproduce any question. Write only question number against the answer.*

(iii) *Number of optional questions up to the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.*

(iv) *Figures to the right indicate the number of marks for the questions.*

(v) *Assume suitable data if necessary and state-it clearly.*

(vi) *Use of Non-programmable calculators is permitted.*

(vii) *Use of I.S. Codes and Steel Table, is not permitted.*

(viii) *Candidate should not write roll number, any name (including his/her own), signature, address or any indication of his/her identity any where inside the answer book otherwise the candidate will be penalised.*

SECTION - "A"

1. (a) Discuss the temporary adjustment of Transit Theodolite. How would you measure the horizontal angle by repetition method ? **10**

(b) Determine the gradient from point 'P' to point 'Q' from the following observations made with a tacheometer fitted with an anallactic lens. The constant of instrument was 100 and staff was held vertically. **10**

inst. station	staff station	Bearing	Vertical Angle	Staff readings b	m	T
P	A	130	10°32′	1.36	1.915	2.470
	B	220	5°6′	1.065	1.885	2.705

(c) Two straight lines 'AB' and 'BC' are intersected by a line 'D_1D_2'. The $\angle$ B D_1D_2 and $\angle$ B D_2D_1 are 40° 30′ and 36° 24′ respectively. The radius of first arc is 600 m. and that of second arc is 800 m. If the chainage at point of intersection point 'B' is 8248. 10m. Calculate the chainage of Tangent Points and point's of compound curve. **10**

P.T.O.

(d) The following consecutive readings were taken with dumpy level and 4m leveling staff on a continuously sloping ground at a common interval of 30 m. **10**

The elevation of point A was 520.45 m. make up a level book and apply usual checks. Also determine the gradient of line AB. The staff readings are as follows.

Staff reading on A = 0.585, 0.936, 1.953, 2.846, 3.644, 3.938, 0.962, 1.035, 1.689, 2.534, 3.844, 0.956, 1.579.

Staff reading on B = 3.016.

2. (a) The table gives the latitude and departure of sides of closed Traverse ABCDA. Calculate the independent co-ordinate of each station and the area of closed Traverse ABCDA. **10**

Side	Latitude		Departure	
	N	S	E	W
AB	214.8		124.0	
BC		245.10	205.70	
CD		155.90		90.00
DA	186.20			239.70

(b) Discuss the advantages and disadvantages of plane table surveying. **10**

(c) What do you mean by local attraction. Following bearings were observed on a closed Compass Traverse. Calculate the interior angle and correct it for observational error taking the bearing of line BC as correct. Find the corrected bearing of remaining sides of the closed traverse : **10**

Line	F.B.	B.B.
AB	191° 15′	10° 15′
BC	120° 45′	300° 45′
CD	339° 5′	169° 00′
DE	339° 35′	160° 40′
EA	296° 00′	115° 00′

(d) An Instrument set up at 'P' and angle of depression to a vane 2m above the foot of the staff held at 'Q' was 5° 36′. The horizontal distance between 'P' and 'Q' was known to be 3000m. Determine the R.L. of staff station 'Q' given that staff reading on a B.M. of elevation 456.050 was 2.865 m. **10**

SECTION - "B"

3. (a) Give account of any three standard sizes for 23 cm bricks as prescribed by PWD in India along with mould sizes. What is effect of presence of oxide of iron and alkali in brick earth on brick after burning ? **10**

(b) How is lime classified ? State suitability of each for application like masonry and plastering with reasons. **10**

(c) Compare Granite, Basalt, lime stone, and Laterite on the basis of suitability for construction type, geological classification, structure, and requirement of seasoning. **10**

(d) Explain various steps involved in preparation of surface of new wood work for painting, with reasons. **10**

4. (a) How is built environment different from natural environment ? Why is an integrated approach essential in building planning ? **10**

(b) Explain essential climatic considerations in building planning with suitable examples. **10**

(c) Explain lighting and ventilation requirements for habitable room, sanitary annexe (WC and Bath), Stairway, and basement as per building bye laws. **10**

(d) What are precautionary measures to avoid acoustical defects in an auditorium. Also explain use of Sabine's expression to work out ORT for an auditorium. **10**

SECTION - "C"

5. (a) Describe the procedure for empirical design of shallow stepped foundation for load bearing wall. **10**

(b) Explain in brief the points to be observed in supervising brick work. **10**

(c) Enlist and explain the contract documents. **10**

(d) Find out the book value, after 40 years, of an asset costing Rs. 4.0 lakhs, assuming 100 years as life of the asset and the salvage value of Rs. 20,000/-. What would be the book value after 30 years of life if the salvage value is nil ? (Assume straight line depreciation). **10**

6. (a) Explain the difficulties faced and precautions to be taken for foundations of buildings in black cotton soils. **10**

(b) Draw a roof plan for pitched roof and explain the components and technical terms in pitched roof. **10**

(d) A construction project consists of 10 activities as shown below : **10**

Activity	Duration	Activities which immediately	
		Precede	Follow
A	8 days	NIL	A, B
B	8 days	NIL	E
C	8 days	A	F
D	10 days	A	G, H
E	8 days	B	G, H
F	8 days	C	I
G	10 days	E, D	I
H	8 days	E, D	J
I	8 days	F, G	NIL
J	8 days	H	NIL

Draw Network diagram and find out all critical activities. Also show activity wise float in tabular form.

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(c) Compare in detail the item rate contract and percentage rate contract. **10**

(d) Prepare an approximate estimate for a G + 3 RCC framed structure. The built up area on ground floor is 500 m^2, and on every successive floor it is reduced by 10% of ground floor built up area. The built up area rate for ground floor is Rs. 10,000/- per square meter, and for every higher floor there is a hike of Rs. 1000/- in this rate. Cost of electrification and plumbing is 15% of building cost. Provide 5% of total cost for contingencies and work - charged establishment. **10**

SECTION - "D"

7. (a) Draw a neat sketch of plasticity chart suggested by IS 1498 and explain how it is used to classify soils. **10**

(b) List out assumptions made by Boussinesq for stresses induced in a soil mass due to concentrated point load and write Boussinesq equation for stress due to point load in a soil mass. Give meaning of all the terms in the equation. **10**

(c) Define optimum moisture content and explain how the compaction of soil is controlled in the field. Also list out the factors which affect compaction. **10**

(d) Explain plate load test with a neat sketch and explain what are its limitations. **10**

8. (a) A retaining wall 4 m high, has a smooth vertical back. The backfill has a horizontal surface in level with the top of the wall. There is uniformly distributed surcharge load of 36 KN/m^2 intensity over the backfill. The unit weight of the backfill is 18 KN/m^2, its angle of shearing resistance is 30° and cohesion is zero. Determine the magnitude and point of application of active earth pressure per metre length of the wall. **10**

(b) An undisturbed sample of soil has a volume of 100 cm^3 and mass 190 g. On oven drying for 24 hours, the mass is reduced to 160 g. If the specific gravity of soil particles is 2.68, determine the water content, voids ratio and degree of saturation of the soil. **10**

(c) With necessary sketches explain sand replacement method to find field density of soil in the field. **10**

(d) A normally consolidated clay stratum of 3 m thickness has two permeable layers at its top and bottom. The liquid limit and the initial void ratio of the clay are 36% and 0.82 respectively, while the initial overburden pressure at the middle of the clay layer is 2 kg/cm^2. Due to the construction of a new building this pressure increases by 1.5 kg/cm^2. Compute the probable consolidation settlement of the building. **10**

P.T.O.

SECTION - "E"

9. (a) What is meant by Scientific management ? How are the methods of Scientific management adopted for the construction jobs ? **10**

(b) A construction project carries out seven activities as shown below : **10**

Activity	Dependancy	Duration
A	Initial Activity	5 days
B	Initial Activity	5 days
C	Depends upon Activity A	5 days
D	Depends upon Activity B	10 days
E	Depends upon Activity B	5 days
F	Depends upon C and D	10 days
G	Depends upon Activity E	10 days

Calculate EST, EFT, LST, LFT, by drawing Network diagram. Also show critical path.

(c) (i) Using the straight line method of depreciation, determine the annual cost of depreciation for a tractor whose initial cost is Rs. 17,50,000/- if the assumed life is 7 years with an Estimated Salvage Value of Rs. 22,000/- **5**

(ii) Explain in brief the causes of Accidents. **5**

(d) What do you mean by Store Management ? What principles are normally adopted to store construction material ? **10**

10. (a) Draw a neat sketch showing the basic parts of "Drag line." **10**

(b) What are the important features of ABC Analysis ? **10**

(c) Define : **10**

(i) Accident Cost

(ii) Injury frequency rate

(iii) Injury Severity rate

(iv) Safety equipments in construction industry

P.T.O.

Maharashtra Engineering (Civil) Services Main Examination - 2011

IRM

2011

CIVIL ENGINEERING (Paper - III)

101052

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :

(i) *Solve any one question from each section.*

(ii) *Do not reproduce any question. Write only question number against the answer.*

(iii) *Number of optional questions up to the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.*

(iv) *Figures to the right indicate the number of marks for the questions.*

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(vi) *Use of Non-programmable calculators is permitted.*

(vii) *Use of I.S. Codes and Steel Table, is not permitted.*

(viii) *Candidate should not write roll number, any name (including his/her own), signature, address or any indication of his/her identity any where inside the answer book otherwise the candidate will be penalised.*

SECTION - A

1. (a) Define and briefly explain Newton's Law of Viscosity. Also differentiate between kinematic and dynamic viscosity. **10**

The surface tension of water in contact with air at 20°C is given as 0.0716 N/m. The pressure inside a droplet of water is to be 0.0147 N/cm^2 greater than the outside pressure. Calculate the diameter of droplet of water.

(b) Explain the condition of equilibrium for a floating body and submerged body. **10**

The velocity vector in a fluid flow is given by, $V = 2x^3\, i - 5x^2y\, i + 4\, tk$. Find the velocity and acceleration of a fluid particle (1, 2, 3) at time t = 1.

(c) What do you understand by most economical section of a channel. Also derive the conditions for rectangular channel of most economical section. **10**

A syphon of diameter 150 mm connects two reservoirs having a difference in elevation of 15 m. The length of the syphon is 400 m and summit is 4 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to summit is 80 m. Determine the discharge through syphon. Also determine the pressure at summit, consider coefficient of friction as 0.020 and neglect minor losses.

P.T.O.

(d) Describe the functions of main components of Pelton turbine with neat sketch. **10**

Find the power required to drive a centrifugal pump which delivers 0.04 cubic metre per second of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70%. Consider coefficient of friction as 0.06.

2. (a) Explain the phenomenon of capillarity and obtain an expression for capillary rise of a liquid. **10**

A rectangular tank 4 m long, 1.5 m wide contains water upto a height of 2 m. Calculate the force due to water pressure on the base of the tank. Also find the direction of this force and depth of centre of pressure from free surface.

(b) Distinguish between following : **10**

(i) Uniform flow and non uniform flow

(ii) Steady flow and unsteady flow

(iii) Rotational flow and irrotational flow

What are the limitations of Bernoulli's theorem ? Water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The discharge through the pipe is 0.04 cumec. The section 1 is 6 m above datum line and section 2 is 3 m above datum. If pressure at section 1 is 29.43 N/cm^2, what is the pressure at section 2 ?

(c) A rectangular channel carries water at the rate of 0.5 cumec when bed slope is 1 in 3000. Find the most economical dimension of the channel if C is 60. **10**

List any three dimensionless numbers. Also explain their significances for fluid flow problems.

(d) Describe the working of reciprocating pump with a neat sketch. **10**

Draw a typical layout of hydroelectric power house and name the components.

SECTION - B

3. (a) Explain the terms infiltration and infiltration capacity. In a 10 Hr storm rainfall occurred over a catchment the rainfall depths are as given below : **10**

Hours	1	2	3	4	5	6	7	8	9	10
Depth cm/hr	1.0	1.5	5.0	6.0	10.5	8.5	9.0	7.0	1.5	1.5

Surface runoff resulting from the storm is equivalent to 20 cm of depth over the catchment. Determine the average infiltration and average rate of infiltration.

10. (a) Give the advantages and disadvantages of 'Dead end,' and 'Grid-iron' layout of distribution system. **10**

Explain the necessity, location and working of non return value with neat sketch.

(b) (i) Calculate the velocity of flow and discharge flowing in a sewer of circular section having diameter 1.0 m laid at a gradient of 1 in 500. Use Mannings formula taking N = 0.012. Assume that sewer is running half full. **10**

(ii) Determine the BOD reaction rate (K) and ultimate BOD (L) by, 'Least square method,' from the given data :

Time 't' days	2	4	6	8	10
BOD y mg/lit	11	18	22	24	26

(c) Write short note on Anaerobic digestion process. Design an oxidation pond for the following data : **10**

(i) Location = 24° Latitude

(ii) Elevation = 900 m above MSL

(iii) Mean monthly temperature = 30°C max and 10°C min

(iv) Population to be served = 8000

(v) Sewage flow = 160 lpcd

(vi) Desired treated effluent BOD_S = 30 mg/lit

(vii) Pond Removal Constant = 0.1/d

(viii) Areal BOD loading at 24° latitude = 225 kg/ha/day

(d) Explain the different sources of air pollution and classify them. Explain the various techniques of noise pollution control. Give the Ambient air quality standards. **10**

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(b) A 60 cm diameter well is being pumped at a rate of 1360 lit/min, measurements in the nearby test well were made at the same time as follows. **10**

At a distance of 6 m from the well being pumped, the drawdown was 6 m and at 15 m the drawdown was 1.5 m. The bottom of the well is 90 m below the ground water table. Find the coefficient of permeability. If all the observation points were on the Dupuit's curve what was the drawdown in the well during pumping. What is the specific capacity of the well ?

(c) What are the different ways by which a concrete gravity dam may fail, and how will you ensure its safety against each type of failure. **10**

(d) What are the different types of cross drainage works that are necessary on a canal alignment, state briefly the conditions under which each one is used. **10**

4. (a) What is evaporation ? What factors control the process of evaporation ? Explain with sketch the method of measurement of evaporation with ISI standard pan. **10**

(b) Find the ordinates of a storm hydrograph resulting from a 3 hour storm with rainfall of 2.0, 6.75 and 3.75 cm during subsequent 3 hour intervals. The ordinates of unit hydrograph are as given below : **10**

Hours	3	6	9	12	15	18
U H ordinates (cumecs)	0	110	365	500	390	310

Hours	21	24	3	6	9	12
U H ordinates (cumecs)	250	235	175	130	95	65

Hours	15	18	21	24
U H ordinates (cumecs)	40	22	10	0

Assume an initial loss of 5 mm, infiltration index of 2.5 mm/hour and baseflow of 10 cumecs.

(c) Explain the importance of rivers and necessity of controlling them. Explain high water training, low water training and mean water training. 10

(d) What are the advantages of tile drains ? What are the different methods of aligning tile drains. 10

SECTION - C

5. (a) Explain the various factors controlling the alignment of roads. Give the details of the drawings to be prepared in a highway project. 10

(b) A National Highway passing through rolling terrain in heavy rainfall area has a horizontal curve of radius 500 m. Design the length of transition curve. Assume Design speed = 80 Kmph., pavement width = 7.0 m, rate of change of centrifugal acceleration 0.52 and allowable rate of introduction of superelevation 1 in 150. Pavement to be rotated about inner edge. Two lanes pavement and wheel base 6.0 m. 10

(c) What is a traffic rotary ? Explain with a sketch. What are its advantages and limitations with reference to traffic conditions in India ? 10

(d) Enlist the various plants and equipments used in the construction of cement concrete road. Enumerate the steps in the construction of cement concrete pavement. 10

6. (a) Explain the various factors on which the stopping sight distance depends. Explain total reaction time and the PIEV theory. 10

(b) Explain the various factors that influence night visibility on roads. What are the various factors to be considered in the design of road lighting. 10

(c) Discuss the IRC recommandations for the CBR method of design of pavements. The CBR value of a subgrade soil is 8 percent, calculate the total thickness of pavement using design formula developed by US corps of Engineers. Assume 3175 kg wheel load and tyre pressure 5 kg/cm^2. 10

(d) Explain various types of failures in rigid pavements, what are its causes ? 10

SECTION - D

7. (a) Enumerate the various loads and forces acting on bridge. 10

Calculate the normal depth of scour in a river with alluvial bed when design discharge is 900 m^3/sec. The river bed consists of coarse sand with size of particle as 0.73 mm. Also, determine the maximum depth of scour when a bridge is to be constructed in a straight reach.

(b) What are the various erection methods for construction of superstructure of concrete and steel girder bridges ? Describe in brief the side slewing method. 10

(c) Explain how will you decide the size and shape of a tunnel. 10

(d) What are the various methods of tunnelling in hard strata ? Describe in brief the process of tunnelling by TBM (Tunnel Boring Machine). 10

P.T.O.

8. (a) Which factors will you consider for selection of a site for bridge construction ? **10**

The river has a slope of 1 in 700. The hydraulic mean depth for the channel is 2.8 m and the Chezy's coefficient is 30. Width of stream at HFL is 300 m and linear waterway under the bridge is 270 m. Assuming coefficient of discharge through bridge as 0.7, calculate the afflux.

(b) What are the various methods of strengthening the steel and concrete girder bridges ? Explain in brief any two methods, through main steps. **10**

(c) Give the sequence of operations of tunnelling by conventional drill and blast method in hard strata. Describe in brief each step. **10**

(d) Explain the necessity of ventilation during and after construction of tunnel. How is it achieved ? **10**

What are the various methods of drainage during construction of tunnel ?

SECTION - E

9. (a) Compare surface water and ground water as a source of drinking water. **10**

Draw a typical flow diagram of water treatment plant for a town having population 2 lakh with water supply rate of 200 lpcd, with 'river' as source of water, also comment on changes to be made in flow diagram if source becomes 'dam reservoir', instead of river.

(b) (i) Compare slow sand filter with rapid sand filter with reference to : **10**

(1) Filtration rate
(2) Coagulation
(3) Efficiency
(4) Economy
(5) Loss of head
(6) Period of cleaning
(7) Method of cleaning
(8) Flexibility in operation

(ii) Determine the size of flocculation tank, power requirement and area of blades of paddle for a flow 300000 litres/hour at 20°C.

Given data t = 20 minutes, Ave. G value = 40/sec, paddle speed = 4.5 rpm Velocity ratio = 0.25.

(c) Explain the term 'Activated sludge process'. Explain the modifications : **10**

(i) Topered aeration and

(ii) Extended aeration

(d) Explain the various factors affecting composting process, and also discuss the mechanical compost plant used for municipal solid waste. **10**

P.T.O.

2013

CIVIL ENGINEERING (Paper - I)

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :

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(vi) *Use of Non-programmable calculators is permitted.*

(vii) *Use of I.S. Codes and Steel Tables is* ***not*** *permitted.*

(viii) *Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer books otherwise they will be penalised.*

(ix) *Candidates are expected to answer all the subquestions of a question together. If subquestion of a question is attempted elsewhere (after leaving a few pages or after attempting another question) the later subquestion shall be overlooked.*

SECTION - A

1. (a) A reinforced concrete column is 230×300 mm in size. It is reinforced with six bars of 16 mm diameter. The column is subjected to 800 kN load. Determine the stresses in concrete and steel. Take modular ratio $m = 13$. **10**

(b) A rectangular section for a beam is to be cut out of a log of wood 600 mm in diameter. Determine the dimensions of the strongest section. **10**

(c) A simply supported beam of span 'L' carries two equal point loads 'P' at quarter points from ends. Using conjugate beam method calculate central deflection. Flexural rigidity of beam is EI. **10**

(d) Compare the load carrying capacity of columns with both ends hinged. **10**

(i) Solid square section 40×40 cms.

(ii) Hollow square section with 50 cms outer side and 30 cms inner side. Use Rankine's formula. Take $\sigma_c = 50$ MPa, $\alpha = \frac{1}{750}$.

Length of columns is 3.6 m.

P.T.O.

2. (a) Using slope deflection equations analyse the portal frame shown in the figure 1. Draw B.M.D. **10**

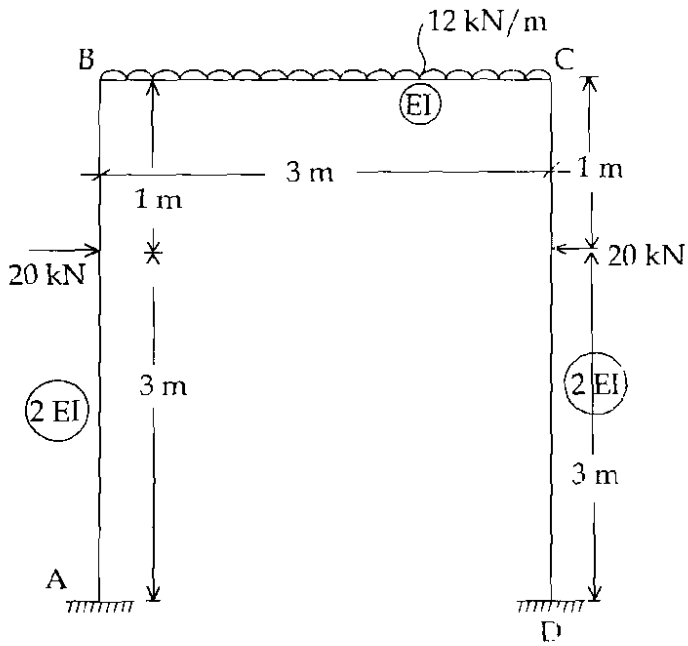

Figure - 1

(b) Determine the forces in all the members of the truss shown in figure. 2. Diagonal members c/s area = 3000 mm^2. Horizontal and vertical members c/s area = 2000 mm^2. **10**

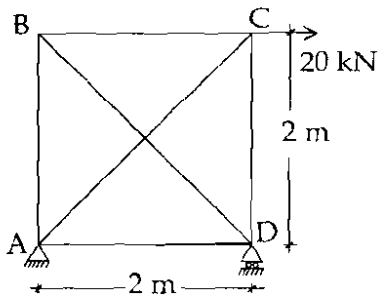

Figure - 2

(c) Find the support moments for the continuous beam ABCD if the support 'B' sinks by 1 cm. Take E = 200 kN/mm^2 I = 800 cm^4. Refer fig. 3. **10**

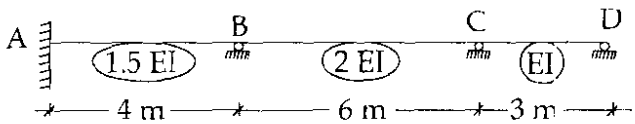

Figure - 3

(d) Find the deflection of the free end of cantilever beam ABC. Refer fig. 4. Take EI = 60000 kN. m^2. **10**

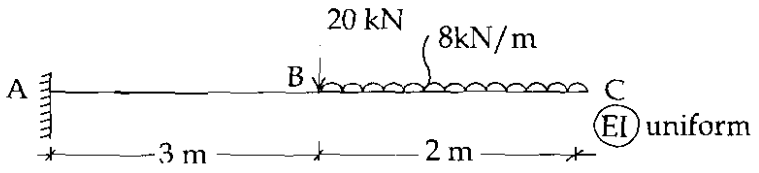

Figure - 4

SECTION - B

3. (a) A beam AD of span 7.5 m is fixed at A and roller supported at D and has an internal hinge at C at a distance of 3 m from D. Construct influence lines for : **10**

(i) Reaction at D, R_D

(ii) Shear at section B, at distance 3 m from A, SF_B

(iii) Moment at A, M_A

(b) A two span continuous beam ABC is fixed at A and simply supported at B and C, such that AB = 4 m, BC = 3 m. It is subjected to uniformly distributed load of intensity 60 kN/m over entire span AB and downward concentrated load of 100 kN at midpoint of span BC. Analyse the beam by using stiffness matrix method. Assume EI is constant throughout the beam. **10**

(c) A laterally supported built up beam consisting of ISMB 400@ 61.5 kg/m and plates of 200 mm × 10 mm each connected to flange, is simply supported over a span of 4 m. The beam is subjected to a factored column load of 400 kN at centre of span. Load is transferred through base plate of 200 mm length and 10 mm thick. Check the beam for web buckling and web crippling. Take $f_y = 250$ MPa. For ISMB 400 : $t_w = 8.9$ mm, $t_f = 16$ mm, $Z_p = 1176.18 \times 10^3$ mm^3, root radius R = 14 mm. **10**

P.T.O.

(d) Design a welded plate girder to carry a superimposed load of 50 kN/m and two concentrated loads of 200 kN each at one-third points of the span. The effective span of the plate girder is 24 m. Assume that the girder is laterally supported throughout its length. Use the tension field method. Take $f_y = 250$ MPa. (Connections need not be designed) **10**

4. (a) A three hinged parabolic arch, hinged at the springings and crown has a span of 20 m. The central rise of the arch is 4 m. It is loaded with a uniformly distributed load of intensity 2 kN/m on the left 8 m length. Calculate the Normal thrust, Radial shear and Bending Moment at 4 m from the left hand hinge. **10**

(b) The towers of a 120 m suspension bridge are of unequal height. One is 15 m and the other 5 m above the lowest point of the cable, which is immediately above the inner pin of a three hinged stiffening girder hinged at the towers. Find the maximum tension in the cable due to a point load of 100 kN crossing the bridge. **10**

(c) A bracket transmits a load of 100 kN at an eccentricity of 200 mm to a column through 8 bolts of 24 mm diameter arranged in two vertical rows 80 mm apart. The pitch of the bolts is 80 mm and the load lies in the plane of the bolts. Calculate the maximum stress in the bolts. **10**

(d) Design a gusseted base for a beam-column ISSC 250@60.3 kg/m to transfer a factored axial compression of 750 kN and a factored bending moment of 75 kNm. The base rests on M30 grade concrete pedestal. Take $f_y = 250$ MPa. **10**

SECTION - C

5. (a) A doubly reinforced rectangular beam is 240 mm wide and 500 mm deep. If the limiting stresses in concrete and steel are 5 N/mm^2 and 230 N/mm^2 respectively. Determine the steel reinforcement for bending moment of 80 kNm. Assume that steel is burried on both faces with its centre 40 mm from either face. Take $m = 19$. Use working stress method. **10**

(b) Design a simply supported slab on masonry walls to the following requirements, using limit state method **10**

- Clear span = 2.5 m
- Live load = 3000 N/m^2
- Use M15 concrete and Fe 250 steel

Also draw plan and section showing reinforcement details.

(c) Design a square footing to carry a column load of 1100 kN from A 400 mm square column. The bearing capacity of soil is 100 kN/m^2. Use M15 concrete and Fe 415 steel. Use limit state method. Show reinforcement details. **10**

(d) Design a RCC short column to the following parameters using limit state method. **10**

(i) Axial load = 1200 kN.

(ii) Grade of concrete = M20.

(iii) Length of column = 1.85 m.

(iv) Grade of steel Fe 250.

Sketch the reinforcement details.

6. (a) Design a dog-legged stair case for a building in which the vertical distance between the floors is 3.6 m. The stair hall measures 2.5 m × 5 m. The live load may be taken as 2500 N/m^2. Use M20 grade concrete and Fe 415 steel. Sketch reinforcement details. **10**

(b) Design a circular tank with flexible base for capacity of 4 lakh litres. The depth of water is to be 4 m, including free board of 200 mm. Use M20 grade concrete Sketch reinforcement details. **10**

P.T.O.

(c) Check the stability of a counterfort retaining wall to retain 7 m high embankment above ground level. The foundation is to be taken 1 m deep, where the safe bearing capacity of soil may be taken as 180 kN/m^2. The top of earth retained is horizontal and soil weighs 18 kN/m^3 with an angle of friction $\phi = 30^\circ$, coefficient of friction between concrete and soil may be taken as 0.5. Use M20 grade concrete and Fe 415 steel. **10**

(d) A reinforced concrete beam AB of rectangular section is fixed at A and B. Span = 8 m. The beam carries ultimate udl of 24 kN/m. Design the beam by limit state method with 30% re-distribution of moment. Use M20 grade concrete and Fe 415 steel. Draw BMD envelopes. **10**

SECTION - D

7. (a) Explain the various post-tensioning systems based on wedge action with neat sketches. **10**

(b) Define 'workability', and briefly explain the factors affecting the workability of fresh concrete. **10**

(c) A rectangular concrete beam, 300 mm × 900 mm with an overhang BC of 2 m is simply supported at A and B over a span of 8 m. It supports a live load in addition to its self-weight of intensity 3.52 kN/m over the whole span of 10 m. Determine the profile of the prestressing cable with an effective force of 500 kN which can balance the dead and live loads on the beam. Sketch the profile of the cable along the length of the beam. **10**

(d) Explain, how the water cement ratio, ratio of cement to aggregate and maximum size of aggregate influence the strength of concrete. **10**

8. (a) List and explain the various types of loss of prestress in pretensioned and post-tensioned members. **10**

(b) Enlist the various non-destructive methods of testing the hardened concrete. Explain in detail the pulse velocity method. **10**

(c) The end block of a post - tensioned prestressed concrete beam, 300 mm wide and 300 mm deep, is subjected to a concentric anchorage force of 832.8 kN by a Freyssinet anchorage of area 11720 mm^2. Design and detail the anchorage reinforcement for the end block. **10**

(d) Enlist various methods of concrete mix design and briefly explain any two of them. **10**

SECTION - E

9. (a) Find the roots of the equation. **10**

$f(x) = x^2 - 3x + 2$

in the vicinity of $x = 0$ using Newton - Raphson Method.

(b) Compute the integral **10**

$$\int_0^{\pi/2} \sqrt{\sin x}\, dx$$

by applying Simpson's one third rule for n = 4 with an accuracy of five decimal places.

(c) Write an algorithm and flow-chart for solving a set of three simultaneous equations using Gauss - Jordan Method. **10**

(d) Solve the following equations by Relaxation Method. **10**

$10x - 2y - 2z = -6$

$-x + 10y - z = -7$

$-x - y + 10z = -8$

P.T.O.

10. (a) Using Trapezoidal Rule evaluate the integral **10**

$$I = \int_a^b (x^3 + 1)\, dx$$

for the intervals (1, 2) and (1, 1.5). Also estimate true error in each case with respect to exact answer.

(b) Perform five iterations of the bisection method to obtain the smallest positive root of the equation. **10**

$f(x) = \cos x - xe^x = 0$

(c) Draw flow chart for the computation of moment of resistance of R.C.C. beam. Take width of the beam 'b', effective depth of beam 'd', permissible stress in concrete is 'σ cbc', permissible stress in steel 'σst' and area of tensile steel is 'Ast'. Width and depth of beam are in 'MM', permissible stresses are in 'MPa' and Area of steel is in '$mm^{2'}$ (Use Working Stress Method). **10**

(d) Write a programme in 'C' or Fortran language to solve the set of simultaneous equations using Gauss - Elimination Method. **10**

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2013

CIVIL ENGINEERING (Paper - II)

Time allowed : 3 Hours] **[Maximum Marks : 200**

Note :

(i) *Solve any one question from each section.*

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SECTION - A

1. (a) Explain use of tape to measure distance AB on sloping ground, as indirect method. **10**
In chaining an area containing a pond two points C and D were selected on either side of chain station A such that A, C, D lie on a line. The point B which is on the other side of pond is on the chain line AB. If distances AC, AD, BC and BD are 35 m, 45 m, 100 m and 95 m respectively, determine the length of chain line AB and the angles which the inclined line CD makes with the chain line AB.

(b) Why declination at a place does not remain constant ? **10**
The true bearing of T as observed from station A was 358° and magnetic bearing of the same was 8°. FB of lines AB, AC and AD was found to be 290°, 340° and 30° respectively. Find the true forebearing of lines AB, AC and AD.

P.T.O.

(c) Explain any five tests that you will perform to assess a plane table in perfect adjustment for accurate work. What adjustment will you recommend if the plane table is not in adjustment ? **10**

(d) Prove that, the area of the traverse is equal to the algebraic sum of the products of the total latitude of each point and algebraic sum of the departures of the lines meeting at that point. **10**

2. (a) A dumpy level was set up midway between two pegs 80 m apart. The readings on the staff at the two pegs were 3.2 and 3.015 m respectively. The instrument was then moved by 20 m ahead of the second peg in line with two pegs. The respective staff readings were 2.825 and 2.69 m. Calculate the staff readings on the two pegs to provide horizontal line of sight. **10**

(b) To determine the gradient between two points A and B, a tacheometer was set up at another station C and following data was observed keeping staff vertical. **10**

Staff at	Vertical angle	Stadia readings
A	+4° 20'	1.3, 1.61, 1.92
B	+10' 40"	1.1, 1.41, 1.72

If the horizontal angle ACB is 35° 20' determine average gradient between A and B

K = 100 ; C = 0

(c) A horizontal curve is to be set. Devise a suitable solution under following situations : **10**

(i) The point of intersection is not accessible

(ii) Both tangent point and point of tangency are not accessible.

(d) Explain the relation between height of the station above a datum and the distance of the station from the point of tangency in case of geodetic surveying. **10**

The elevations of two triangulation stations A and B 100 km apart are 180 m and 450 m respectively. The intervening obstruction situated at C 75 km from A has an elevation of 259 m. Ascertain if A and B are intervisible. If not then by how much should B be raised so that the line of sight must nowhere be less than 3 m above the surface of the ground, assuming A as the ground station.

SECTION - B

3. (a) Explain the following vibrators used for compaction of concrete **10**

(i) Internal vibrators

(ii) External or form vibrators

(iii) Surface vibrators

(iv) Table vibrators

(b) Discuss the structural shapes of common rolled steel sections used for construction with examples [Figure for each shape is expected]. **10**

(c) State the reasons for artificial seasoning of timber. **10**

Explain any four methods of artificial seasoning from the following methods :

(i) Water seasoning

(ii) Seasoning by boiling or steaming

(iii) Kiln or hot air seasoning

(iv) Chemical or Salt seasoning

(v) Electrical seasoning

(vi) Smoke drying

(vii) Charring or scorching

(d) State the essential and other ingredients of a paint or oilpaint. Discuss the essential ingredients. **10**

P.T.O.

4. (a) (i) Give the distances of building line and control lines for ribbon development along approaches specified by National Building Code for National Highway, State Highway, Major district Road, Other district Road and village road. 5

(ii) Enlist the different principles of planning. Explain "Aspect" principle for different units of a residential building. 5

(b) Explain with a sketch 10

(i) Grease Trap

(ii) Intercepting trap

(c) Discuss the general principles and factors in Acoustical design of a Cinema Hall. 10

(d) Explain the general measures of fire safety that have been recommended in buildings 10

(i) Alarm system

(ii) Fire Extinguishing Arrangements

(iii) Escape Route (means of escape)

SECTION - C

5. (a) Explain with neat sketches different types of Ashlar masonry. 10

(b) Explain in brief the factors that affect the selection of flooring material. 10

(c) Briefly describe, with neat sketches, the various types of pointing. 10

(d) What are the different causes of dampness in a building ? Enlist different methods of prevention of dampness in a building. 10

6. (a) State purpose of rate analysis and explain in brief factors affecting rate analysis. 10

(b) Explain briefly the situations when lowest tender is rejected. 10

(c) What is meant by a 'Contract'? What are the essentials of valid contract ? 10

(d) Explain constant percentage method to calculate depreciation. Find out book value of a construction equipment after 5 years costing Rs. 80,000/-. Assume life as 8 years and the salvage value Rs. 8000/-. Use constant percentage method. 10

SECTION - D

7. (a) Define voids ratio, porosity, degree of saturation with respect to soil mass. **10**

Derive the equation $es_r = \omega G$

(b) Enlist the assumptions made by Boussinesq in his theory for the problem of stress distribution in soils due to a concentrated load. **10**

And with a neat sketch explain stress isobar and its significance.

(c) Explain the following terms in connection with shear tests on soil sample **10**

(i) Undrained test

(ii) Consolidated undrained test

(iii) Drained test

A cylinder of soil fails under an axial vertical stress of 160 kN/m^2, when it is laterally unconfined. The failure plane makes an angle of 50° with the horizontal. Calculate the value of cohesion and the angle of internal friction of the soil.

(d) Define optimum moisture content. What is the effect of increase in compactive effort on optimum moisture content for a given soil. Explain it with a neat sketch. **10**

A cohesive soil yields a maximum dry density of 18 kN/m^3 at an OMC of 18% during a standard proctor test. If the value of G is 2.7, what is the degree of saturation ?

8. (a) State any five assumptions made in Terzaghi's theory of consolidation. **10**

An undisturbed sample of clay 24 mm thick consolidated 50% in 22 minutes when tested in laboratory with double drainage. The clay layer from which the sample was obtained, is 5 m thick in the field. How much time will it take to consolidate 50% with double drainage ?

(b) Distinguish between active earth pressure and passive earth pressure. **10**

A 5 m high retaining wall has a granular backfill with a level top. The retaining wall face makes an angle of 85° with the base. Soil parameters r, ϕ and δ are 16 kN/m^3, 35° and 10° respectively. Using Columb's method obtain active thrust on the wall.

P.T.O.

(c) State the characteristics of bearing capacity failures namely general, local and punching shear failure, with neat sketches. 10

(d) Define critical depth of a slope.

A long natural slope of cohesionless soil is inclined at 13° to the horizontal. If $\phi = 30°$ determine the factor of safety of the slope. 10

SECTION - E

9. (a) A construction equipment was purchased in Rs.12000/- (Rs. Twelve thousand). Assuming its salvage value at the end of 6 years to be Rs.3000/-, determine amount of depreciation for each year by 10

(i) Straight line method

(ii) Constant percentage method.

[show the answer in the following format]

Format

Age in years	Book value at the end of year	Depreciation	Total depreciation
0			
1			
2			
3			
4			

(b) Discuss the advantages of following hammers used as a pile driving equipment 10

(i) Drop hammer

(ii) Single acting steam hammer

(iii) Double acting steam hammer

(iv) Diesel hammer

(v) Hydraulic Hammer

(c) While submitting a proposal for construction of a building, service plan is also to be submitted to the local authorities. **10**
Which points are to be submitted in this service plan ? Explain each point.

(d) A project consists of following activities. **10**

Activity	Preceded by	Duration (days)
A	Nil	4
B	A	8
C	A	6
D	C	8
E	C	4
F	E	12
G	E	8
H	A	2
J	H	8
K	F	6
L	G, K	4
M	D, J, L	4
N	B	4
O	M, N	4

(i) Draw the network.

(ii) Find out critical path and project duration.

(iii) Calculate Free Float and Independent Float for non critical activities.

P.T.O.

10. (a) Explain the safety measures to be adopted on worksite for demolition of a building. **10**

(b) A PERT project consists of following activities with their duration. **10**

Activity	Optimistic time	Pessimistic time	Most likely time
	in days (to)	in days (tp)	in days (tm)
1-2	6	18	9
1-3	5	17	8
2-4	4	22	7
3-4	4	16	7
2-5	4	10	7
3-5	2	8	5
4-5	4	22	10

Find out the probability of completion of project in 37 days

[For Z = 1, probability 84.13%

For Z = 2, probability 97.72%]

(c) Describe the stages of inspection and quality control for **10**

(i) Earthwork

(ii) Masonry

(iii) Reinforcement in RCC

(d) Who is the father of scientific management ? State and explain salient features of scientific management. **10**

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