CBCS Scheme

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15MAT31

Third Semester B.E. Degree Examination, June/July 2018
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Obtain the Fourier series for the function :

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$$

Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + ----$. **(08 Marks)**

b. Obtain the half–range cosine series for the function $f(x) = (x-1)^2$, $0 \le x \le 1$. Hence deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + -----$. **(08 Marks)**

OR

2 a. Find the Fourier series of the periodic function defined by $f(x) = 2x - x^2$, $0 < x < 3$. **(06 Marks)**

b. Show that the half range sine series for the function $f(x) = \ell x - x^2$ in $0 < x < \ell$ is

$$\frac{8\ell^2}{\pi^3} \sum_{0}^{\infty} \frac{1}{(2n+1)^3} \sin\left(\frac{2n+1}{\ell}\right)\pi x .$$ **(05 Marks)**

c. Express y as a Fourier series upto 1st harmonic given :

x	0	1	2	3	4	5
y	4	8	15	7	6	2

(05 Marks)

Module-2

3 a. Find the Fourier transform of

$$f(x) = \begin{cases} 1-|x|, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$$

and hence deduce that $\int_0^{\infty} \frac{\sin^2 t}{t^2} dt = \frac{\pi}{2}$. **(06 Marks)**

b. Find the Fourier Sine and Cosine transforms of $f(x) = e^{-\alpha x}$, $\alpha > 0$. **(05 Marks)**

c. Solve by using z – transforms $y_{n+1} + \frac{1}{4} y_n = \left(\frac{1}{4}\right)^n$ $(n \ge 0), y_0 = 0$. **(05 Marks)**

OR

4 a. Find the Fourier transform of $f(x) = e^{-|x|}$. **(06 Marks)**

b. Find the Z – transform of $\sin(3n + 5)$. **(05 Marks)**

c. Find the inverse Z – transform of : $\frac{z}{(z-1)(z-2)}$. **(05 Marks)**

Module-3

5 a. Find the correlation coefficient and the equation of the line of regression for the following values of x and y. **(06 Marks)**

x	1	2	3	4	5
y	2	5	3	8	7

b. Find the equation of the best fitting straight line for the data : **(05 Marks)**

x	0	1	2	3	4	5
y	9	8	24	28	26	20

c. Use Newton – Raphson method to find a real root of the equation $x \log_{10} x = 1.2$ (carry out 3 iterations). **(05 Marks)**

OR

6 a. Obtain the lines of regression and hence find the coefficient of correlation for the data :

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

(06 Marks)

b. Fit a second degree parabola to the following data : **(05 Marks)**

x	1	2	3	4	5
y	10	12	13	16	19

c. Use the Regula–Falsi method to find a real root of the equation $x^3 - 2x - 5 = 0$, correct to 3 decimal places. **(05 Marks)**

Module-4

7 a. Given $\sin45° = 0.7071$, $\sin50° = 0.7660$, $\sin55° = 0.8192$, $\sin60° = 0.8660$ find $\sin57°$ using an appropriate interpolation formula. **(06 Marks)**

b. Construct the interpolation polynomial for the data given below using Newton's divided difference formula :

x	2	4	5	6	8	10
y	10	96	196	350	868	1746

(05 Marks)

c. Use Simpson's $\frac{1}{3}$rd rule with 7 ordinates to evaluate $\int_2^8 \frac{dx}{\log_{10} x}$. **(05 Marks)**

OR

8 a. Given f(40) = 184, f(50) = 204, f(60) = 226, f(70) = 250, f(80) = 276, f(90) = 304, find f(38) using Newton's forward interpolation formula. **(06 Marks)**

b. Use Lagrange's interpolation formula to fit a polynomial for the data :

x	0	1	3	4
y	–12	0	6	12

Hence estimate y at x = 2. **(05 Marks)**

c. Evaluate $\int_0^1 \frac{x}{1+x^2}dx$ by Weddle's rule taking seven ordinates and hence find $\log_e 2$. **(05 Marks)**

Module-5

9 a. Find the area between the parabolas $y^2 = 4x$ and $x^2 = 4y$ using Green's theorem in a plane. **(06 Marks)**

b. Verify Stoke's theorem for the vector $\vec{F} = (x^2 + y^2)i - 2xyj$ taken round the rectangle bounded by x = 0, x = a, y = 0, y = b. **(05 Marks)**

c. Find the extremal of the functional : $\int_{x_1}^{x_2} [y' + x^2(y')^2]dx$. **(05 Marks)**

OR

10 a. Verify Green's theorem in a plane for $\oint_c (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where c is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$. **(06 Marks)**

b. If $\vec{F} = 2xyi + yz^2j + xzk$ and S is the rectangular parallelopiped bounded by x = 0, y = 0, z = 0, x = 2, y = 1, z = 3 evaluate $\iint_S \vec{F} \cdot \hat{n}\, ds$. **(05 Marks)**

c. Find the geodesics on a surface given that the arc length on the surface is $S = \int_{x_1}^{x_2} \sqrt{x[1 + (y')^2}\ dx$. **(05 Marks)**

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CBCS Scheme

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15CV/CT32

Third Semester B.E. Degree Examination, June/July 2018
Strength of Materials

Time: 3 hrs. Max. Marks: 80

Note: *1.* **Answer any FIVE full questions, choosing ONE full question from each module.**
2. Missing data, if any, may be suitably assumed.

Module-1

1 a. For a bar of uniform section derive an expression for elongation due to self weight. **(06 Marks)**

b. Evaluate the deformation of the bar, given, $E_1 = E_2 = E_3 = 200GPa$, refer Fig.Q1(b). **(10 Marks)**

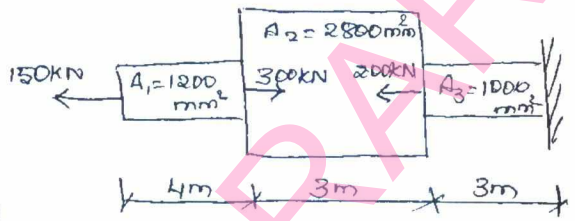

Fig.Q1(b)

OR

2 a. Derive an expression between Young's modulus, Modulus of rigidity and Poisson's ratio. **(10 Marks)**

b. A circular rod of dia 200mm and 500mm long is subjected to a tensile force of 45kN modulus of elasticity = 200 kN/mm^2, Find stress, strain and elongation of bar due to applied load. **(06 Marks)**

Module-2

3 At a certain point in a stressed body, the principal stresses are σ_x = 80 MPa and σ_y = –40MPa. Determine σ and τ on the planes whose normal's are at +30° and +120° with x – axis. **(16 Marks)**

OR

4 a. Derive an expression of tangential stress and longitudinal stress of thin walled pressure vessels. **(08 Marks)**

b. A rectangular block of material is subjected to a tensile stress of 100N/mm^2 on one plane and a tensile stress of 50N/mm^2 on a plane at right angles together with shear stress of 60 N/mm^2 on same planes, find : i) direction of the principal plane ii) magnitude of the principal plane iii) magnitude of greatest shear stress. **(08 Marks)**

Module-3

5 a. Define : i) bending moment ii) shear force iii) shear force diagram iv) bending moment diagram. **(08 Marks)**

b. Draw SFD and BMD for the cantilever beam shown in Fig.Q5(b). **(08 Marks)**

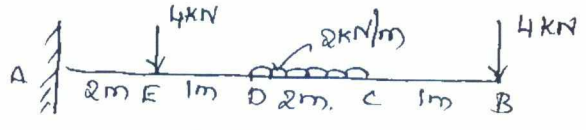

Fig.Q5(b)

OR

6 a. Derive the relation between load intensity, bending moment and shear force. **(06 Marks)**

b. A beam ABC, 8m long has supplied at A and B, it is long between A and B. The beam carries an udl of 10kN/m between A and B. At free end point C, a point load of 15 kN acts. Draw BMD and locate point of contra-flexure, if any. **(10 Marks)**

Module-4

7 a. Explain pure bending with an suitable example and mention the assumptions of pure bending. **(06 Marks)**

b. A cast iron beam section shown in Fig.Q7(b) is freely supported on a span of 5m. IF the tensile stress is not to exceed 20 N/mm^2. Find the safe UDL which the beam can carry. Find also the maximum compressive stress. **(10 Marks)**

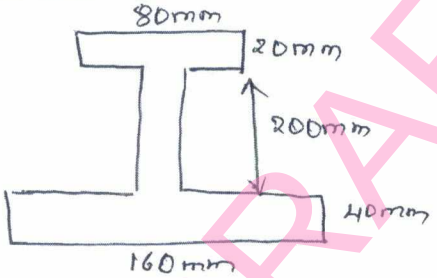

Fig.Q7(b)

OR

8 a. Derive an Euler's crippling load when both ends of the column are pinned. **(08 Marks)**

b. A hollow cylindrical cost iron column is 4m long both ends being fixed. Design the column to carry a axial load of 250 kN. Use Rankine's formula and factor of safety = 5. The internal diameter may be taken as 0.80 time the external diameter. Take E_C = 550 N/mm^2 and $\alpha = \frac{1}{1600}$. **(08 Marks)**

Module-5

9 a. Derive torsional equation for circular shaft. **(08 Marks)**

b. A steel shaft transmits 105kN at 160 rpm. If the shaft is 100mm in diameter. Find the torque on the shaft and the maximum sharing stress induced. **(08 Marks)**

OR

10 a. Define pure torsion, polar modulus and torsional rigidity. **(06 Marks)**

b. A solid shaft is subjected to a torque of 15 kN-m. Find the necessary diameter of the shaft if the allowable shearing stress is 60N/mm^2 and the allowable twist is 1 degree in a length of 20 diameters of the shaft. Take C = 8 × 10^4 N/mm^2. **(10 Marks)**

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CBCS Scheme

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15CV33

Third Semester B.E. Degree Examination, June/July 2018
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing one full question from each module.
2. Assume missing data if any suitably.

Module-1

1 a. Distinguish between
i) Ideal fluid and real fluid
ii) Newtonion and non Newtonion fluid
iii) Cohesion and adhesion **(06 Marks)**

b. State and prove Pascal's law. **(04 Marks)**

c. Calculate the specific weight, density, specific volume and specific gravity of two litres of a liquid which weighs 15 N. **(06 Marks)**

OR

2 a. With the help of neat sketches, explain (i) simple U-tube manometer and (ii) differential U-tube manometer. **(06 Marks)**

b. What is capillarity? Derive an expression for capillary rise and a liquid in a glass tube. **(04 Marks)**

c. A U tube differential manometer connects two pipes A and B. Pipe A contains carbon tetra chloride having specific gravity 1.594 under a pressure of 117.72 kN/m^2 and pipe B contains oil of specific gravity 0.8 under a pressure of 117.72 kN/m^2. The pipe A lies 2.5 m above pipe B. Find the difference in pressure measured by mercury as fluid filling U-tube. Assume mercury in the right limb is 50 cm below centre of pipe B. **(06 Marks)**

Module-2

3 a. Distinguish between:
i) Steady and unsteady flow
ii) Rotational and irrotational flow **(04 Marks)**

b. Derive the expressions for total pressure and centre of pressure for a plane surface submerged vertically in a liquid. **(06 Marks)**

c. A circular opening 3m diameter, in a vertical side of a tank is closed by a disc of 3m diameter which can rotate about a horizontal diameter. Calculate: (i) The force on the disc, and (ii) The torque required to maintain the disc in equilibrium in vertical position when the head of water above the horizontal diameter is 6m. **(06 Marks)**

OR

4 a. Define the terms velocity potential function and stream function. **(04 Marks)**

b. Derive an expression for continuity equation for a three dimensional flow. **(06 Marks)**

c. A stream function in a two dimensional flow is $\psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential ϕ. **(06 Marks)**

Module-3

5 a. What is pitot tube? How will you determine velocity using pitot tube? **(04 Marks)**

b. State and prove Bernoulli's theorem for steady flow of an incompressible fluid. **(06 Marks)**

c. The water is flowing through a tapper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end at the rate of 50 litres/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher end is 196.2 kPa. **(06 Marks)**

OR

6 a. Define the terms: i) forced vertex flow and ii) free vertex flow. **(04 Marks)**

b. What is venturimeter? Derive an expression for discharge through a venturimeter. **(06 Marks)**

c. A pipe of 300 mm diameter conveying 300 litres/s of water has a right angled bend in a horizontal plane. Find the resultant force exerted on the bend if the pressure at inlet and outlet of bend are 245.25 kPa and 235.44 kPa. **(06 Marks)**

Module-4

7 a. Explain different hydraulic coefficient and establish the relation between them. **(04 Marks)**

b. Derive an expression for discharge over a triangular notch. **(06 Marks)**

c. The head of water over an orifice of diameter 100 mm is 5m. The water coming out from the orifice is collected in a circular tank of diameter 2 m. The rise of water level in circular tank is 450 mm in 30 seconds. Also the coordinates at a certain point on the jet, measured from vena-contracta are 1000 mm horizontal and 52 mm vertical. Find the hydraulic coefficients C_V, C_d and C_C. **(06 Marks)**

OR

8 a. Explain the terms:
i) Velocity of approach
ii) Effect of end contractions in notches **(04 Marks)**

b. What is Cipolletti notch? Derive an expression for discharge over a Cipolletti notch. **(06 Marks)**

c. Water flows over a rectangular weir 1.2m wide at a depth of 15 cm and afterwards passes through a triangular right angled weir. Taking coefficient of discharge for rectangular Weir 0.62 and for triangular Weir 0.59 find the depth over the triangular Weir. **(06 Marks)**

Module-5

9 a. Explain briefly:
i) Hydraulic gradient line and
ii) Energy gradient line **(04 Marks)**

b. Derive an expression for head loss due to friction in pipes. **(06 Marks)**

c. A rigid pipe conveying water is 3200 m long. The velocity of flow is 1.2 m/s. Calculate the rise of pressure behind a valve at the lower end if it is closed (i) in 20 seconds (ii) in 3 seconds. Take bulk modulus and water equal to 2000 N/mm^2. **(06 Marks)**

OR

10 a. Explain briefly the phenomenon of water hammer. **(04 Marks)**

b. Derive an expression for head loss due to sudden enlargement in a pipe flow. **(06 Marks)**

c. At a sudden enlargement of a water main from 240 mm to 480 mm diameter, the hydraulic gradient rises by 10 mm. Estimate the rate of flow. **(06 Marks)**

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CBCS SCHEME

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Third Semester B.E. Degree Examination, June/July 2018
Basic Surveying

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define surveying. **(02 Marks)**

b. What are the primary divisions of surveying? Explain briefly. **(05 Marks)**

c. The area of the plan of an old survey plotted to a scale of 10 meters to 1cm measures now as 100.2 sq.cm as found by a planimeter. The plan is found to have shrunk, so that a line originally 10cm long now measures 9.7cm only. There was a note on the plan that the 20m chain used was 8cm too short. Find the true area of plan. **(09 Marks)**

OR

2 a. By means of neat sketches show any six conventional symbols used in surveying. **(06 Marks)**

b. Define precision and accuracy. **(02 Marks)**

c. In passing an obstacle in the form of a pond, stations A and D on the main line were taken on the opposite sides of pond, on the left of AD, a line AB, 200m long was laid down and a second line AC, 250m long was ranged on right of AD points B, D and C being in the same straight line, BD and DC were then chained and found to be 125m and 150m. Find the length AD. **(08 Marks)**

Module-2

3 a. Differentiate between prismatic and surveyors compass (any 3). **(06 Marks)**

b. Convert the whole circle bearings to quadrantal bearings :
i) 22°30′ ii) 170°12′ iii) 211°54′ iv) 327°24′. **(02 Marks)**

c. Determine the value of included angles in a closed compare surrey ABCD conducted in clockwise direction given the following data. Apply the check.

Line	FB
AB	40°
BC	70°
CD	210°
DA	280°

(08 Marks)

OR

4 a. Define : i) Face left ii) Transiting iii) Swining as applied to theodolite surveying. **(03 Marks)**

b. With a neat sketch, explain the method of measurement of horizontal angle by repletion method. State the errors eliminated by this method. **(05 Marks)**

c. The following angles were observed in the clockwise direction in an open traverse.
$\angle ABC = 124°15'$, $\angle BCD = 156°30'$, $\angle CDE = 102°00'$, $\angle DEF = 95°15'$, $\angle EFG = 215°45'$
The magnetic bearing of the line AB = 240°30′ what would be the bearing of line FG? **(08 Marks)**

Module-3

5 a. Explain closed and open traversed with neat sketches. **(06 Marks)**

b. State Bowditch's and Transil rule. **(04 Marks)**

c. Calculate latitudes, departures and closing error for the following traverse conducted at a place.

Line	Length (m)	Web
AB	89.31	45°10′
BC	219.76	72°05′
CD	151.18	161°52′
DE	159.10	228°43′
EA	232.26	300°42′

(06 Marks)

OR

6 a. Define tacheometry under what circumstances it is used? **(04 Marks)**

b. State any four characteristics of a tacheometer. **(02 Marks)**

c. A tacheometer is setup at an intermediate point on a traverse course PQ and the following observations are made on a vertically held staff.

Staff stn	Vertical angle	Staff intercept	Axial hair reading
P	+8°36′	2.350	2.105
Q	+6°6′	2.055	1.895

The instrument is fitted with an anallatic lens and the constant is 100.000. Compute the length of PQ and reduced level of Q, if that of P being 321.50 meters. **(10 Marks)**

Module-4

7 a. Define the terms : i) Back sight ii) Fore sight iii) Intermediate sight iv) change point. **(04 Marks)**

b. Compare height of instrument method and rise and fall method of reduction of levels. **(04 Marks)**

c. The following consecutive readings were taken with a level and 5m leveling staff on continuously sloping ground at a common interval of 20 meters :

0.835, 1.030, 1.925, 2.825, 3.730, 4.685, 0.625, 2.005, 3.110 and 4.485m.

The reduced level of first point was 208.125m. Rule outer page of level field book and enter the readings. Calculate the reduced levels of points by rise and fall method and apply check. Calculate also the gradient of line joining the first and last point. **(08 Marks)**

OR

8 a. Explain reciprocal leveling. **(04 Marks)**

b. An observer standing on the deck of ship just sees a light house. The top of light house is 42m above the sea level and the height of observers Eye is 6m above the sea level. Find the distance of observes from the light house. **(05 Marks)**

c. In order to ascertain the elevation of the top (Q) of the signal on a hill, observations were made from two instrument stations P and R at a horizontal distance 100m apart, the stations P, R, and Q are in a line. The angles of elevation of Q at P and R were 28°42′ and 18°6′ respectively. The staff reading on a bench mark of elevation 287.28m from P = 2.870, from R = 3.750. Determine the Elevation of foot of signal if height of signal = 3M. **(07 Marks)**

Module-5

9 a. The following perpendicular offsets were taken from a chain line to an irregular boundary.

Chainage (m)	0	30	60	90	120	150	180	210
Offset length (m)	0	2.65	3.80	3.75	4.65	3.60	5.00	5.80

Calculate the area between the chain lines and irregular boundary, first and last offsets by i) Trapezoidal rule ii) Simpson's rule. **(08 Marks)**

b. Calculate the area enclosed by a traverse ABCD for the following data : Assume co-ordinater as (100, 200).

Line	Latitude (m)	Departure(m)
AB	+32.05	+40.20
BC	–3	+92.00
CD	–97.85	+6.402
DE	–15.8	–107.00
EA	+84.6	–31.602

(08 Marks)

OR

10 a. With neat sketches explain any six characteristics of contours. **(06 Marks)**

b. Calculate the area of zero circle with the following data :

IR	FR	Position anchor point	Remarks
6.520	2.724	Outside the fig	Zero of counting dise crossed index once clockwise
1.222	7.720	Inside the fig	Zero of counting dise crossed and index twice anticlockwise

Assume that tracing arm of planimeter was so set that tone revolution of measuring wheel measures 100cm^2 on paper. **(06 Marks)**

c. Write short notes on :

i) Interpolation of contours

ii) Contour gradient. **(04 Marks)**

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CBCS SCHEME

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15CV/CT35

Third Semester B.E. Degree Examination, June/July 2018
Engineering Geology

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Describe the importance and applications of geology in civil engineering practices. **(05 Marks)**

b. Describe the internal structure and composition of the earth with a neat diagram. **(05 Marks)**

c. Define what is a mineral? Describe how minerals are classifieds. Describe the physical properties. Luster and fracture with mineral examples. **(06 Marks)**

OR

2 a. Define what is rock? Classify the different types of rocks and describe how it is formed. Give examples. Explain the rock cycle. **(06 Marks)**

b. What is fold? Describe with a neat diagram the different parts of a fold. **(05 Marks)**

c. What are joints? Describe the classification of joints. Explain the different types joints present in igneous, sedimentary and metamorphic rocks. **(05 Marks)**

Module-2

3 a. What is fault? Draw a net diagram of the fault and describe the different parts. Write the classification of fault with neat sketch. **(08 Marks)**

b. Describe the geological considerations of joints and folds in the construction of dams and tunnels. **(08 Marks)**

OR

4 Describe in detail with neat sketches concordant and discordant igneous intrusions. **(16 Marks)**

Module-3

5 a. What is weathering? Describe in detail about physical weathering and chemical weathering. **(08 Marks)**

b. Give a detailed account of geologic work of rivers. **(08 Marks)**

OR

6 a. What is earth quake? Write the causes and effects. **(08 Marks)**

b. What are seismic waves? Describe in detail the different seismic waves. **(08 Marks)**

Module-4

7 What is an aquifer? Explain the different types of aquifers and its properties. **(16 Marks)**

OR

8 What is ground water investigation? Describe the different methods involved in selection of well sites. Describe the electrical resistivity method of selecting a well site. **(16 Marks)**

Module-5

9 What is remote sensing? Explain the basic concepts of remote sensing with a neat sketch. Explain the advantages and disadvantages of remote sensing. **(16 Marks)**

OR

10 Describe in detail the impact of mining, quarrying and reservoirs on environment. **(16 Marks)**

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CBCS SCHEME

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15CV36

Third Semester B.E. Degree Examination, June/July 2018
Building Materials and Construction

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. What are the requirements of good building stone? Explain the dressing of stones. **(08 Marks)**

b. List the various tests conducted on coarse aggregate. Explain any one of them in brief. **(08 Marks)**

OR

2 a. Explain the different types of preservations commonly adopted in the preservation of stones. **(08 Marks)**

b. What are the requirements of good bricks and explain the field and laboratory tests on bricks. **(08 Marks)**

Module-2

3 a. Explain the essential requirements of a good foundation. **(08 Marks)**

b. With the help of neat sketches explain the various types of Joints used in stone masonry. **(08 Marks)**

OR

4 a. What is safe bearing capacity (SBC) of a soil? Briefly explain various methods adopted to improve SBC. **(08 Marks)**

b. Explain the following :
(i) Header, (ii) Flemish bond, (iii) Load bearing, (iv) Partition walls. **(08 Marks)**

Module-3

5 a. Define lintels and mention its function and classification. **(08 Marks)**

b. Sketch a King post truss made of timber, which has to support tile roofing. Name the components. **(08 Marks)**

OR

6 a. Give the classification of arches and explain stability of an arch. **(08 Marks)**

b. Discuss the various flooring materials used and explain any two of them in detail. **(08 Marks)**

Module-4

7 a. Briefly explain the factors to be considered while locating the position of doors and windows. **(08 Marks)**

b. With the help of a neat sketch briefly explain the dog legged staircase and its components. **(08 Marks)**

OR

8 a. With the help of a neat sketch explain the following :
(i) Wooden paneled door (ii) Collapsible door. **(08 Marks)**

b. Write a note on different types of stairs and explain the requirements of a good stair. **(08 Marks)**

Module-5

9 a. Briefly explain the purpose of plastering and explain the various methods of plasters. **(08 Marks)**

b. Explain in brief causes and effects of dampners in a building. **(08 Marks)**

OR

10 a. What are the objects of plastering and painting. **(08 Marks)**

b. Describe the different types of paints available in market and their specific usage. **(08 Marks)**

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CBCS Scheme

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15MATDIP31

Third Semester B.E. Degree Examination, June/July 2018
Additional Mathematics – I

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Find the modulus and amplitude of $\frac{(1+i)^2}{3+i}$. **(05 Marks)**

b. Prove that $\left(\frac{1+\cos\theta+i\sin\theta}{1+\cos\theta-i\sin\theta}\right)^n = \cos n\theta + i\sin n\theta$. **(05 Marks)**

c. If $z = \cos\theta + i\sin\theta$, then show that $x^n + \frac{1}{x^n} = 2\cos n\theta$, $x^n - \frac{1}{x^n} = 2i\sin n\theta$. **(06 Marks)**

OR

2 a. Find the sine of the angle between $\vec{a} = 2\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$. **(05 Marks)**

b. Find the unit vector perpendicular to both $\vec{a}$ and $\vec{b}$, where $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = 2\hat{i} + \hat{j} + \hat{k}$ **(05 Marks)**

c. Show that (3, –2, 4), (6, 3, 1), (5, 7, 3) and (2, 2, 6) are coplanar. **(06 Marks)**

Module-2

3 a. Find the n^{th} derivative of sin(3x)cosx. **(05 Marks)**

b. Find the angle between radius vector and tangent to the curve $\gamma^m \cos m\theta = a^m$. **(05 Marks)**

c. Find the pedal equation of $\gamma = a(1 + \cos\theta)$. **(06 Marks)**

OR

4 a. If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin(2u)$. **(05 Marks)**

b. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$. **(05 Marks)**

c. If $u = x + y$, $v = y + z$, $w = z + x$, find $J\left(\frac{uvw}{xyz}\right)$. **(06 Marks)**

Module-3

5 a. Evaluate $\int_0^{\pi} x \cos^6 x \, dx$. **(05 Marks)**

b. Evaluate $\int_0^{\infty} \frac{x^2}{(1+x^6)^{7/2}} dx$ **(05 Marks)**

c. Evaluate $\int_0^1 x^5 (1-x^2)^{5/2} dx$. **(06 Marks)**

OR

6 a. Evaluate $\int_1^2 \int_3^4 (xy + e^y) \, dy \, dx$. **(05 Marks)**

b. Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy \, dy \, dx$. **(05 Marks)**

c. Evaluate $\int_0^1 \int_0^1 \int_0^y xyz \, dx \, dy \, dz$. **(06 Marks)**

Module-4

7 a. Find the angle between the tangents to the curve $x = t^2, y = t^3, z = t^4$ at $t = 2$, and $t = 3$. **(05 Marks)**

b. Find the unit normal to the curve $\vec{\gamma} = 4\sin t \, \hat{i} + 4\cos t \, \hat{j} + 3t \, \hat{k}$. **(05 Marks)**

c. Find the velocity and acceleration to the curve $\vec{\gamma} = t^2 \hat{i} - t^3 \hat{j} + t^4 \hat{k}$ at $t = 1$. **(06 Marks)**

OR

8 a. Find the directional derivative of $\varphi = x^3y^3z^3$ at (1, 2, 1) in the direction of $\hat{i} + 2\hat{j} + 2\hat{k}$. **(05 Marks)**

b. Find the unit normal to the surface $xy + x + zx = 3$ at $(1, 1, 1)$. **(05 Marks)**

c. If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$, find div $\vec{F}$. **(06 Marks)**

Module-5

9 a. Solve $\frac{dy}{dx} = \frac{y^2}{xy - x^2}$. **(05 Marks)**

b. Solve $\frac{dy}{dx} + y\cot x = \sin x$. **(05 Marks)**

c. Solve $y(x + y)dx + (x + 2y - 1)dy = 0$. **(06 Marks)**

OR

10 a. Solve $(x^2 + y)dx + (y^3 + x)dy = 0$. **(05 Marks)**

b. Solve $\frac{dy}{dx} + \frac{y}{x} = xy^2$. **(05 Marks)**

c. Solve $(x^2 + y^2)\frac{dy}{dx} = xy$. **(06 Marks)**

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