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10MAT41

Fourth Semester B.E. Degree Examination, June/July 2016
Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of statistical tables permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Using Taylor's series method, solve $y' = x + y^2$, $y(0) = 1$ at $x = 0.1, 0.2$, considering upto 4th degree term. **(06 Marks)**

b. Using modified Euler's method, find an approximate value of y when x = 0.2 given that $\frac{dy}{dx} = x + y$ and y = 1 when x = 0. Take h = 0.1. Perform two iterations in each stage. **(07 Marks)**

c. Using Adams-Bashforth method, obtain the solution of $\frac{dy}{dx} = x - y^2$ at x = 0.8 given that y(0) = 0, y(0.2) = 0.0200, y(0.4) = 0.0795, y(0.6) = 0.1762. Apply the corrector formula twice. **(07 Marks)**

2 a. Employing the Picard's method, obtain the second order approximate solution of the following problem at x = 0.2, $\frac{dy}{dx} = x + yz$, $\frac{dz}{dx} = y + zx$, $y(0) = 1$, $z(0) = -1$. **(06 Marks)**

b. Solve $\frac{dy}{dx} = 1 + xz$ and $\frac{dz}{dx} = -xy$ for x = 0.3 by applying Runge Kutta method given y(0) = 0 and z(0) = 1. Take h = 0.3. **(07 Marks)**

c. Using the Milne's method, obtain an approximate solution at the point x = 0.4 of the problem $\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0$ given that y(0) = 1, y(0.1) = 1.03995, y(0.2) = 1.138036, y(0.3) = 1.29865, $y'(0) = 0.1$, $y'(0.1) = 0.6955$, $y'(0.2) = 1.258$, $y'(0.3) = 1.873$. **(07 Marks)**

3 a. Define an analytic function and obtain Cauchy-Riemann equations in polar form. **(06 Marks)**

b. Show that $u = e^{2x}(x\cos 2y - y\sin 2y)$ is a harmonic function and determine the corresponding analytic function. **(07 Marks)**

c. If f(z) is a regular function of z, prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$. **(07 Marks)**

4 a. Evaluate using Cauchy's integral formula $\int_c \frac{\cos \pi z}{z^2 - 1} dz$ around a rectangle with vertices $2 \pm i$, $-2 \pm i$. **(06 Marks)**

b. Find the bilinear transformation which maps 1, i, -1 to 2, i, -2 respectively. Also find the fixed points of the transformation. **(07 Marks)**

c. Discuss the conformal transformation of $w = z^2$. **(07 Marks)**

PART – B

5 a. Reduce the differential equation:

$$x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}+(k^2x^2-n^2)y=0$$ into Bessel form and write the complete solution in terms of $\tau_n(x)$ and $\tau_{-n}(x)$. **(06 Marks)**

b. Express $f(x) = x^3 + 2x^2 - x - 3$ in terms of Legendre polynomials. **(07 Marks)**

c. If α and β are the roots of $\tau_n(x) = 0$ then prove that

$$\int_0^1 x\tau_n(\alpha x)\,\tau_n(\beta x)\,dx = \begin{cases} 0, & \alpha \neq \beta \\ \frac{1}{2}\left[\tau_{n+1}(\alpha)\right]^2, & \alpha = \beta \end{cases}.$$ **(07 Marks)**

6 a. The probability that sushil will solve a problem is 1/4 and the probability that Ram will solve it is 2/3. If sushil and Ram work independently, what is the probability that the problem will be solved by (i) both of them; (ii) at least one of them? **(06 Marks)**

b. A committee consists of 9 students two of which are from first year, three from second year and four from third year. Three students are to be removed at random. What is the chance that (i) the three students belong to different classes; (ii) two belong to the same class and third to the different class; (iii) the three belong to the same class? **(07 Marks)**

c. The contents of three urns are: 1 white, 2 red, 3 green balls, 2 white, 1 red, 1 green balls and 4 white, 5 red, 3 green balls. Two balls are drawn from an urn chosen at random. These are found to be one white and one green. Find the probability that the balls so drawn came from the third urn. **(07 Marks)**

7 a. The probability mass function of a variate X is

x	0	1	2	3	4	5	6
p(x)	k	3k	5k	7k	9k	11k	13k

i) Find k

ii) Find $p(x < 4)$, $p(x \geq 5)$, $p(3 < x \leq 6)$, $p(x > 1)$

iii) Find the mean. **(06 Marks)**

b. Derive the mean and variance of Poisson distribution. **(07 Marks)**

c. The mean height of 500 students is 151cm and the standard deviation is 15cm. Assuming that the heights are normally distributed, find how many students heights i) lie between 120 and 155cm ii) more than 155cm. [Given A(2.07) = 0.4808 and A (0.27) = 0.1064, where A(z) is the area under the standard normal curve from 0 to z > 0]. **(07 Marks)**

8 a. The means of simple samples of sizes 1000 and 2000 are 67.5 and 68.0cm respectively. Can the samples be regarded as drawn from the same population of S.D 2.5cm [Given $z_{0.05} = 1.96$]. **(06 Marks)**

b. A random sample of 10 boys had the following I.Q: 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q of 100? [Given $t_{0.05}$ for 9d.f = 2.26]. **(07 Marks)**

c. The following table gives the number of aircraft accidents that occurred during the various days of the week. Find whether the accidents are uniformly distributed over the week.

Days :	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Total
No. of accidents :	14	16	8	12	11	9	14	84

[Given $\psi^2_{0.05}$ 6d.f = 12.59] **(07 Marks)**

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10CV/CT42

Fourth Semester B.E. Degree Examination, June/July 2016

Concrete Technology

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of IS10262-2009 and IS 456-2000 is permitted.***

PART – A

1 a. Describe any five field tests that can be done on cement. **(10 Marks)**
b. Draw a flow chart for the manufacturing of cement by wet process. **(10 Marks)**

2 a. What do you understand by grading analysis? Explain how it is done for fine aggregates. **(10 Marks)**
b. Mention the maximum impact value for wearing and non-wearing surfaces and also explain how impact test is done for coarse aggregate. **(10 Marks)**

3 a. What is workability? Explain its importance in fresh concrete. **(10 Marks)**
b. List out any ten methods adopted for transportation of concrete. **(10 Marks)**

4 a. Explain the flocculation and de-flocculation of cement grains under the influence of superplasticizer, with the help of a diagram. **(10 Marks)**
b. Briefly explain the effect of fly ash on fresh and hardened concrete. **(10 Marks)**

PART – B

5 a. Discuss any five factors affecting the strength of concrete. **(10 Marks)**
b. Discuss any five factors affecting the strength test results. **(10 Marks)**

6 a. List out any ten factors contributing to cracks in concrete. **(10 Marks)**
b. List out any five methods each for controlling sulphate attack and corrosion of steel due to chloride attack. **(10 Marks)**

7 Write short notes on the factors affecting the following:
a. Modulus of elasticity b. Shrinkage
c. Creep d. Workability **(20 Marks)**

8 With the help of the following design stipulations and test data for materials design a M20 grade concrete:
a. Design stipulations:
i) Characteristic compressive strength at 28 days = 20 N/mm^2
ii) Maximum size of aggregate = 20 mm (angular)
iii) Degree of workability = 0.90 compacting factor
iv) Degree of quality control = good
v) Type of exposure = mild
b. Test data for materials:
i) Specific gravity of cement = 3.15;
ii) Specific gravity of coarse aggregate = 2.60;
iii) Specific gravity of fine aggregate = 2.60;
iv) Water absorption of coarse aggregate = 0.5% ;
v) Water absorption of fine aggregate = 1.0% ;
vi) Free moisture in coarse aggregate = Nil ;
vii) Free moisture in fine aggregate = 2.0% ;
viii) Grading of fine aggregate = Zone III
Any missing data may be suitably assumed. **(20 Marks)**

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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Fourth Semester B.E. Degree Examination, June/July 2016
Structural Analysis – I

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain static indeterminacy and kinematic indeterminacy of structures with examples. **(06 Marks)**

b. Derive an expression for strain energy stored in a beam due to bending with usual notations. **(08 Marks)**

c. Explain any three structural forms with examples. **(06 Marks)**

2 a. Determine the slope and deflection at the free end of the cantilever beam of span ℓ subjected to udℓ of intensity ω/unit length throughout the span. EI is constant. Use moment area theorem. **(08 Marks)**

b. Find the slope at support A and deflection at centre span of a simply supported beam subjected to loading as shown in Fig.Q2(b). Use conjugate beam method. E is constant.

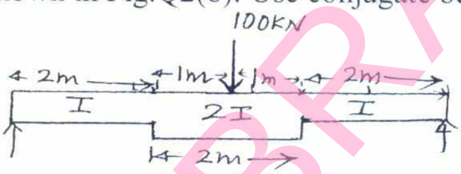

Fig.Q2(b) **(12 Marks)**

3 Find the vertical deflection at the joint C for the pin jointed truss shown in Fig.Q3, by strain energy method. The cross sectional area is shown. Take E = 200 kN/mm^2.

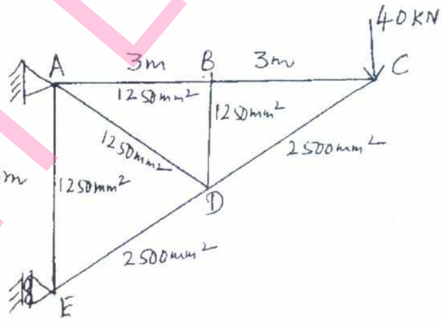

Fig.Q3 **(20 Marks)**

4 a. Determine horizontal and vertical component of deflection at point 'C' for the frame loaded as shown in Fig.Q4 by strain energy method.

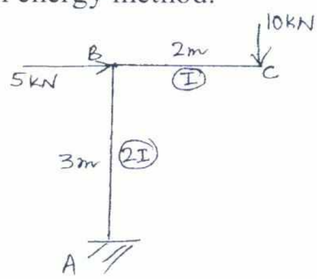

Fig.Q4 **(14 Marks)**

b. Using strain energy method, compute the deflection at mid span of a simply supported beam carrying a uniformly distributed load of ω kN/m. Assume an uniform flexural rigidity. **(06 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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PART – B

5 a. Derive an expression to find length of a cable subjected to uniformly distributed load throughout with usual notations. **(08 Marks)**

b. A three hinged parabolic arch is loaded as shown in Fig.Q5(b). Determine the reactions at supports, normal thrust, radial shear and bending moment at left quarter span point.

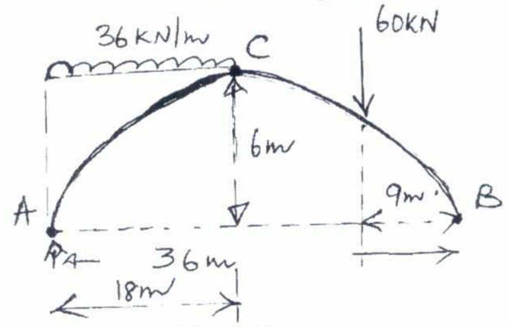

Fig.Q5(b) **(12 Marks)**

6 a. Draw SFD and BMD for the propped cantilever beam loaded as shown in Fig.Q6(a). Use consistent deformation method.

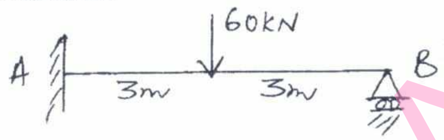

Fig.Q6(a) **(08 Marks)**

b. For a rigidly fixed beam AB of span 5m carrying a uniformly distributed load of 10 kN/m over the entire span, locate the point of contra flexure and draw BMD and SFD. [Fig.Q6(b)], carryout complete analysis using consistent deformation method.

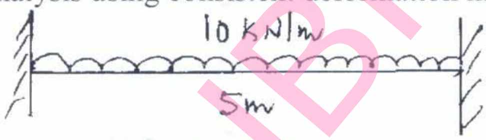

Fig.Q6(b) **(12 Marks)**

7 Analyze the continuous beam shown in Fig.Q7, by three moment theorem. E is constant. Draw the BMD and SFD.

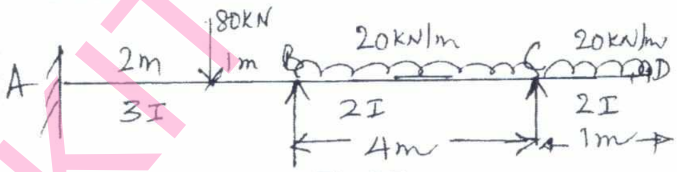

Fig.Q7 **(20 Marks)**

8 A two hinged parabolic arch of constant cross-section has a span of 60 m and a central rise of 10 m. It is subjected to loading as shown in Fig.Q8. Calculate the reactions at supports of the arch, normal thrust and radial shear at 20 m from left support.

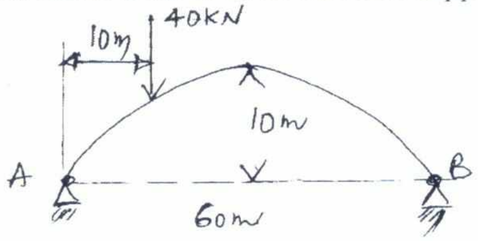

Fig.Q8 **(20 Marks)**

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10CV/CT44

Fourth Semester B.E. Degree Examination, June/July 2016
Surveying – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Differentiate between the following terms:
(i) Transiting and swinging of telescope.
(ii) The upper plate and the lower plate.
(iii) Face left and face right observations. **(06 Marks)**

b. List the miscellaneous operations that can be performed with a transit theodolite and explain the method of measuring the magnetic bearing of a line. **(08 Marks)**

c. Explain the procedure for measured of horizontal angles by the method of reiteration. **(06 Marks)**

2 a. Mention the permanent adjustments of theodolite and explain the spire test used in the permanent adjustment of a theodolite. **(10 Marks)**

b. The following observations when taken during the testing of a dumpy level:

Instrument at	Staff reading on	
	A	B
A	1.615	2.325
B	2.200	3.175

(i) Is the instrument in adjustment?
(ii) To what reading should the line of collimation be adjusted, when the instrument at B.
(iii) If the RL of A is 238.00 m, what should be the RL of B? **(10 Marks)**

3 a. Derive the expression for horizontal distances, height and RL of an elevated object by double plane method, when the base is inaccessible. **(08 Marks)**

b. Mention the advantages of total station over the conventional instruments. **(02 Marks)**

c. Find the elevation of top of the tower from the following data:

Instrument station	Rdg on Big	Angle of elevation	Remarks
A	0.862	18°36′	RL of BM = 421.38
B	1.222	10°12′	Distances AB = 50 m

Stations A, B and tower are in the same vertical plane. **(10 Marks)**

4 a. Derive the standard tacheometric expression for the horizontal distance with usual notations. **(06 Marks)**

b. Write short notes on the following:
(i) Anallactic lens. (ii) Beaman's stadia arc. (iii) Tacheometric constants. **(06 Marks)**

c. A tacheometer fitted with a anallactic lens was set up at station D with the following observations. K = 100

Station Sighted	Bearing	Staff rdg	Verticle Angle
A	330° 20′	1.255, 1.860, 2.465	+12°12′
B	20° 36′	1.30, 1.885, 2.47	+10°36′

Calculate the RL of A and B and also the gradient from A to B. RL of instrument axis = 150 m. **(08 Marks)**

PART – B

5 a. What are the different methods of setting out a simple curve? Explain the procedure for setting out a simple curve by offsets from chords produced. **(10 Marks)**

b. Two straight lines having a total deflection angle of 76° are to be connected by a compound curve. The radius of first arc is 500 m and that of second arc is 800 m. If the chainage of point of intersection is 7540 m find the chainage of tangent points and point of compound curvature. Deflection angle for the first arc is 35°. **(10 Marks)**

6 a. Define satellite station and reduction to centre. **(04 Marks)**

b. Explain the different tape corrections applied for base length calculations. **(08 Marks)**

c. From a satellite station S, 6.8 m from the main triangulation station A the following directions were observed:

$A = 0°0'$, $B = 132°18'30''$, $C = 232°24'6''$, $D = 290°6'11''$

The length of AB, AC and AD were 3265.5 m, 4022.2 m and 3086.4 m respectively. Determine the direction of AB, AC and AD. **(08 Marks)**

7 a. Define : (i) Transition curves (ii) Super elevation (iii) Bernoullis Laminiscate curve **(06 Marks)**

b. With neat sketches, explain the types of vertical curves. **(06 Marks)**

c. A road bend which deflects 76° is to be designed for a maximum speed of 80 km per hour. If the maximum centrifugal ratio is $\frac{1}{4}$ and maximum rate of change of radial acceleration is 0.3 m/sec^3. Calculate

(i) Radius of the circular arc.
(ii) Length of transition curve.
(iii) Total length of transition curve. **(08 Marks)**

8 a. Describe the principle of working of a planimeter. **(06 Marks)**

b. The following readings were obtained when an area was measured by a planimeter, the tracing arm being set to the natural scale. The initial and final readings were 3.46 and 5.25. The zero of the disc passed the index mark once in the clockwise direction the anchor point was inside the figure with the value of constant C of the instrument is 26.430. Calculate the area of the figure. Take M = 100 sq.cm. **(06 Marks)**

c. A railway embankment is 10 m wide with side slope $1\frac{1}{2}:1$. Assuming the ground to be level in a direction transverse to the center line, calculate the volume of earthwork in a length of 140 m. The formation level at zero chainage is 409.50 m and the ground has a rising gradient of 1 in 100. **(08 Marks)**

Distance m	0	50	100	150	200	250	300	350
R.L. m	407.50	408.50	409.10	410.90	411.50	410.60	409.50	409.00

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10CV45

Fourth Semester B.E. Degree Examination, June/July 2016
Hydraulics and Hydraulic Machines

Time: 3 hrs. Max. Marks:100

Note: *Answer FIVE full questions, selecting at least TWO questions from each part.*

PART – A

1 a. Define repeating variable. What are the guidelines for selection of repeating variables? **(05 Marks)**

b. The resistance due to wind on a tall vertical Chimney is dependent on the density ρ, viscosity μ of air, wind velocity V, diameter D and height H of the Chimney. By means of π-theorem develop an expression for the resistance of the building in terms of these quantities. **(09 Marks)**

c. A spillway model is constructed in the laboratory such that velocity and discharge in the model are respectively 2m/s and $2.5 m^3/s$. If the velocity in the prototype is 20m/s, what is the scale ratio of the model and the discharge in the prototype? **(06 Marks)**

2 a. Distinguish between open channel flow and pipe flow. **(06 Marks)**

b. Show that for most efficient triangular channel section, the crest angle will be 90°. **(06 Marks)**

c. A trapezoidal channel with side slopes 1:1 has to be designed to convey $10 m^3/s$ of water so that the amount of lining is minimum. Find the dimensions of channel. Take n = 0.015 and channel bed slope is 0.00056. **(08 Marks)**

3 a. Derive the dynamic equation for non uniform flow in open channel:

$$\frac{dy}{dx} = \frac{s_o - s_f}{1 - \frac{Q^2 T}{g\bar{A}^3}}.$$ **(08 Marks)**

b. In a horizontal jump on a horizontal floor, the Froude number before jump is $\sqrt{6}$, find Froude number after jump. **(04 Marks)**

c. A 3m wide rectangular channel carries $2.4 m^3/s$ discharge at a depth of 0.7m. Determine: i) Specific energy at 0.7m depth; ii) Determine critical depth; iii) Determine alternate depth to 0.7m. **(08 Marks)**

4 a. A jet of water with velocity 'v' strikes a series of flat vanes moving with velocity 'u' in the direction of jet. The vanes are held normal to the jet. Show that the maximum efficiency of jet is 50%. **(10 Marks)**

b. A square plate weighing 100N and of uniform thickness has side 20cm and it can swing freely about the top edge. A horizontal jet 2cm diameter and velocity 12.5 m/s impinges on the plate. The center of the jet is 15cm below the hinge. The jet strikes normal to the plate. Calculate:

i) What horizontal force must be applied to the bottom of plate to hold the plate vertical?

ii) If the plate is allowed to swing freely, what is the angle of inclination made by the plate with vertical with the force removed? **(10 Marks)**

PART – B

5 a. Show that the maximum efficiency for the jet striking a single semicircular vane symmetrical about the axis of the jet moving in the direction of jet is 16/27. **(10 Marks)**

b. A jet of water moving at 30m/s impinges on a series of vanes moving with a velocity of 15m/s. The jet makes an angle of 30° to the direction of motion of vanes when entering and leaves at an angle of 120° to the direction of motion of the vanes. Draw the velocity triangle at inlet and outlet and find: i) the angle of vane tips at inlet and outlet, ii) the work done per N of water and iii) hydraulic efficiency. **(10 Marks)**

6 a. Give the list of classification of turbines with example. **(10 Marks)**

b. Design a Pelton wheel turbine required to develop a power of 1500 kW working under a head of 160m at a speed of 400rpm. The overall efficiency may be taken as 85%. Take $C_v = 0.98$ and $C_u = 0.46$. Jet ratio = 12. **(10 Marks)**

7 a. Explain cavitation in turbines. How to prevent it? **(06 Marks)**

b. Define draft tube and explain its function. **(06 Marks)**

c. A Kaplan turbine runner is to be designed to develop 7350 kW power under a head of 5.5 m. Determine: i) Diameter of runner and boss; ii) Speed; iii) Specific speed. Take diameter of boss = $\frac{1}{3}$ of runner, speed ratio = 2.09 and flow ratio = 0.68, $\eta_o = 85\%$. **(08 Marks)**

8 a. Define: i) Manometric head; ii) Static head; ii) Suction head; iv) Delivery head. **(04 Marks)**

b. What is the minimum starting speed of a centrifugal pump? Derive an expression for the same. **(08 Marks)**

c. A centrifugal pump is to deliver 0.12 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, width at outlet is 50 mm. The manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. **(08 Marks)**

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Fourth Semester B.E. Degree Examination, June/July 2016
Building Planning and Drawing

Time: 4 hrs.   Max. Marks:100

Note: 1. ***Part – A is compulsory. Answer any TWO questions from Part – B.***
2. ***Missing data may be assumed suitably wherever necessary.***

PART – A

1 Line diagram of residential building is given in Fig Q1. Draw to a scale of 1:100

a. Plan at sill level **(25 Marks)**

b. Front Elevation **(15 Marks)**

c. Section at A-A **(15 Marks)**

d. Schedule of openings **(05 Marks)**

Note : All load bearing walls are 300 mm thick and partition walls are 200 mm thick. All walls are of Burnt brick masonry (BBM) in CM 1:6, build on sized stone masonry in CM (1:6), depth of foundation is 1.20m for load bearing walls and 1m for partition walls (⫲ indicates partition walls). Openings shall be suitably located with suitable dimension given line diagram is not to the scale and it indicates carpet dimensions only. Roof height can be taken as 3m and lintel level at 2.10m from floor level. Assume any other missing data.

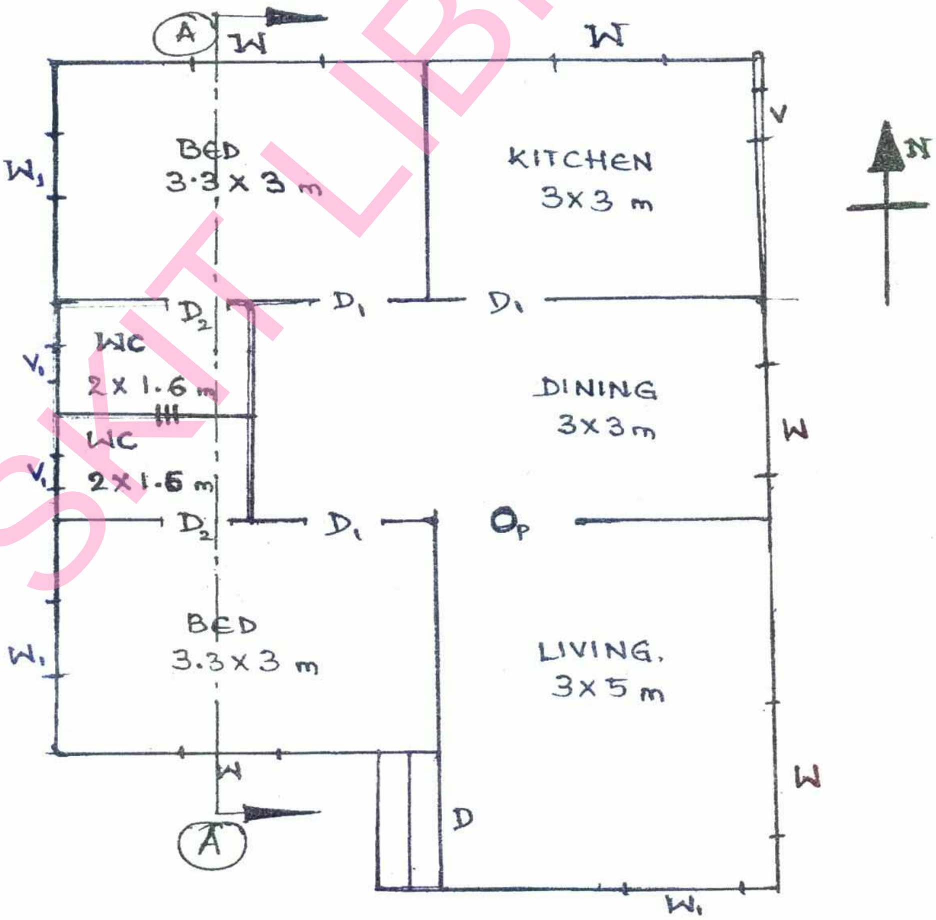

Fig. 1

PART – B

2 Draw plan and sectional Elevation of a RCC isolated sloped footing with the following details.

a) Size of column → 350 × 500 mm
b) Size of footing → 2 × 2.5 m
c) Depth of foundation below GL = 1.2 m
d) Thickness of PCC (1:3:6) = 75 mm
e) Depth of footing = 600mm @ face of column
   = 200mm @ edge of footing

Reinforcement details.

Column – 8 number of 16ϕ bars – main rft.
and lateral ties of 8mm bars @ 200C/C.

Footing – 12 mm bars at 120 mm C/C both ways.

(20 Marks)

3 Draw the front elevation, sectional plan and sectional elevation of 3 paneled single shutter door of size 1.2 × 2.1 m **(20 Marks)**

4 Prepare a bubble diagram and develop a line diagram for a primary health centre to a suitable scale. **(20 Marks)**

5 Prepare the water supply and sanitary layout for a residential building shown in Fig. Q1 with suitable notations. **(20 Marks)**

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MATDIP401

Fourth Semester B.E. Degree Examination, June/July 2016
Advanced Mathematics – II

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Find the angle between any two diagonals of a cube. **(07 Marks)**

b. Prove that the general equation of first degree in x, y, z represents a plane. **(07 Marks)**

c. Find the angle between the lines,

$$\frac{x-1}{1}=\frac{y-5}{0}=\frac{z+1}{5} \text{ and } \frac{x+3}{3}=\frac{y}{5}=\frac{z-5}{2}.$$ **(06 Marks)**

2 a. Prove that the lines,

$$\frac{x-5}{3}=\frac{y-1}{1}=\frac{z-5}{-2} \text{ and } \frac{x+3}{1}=\frac{y-5}{3}=\frac{z}{5} \text{ are perpendicular.}$$ **(07 Marks)**

b. Find the shortest distance between the lines.

$$\frac{x-8}{3}=\frac{y+9}{-16}=\frac{z-10}{7} \text{ and } \frac{x-15}{3}=\frac{y-29}{8}=\frac{z-5}{-5}.$$ **(07 Marks)**

c. Find the equation of the plane containing the point (2, 1, 1) and the line, $\frac{x+1}{2}=\frac{y-2}{3}=\frac{z+1}{-1}$ **(06 Marks)**

3 a. Find the constant 'a' so that the vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}+2\hat{j}-3\hat{k}$ and $3\hat{i}+a\hat{j}+5\hat{k}$ are co-planar. **(07 Marks)**

b. If $\vec{a}=2\hat{i}+3\hat{j}-4\hat{k}$ and $\vec{b}=8\hat{i}-4\hat{j}+\hat{k}$ then prove that $\vec{a}$ is perpendicular to $\vec{b}$ and also find $|\vec{a}\times\vec{b}|$. **(07 Marks)**

c. Find the volume of the parallelopiped whose co-terminal edges are represented by the vectors,

$\vec{a}=\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{c}=\hat{i}-\hat{j}-\hat{k}$ **(06 Marks)**

4 a. Find the velocity and acceleration of a particle moves along the curve $\vec{r}=e^{-2t}\hat{i}+2\cos 5t\hat{j}+5\sin 2t\hat{k}$ at any time 't'. **(07 Marks)**

b. Find the directional derivative of x^2yz^3 at (1, 1, 1) in the direction of $\hat{i}+\hat{j}+2\hat{k}$. **(07 Marks)**

c. Find the divergence of the vector $\vec{F}=(xyz+y^2z)\hat{i}+(3x^2+y^2z)\hat{j}+(xz^2-y^2z)\hat{k}$. **(06 Marks)**

5 a. $\vec{F}=(x+y+1)\hat{i}+\hat{j}-(x+y)\hat{k}$, show that $\vec{F}\cdot \text{curl}\,\vec{F}=0$. **(07 Marks)**

b. Show that the vector field, $\vec{F}=(3x+3y+4z)\hat{i}+(x-2y+3z)\hat{j}+(3x+2y-z)\hat{k}$ is solenoidal. **(07 Marks)**

c. Find the constants a, b, c such that the vector field,

$\vec{F}=(x+y+az)\hat{i}+(x+cy+2z)\hat{j}+(bx+2y-z)\hat{k}$ is irrotational. **(06 Marks)**

6 a. Prove that $L(\sin at) = \frac{a}{s^2 + a^2}$. **(07 Marks)**

b. Find $L[\sin t \quad \sin 2t \quad \sin 3t]$. **(07 Marks)**

c. Find $L[\cos^3 t]$. **(06 Marks)**

7 a. Find the inverse Laplace transform of $\frac{1}{(s+1)(s+2)(s+3)}$. **(07 Marks)**

b. Find $L^{-1}\left[\log\left(1 + \frac{a^2}{s^2}\right)\right]$. **(07 Marks)**

c. Find $L^{-1}\left[\frac{s+2}{s^2 - 4s + 13}\right]$. **(06 Marks)**

8 a. Solve the differential equation, $y'' + 2y' + y = 6te^{-t}$ under the conditions $y(0) = 0 = y'(0)$ by Laplace transform techniques. **(10 Marks)**

b. Solve the differential equation, $y'' - 3y' + 2y = 0 \quad y(0) = 0, \quad y'(0) = 1$ by Laplace transform techniques. **(10 Marks)**

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