CBCS SCHEME

USN | | | | | | | | | | | **15MAT31**

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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 Fourier series expansion of $f(x) = |x|$ in the intercal $(-\pi, \pi)$ and hence deduce $\pi^2/8 = \sum_1^{\infty} 1/(2n-1)^2$. **(08 Marks)**

b. Obtain half range cosine series of
$$f(x) = \begin{cases} x, & 0 < x < \pi/2 \\ \pi - x, & \pi/2 < x < \pi \end{cases}.$$ **(08 Marks)**

OR

2 a. Obtain Fourier series expansion of
$$f(x) = \frac{\pi - x}{2},\ 0 \le x \le 2\pi.$$ **(06 Marks)**

b. Obtain half range sine series of $f(x) = x^2$ in the interval $(0, \pi)$. **(05 Marks)**

c. Obtain the Fourier series for the following function neglecting the terms higher than first harmonic. **(05 Marks)**

x :	0	1	2	3	4	5
y :	9	18	24	28	26	20

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 $\int_0^{\infty} \frac{\sin^2 x}{x^2} dx = \pi/2$. **(06 Marks)**

b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$. **(05 Marks)**

c. Find the Inverse Z – transform of
$$\frac{8z^2}{(2z-1)(4z-1)}.$$ **(05 Marks)**

OR

4 a. Find the Fourier Cosine transform of
$$f(x) = \begin{cases} 4x, & 0 < x < 1 \\ 4 - x, & 1 < x < 4 \\ 0, & x > 4 \end{cases}.$$ **(05 Marks)**

b. Find the Z – transform of i) $\sinh n\theta$ ii) n^2. **(06 Marks)**

c. Solve the difference equation : $U_{n+2} - 5U_{n+1} + 6U_n = 2$, $U_0 = 3$, $U_1 = 7$. **(05 Marks)**

Module-3

5 a. Compute the coefficient of correlation and the equation of lines of regression 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 $y = ax^2 + bx + c$ for the following data :

x	0	1	2	3	4	5	6
y	14	18	27	29	36	40	46

(05 Marks)

c. Using Newton Raphson method, find a real root of $x \sin x + \cos x = 0$ near $x = \pi$, corrected to four decimal places. (05 Marks)

OR

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

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

(06 Marks)

b. By the method of Least square, find a straight line that best fits the following data :

x	5	10	15	20	25
y	16	19	23	26	30

(05 Marks)

c. Using Regula – Falsi method to find a real root of $x \log_{10} x - 1.2 = 0$, carry out 3–iterations. (05 Marks)

Module-4

7 a. Find the interpolating formula f(x), satisfying f(0) = 0, f(2) = 4, f(4) = 56, f(6) = 204, f(8) = 496, f(10) = 980 and hence find f(3). (06 Marks)

b. Use Newton's divided difference formula to find f(9), given

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

(05 Marks)

c. Evaluate $\int_0^1 \frac{x}{1+x^2}\,dx$ by applying Simpson's ⅜ th rule, taking 7 ordinates. (05 Marks)

OR

8 a. Using Newton's backward interpolation formula, find f(105), given

x	80	85	90	95	100
f(x)	5026	5674	6362	7088	7854

(06 Marks)

b. Apply Lagrange formula to find root of the equation f(x) = 0, given f(30) = -30, f(34) = -13, f(38) = 3 and f(42) = 18. (05 Marks)

c. Evaluate $\int_0^{0.3} \sqrt{1-8x^3}\,dx$, taking 6 – equal strips by applying Weddle's rule. (05 Marks)

Module-5

9 a. If $\vec{F} = (3x^2 + 6y)i - 14yzj + 20xz^2k$, evaluate $\int \vec{F}.d\vec{r}$ from (0, 0, 0) to (1, 1, 1) along the curve given by $x = t$, $y = t^2$, $z = t^3$. **(06 Marks)**

b. Find the extremal of the functional $\int_0^{\pi/2} (y^2 - y'^2 - 2y \sin x)dx, y(0) = y(\pi/2) = 0$. **(05 Marks)**

c. Prove that geodesics on a plane are straight lines. **(05 Marks)**

OR

10 a. Find the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$ with the help of Green's theorem in a plane. **(06 Marks)**

b. Verify Stoke's theorem for $\vec{F} = yi + zj + xk$. Where S is the upper half of the sphere $x^2 + y^2 + z^2 = 1$ and C is it boundary. **(05 Marks)**

c. A heavy chain hangs freely under the gravity between two fixed points. Show that the shape of the chain is a Catenary. **(05 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | **15CV/CT32**

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Strength of Materials

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. State and explain Elastic constants. **(04 Marks)**

b. A bar of 20mm is tested in tension. It is observed that when a load of 40kN is applied, the extension measured over a gauge length of 200mm is 0.12mm and contraction in diameter is 0.0036min. Find Poisson's ratio and elastic constants E, C, K. **(12 Marks)**

OR

2 a. Define temperature stresses and state its importance. **(06 Marks)**

b. A composite bar is rigidly fitted at the supports A and B as shown in the Fig.Q.2(b). Determine the reactions at the supports when temperature rises by 20°C. Take $E_a = 70\ GN/m^2$, $E_s = 200\ GN/m^2$, $\alpha_a = 11 \times 10^{-6}/°C$ and $\alpha_s = 12 \times 10^{-6}/°C$. **(10 Marks)**

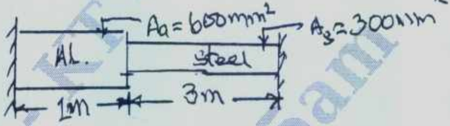

Fig.Q.2(b)

Module-2

3 a. Define principal planes and principal stresses. **(04 Marks)**

b. Stresses acting at a point in a two dimensional stress system shown in the Fig.Q.3(b), find:

i) Normal and shear stresses on the inclined plane

ii) Principal stresses and their planes

iii) Maximum shear stresses and their planes.

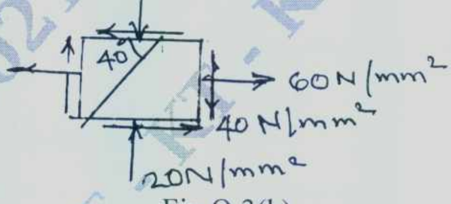

Fig.Q.3(b)

(12 Marks)

OR

4 a. Derive expressions for hoop stress and longitudinal stress in a thin cylinder. **(06 Marks)**

b. A cylindrical thin shell 800mm diameter and 3m long is having 10mm metal thickness. The shell is subjected to an internal pressure of $2.5N/mm^2$. Determine:

i) Change in diameter

ii) Change in length

iii) Change in volume

Take $E = 2 \times 10^5 N/mm^2$ $\mu = 0.3$ **(10 Marks)**

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.

Module-3

5 a. Derive the relationship between intensity of load, shear force and bending moment. **(06 Marks)**

b. Draw shear force and bending moment diagrams for the beam shown in the Fig.Q.5(b).

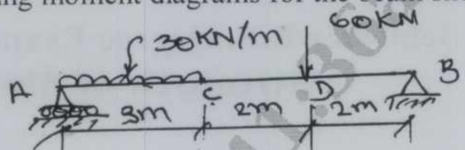

Fig.Q.5(b)

(10 Marks)

OR

6 a. Explain:
i) Sagging bending moment
ii) Hogging bending moment
iii) Point of contra flexure. **(06 Marks)**

b. Draw shear force and bending moment diagrams for the beam shown in the Fig.Q.6(b). Locate the points of contra flexure. **(10 Marks)**

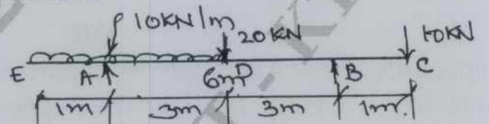

Fig.Q.6(b)

Module-4

7 a. What are assumptions made in bending theory? **(04 Marks)**

b. Derive the bending equation $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$ with usual notations. **(06 Marks)**

c. Prove that maximum shear stress is 1.5 times the average shear stress in rectangular section. **(06 Marks)**

OR

8 a. What is effective length of column? How it is related with end conditions of column and explain with neat sketches. **(08 Marks)**

b. A hollow cast iron column whose outside diameter is 200mm and has a thickness of 20mm, 4.5m long and is fixed at both ends. Evaluate Rankine's crippling load using $f_c = 550N/mm^2$. Take Rankines constant $\frac{1}{1600}$. **(08 Marks)**

Module-5

9 a. Derive the Torsion equation $\frac{I}{J}=\frac{\tau}{R}=\frac{C\theta}{L}$ with usual notation. **(06 Marks)**

b. A solid circular shaft is to be designed to transmit 440kW power at 280rpm. If the maximum shear stress is not to exceed $40N/mm^2$ and the angle of twist is not to exceed 1° per meter length, determine the diameter of the shaft. Take modulus of rigidity $84kN/mm^2$. **(10 Marks)**

OR

10 a. Explain: i) Maximum principal stress theory ii) Maximum shear stress theory. **(06 Marks)**

b. A bolt is required to resist an axial tension of 25kN and a transverse shear of 20kN. Find the size of the bolt by using i) Maximum principal stress theory ii) Maximum shear stress theory $\sigma_e = 300N/mm^2$, F.S = 3 **(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | |

15CV33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following with units:
i) Mass Density ii) Specific gravity iii) Dynamic viscosity iv) Surface tension. **(06 Marks)**

b. Derive an expression for capillary rice in a liquid in the form $h = \frac{4\sigma}{\rho g d}$ with usual notations. **(04 Marks)**

c. If the velocity profile of a fluid over a plate is a parabolic with the vertex 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradients and shear stress at a distance of zero and 10cm from the plate assuming the viscosity of the fluid as $0.85 NS/m^2$. **(06 Marks)**

OR

2 a. State and prove Pascal's law. **(06 Marks)**

b. Explain the working of a Bourdan's pressure gauge with a sketch. **(04 Marks)**

c. A single column manometer is connected to a pipe containing a liquid of specific gravity 0.9 as shown in Fig.Q.2(c). Find the pressure in the pipe if the area of the reservoir is 100 times the area of the tube for the manometer reading shown in Fig.Q.2(c). The specific gravity of heavier liquid is 13.6. **(06 Marks)**

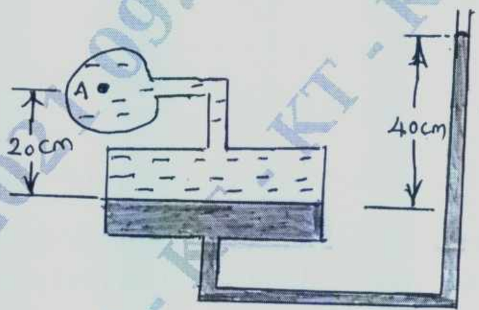

Fig.Q.2(c)

Module-2

3 a. Derive an expression for total pressure and centre of pressure on a vertically immersed plane surface. **(08 Marks)**

b. The stream function for a two dimensional flow is given by $\psi = 2xy$. Determine the velocity at point P(2, 3). Also find the velocity potential. **(06 Marks)**

c. What is flow net? Mention two uses of flow nets. **(02 Marks)**

OR

4 a. A rectangular plane surface 1m wide and 3m deep lies in water in such a way that its plane makes an angle of 30° with the free surface of water. Determine the total pressure and the depth of centre of pressure when the upper edge of the plate is 2m below the free surface. **(06 Marks)**

b. Explain:
   i) Steady and unsteady flow
   ii) Rotational and irrotational flow
   iii) Laminar and turbulent flow. **(06 Marks)**

c. The following case represents the two velocity components. Determine the third component of velocity such that they satisfy continuity equation - $v = 2y^2$, $w = 2xyz$. **(04 Marks)**

Module-3

5 a. Define momentum equation and give its applications. **(03 Marks)**

b. Derive the Bernoulli's equation starting from Euler's equation of motion with a neat sketch. **(06 Marks)**

c. A pipe of diameter 400mm carries water at a velocity of 20m/s. The pressures at the points E and F are given as $29N/cm^2$ and $22N/cm^2$ respectively while the datum head at E and F are 18m and 20m. Find the loss of head between E and F. **(07 Marks)**

OR

6 a. Derive an expression for discharge through venturimeter. **(05 Marks)**

b. Water flows at the rate of $0.147m^3/s$ through a 150mm diameter orifice inserted in a 300mm diameter pipe. If the pressure gauges fitted upstream and downstream of the orifice plate have shown readings of $176.58kN/m^2$ and $88.29kN/m^2$ respectively, find the coefficient of discharge 'C' of the orifice meter. **(05 Marks)**

c. A 45° reducing bend is connected in a pipe line, the diameter at the inlet and outlet of the bend being 600mm and 300mm respectively. Determine the force exerted by water on the bend if the intensity of pressure at inlet to bend is $8.829 \times 10^4 N/m^2$ and rate of flow of water is 600 litre/s. **(06 Marks)**

Module-4

7 a. Define the hydraulic coefficients (C_c, C_d, C_v) for an orifice and obtain a relation between them. **(04 Marks)**

b. Show that the side slopes in a Cipolleti notch is $\tan \theta/2 = 1/4$, to reduce end contractions. **(07 Marks)**

c. Mention two advantages of triangular notch over rectangular notch. Find the discharge over a triangular notch of angle 60° when the head over the V-notch is 0.3m. Assume $C_d = 0.6$. **(05 Marks)**

OR

8 a. Explain how do you classify the mouth piece and show that discharge for Borda's mouth piece running free, $Q = 0.5a\sqrt{2g\bar{h}}$ with usual notations. **(06 Marks)**

b. Explain ventilation of Weir's. **(04 Marks)**

c. A broad crested weir of 50m length has 50cm height of water above its crest. Find the maximum discharge i) neglecting velocity of approach ii) Considering velocity of approach, when the channel has a cross sectional area of $50m^2$ on the upstream side. **(06 Marks)**

Module-5

9 a. Derive Darcy Weisbach expression for the loss of head due to friction in pipes. **(06 Marks)**

b. Three pipes of lengths 1000m, 800m and 500m and diameters 500mm, 400mm and 300mm respectively are connected in series. These pipes are to be replaced by a single pipe of length 2300m. Find the diameter of the single pipe. **(04 Marks)**

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

OR

10 a. Explain the terms hydraulic gradient and total energy line. **(04 Marks)**

b. Derive the expression for pressure rise due to sudden closure of the valve when the pipe is rigid. **(04 Marks)**

c. For a pipe network shown in Fig.Q.10(c), determine the flow in each pipe. The value of 'n' may be assumed as 2.0. **(08 Marks)**

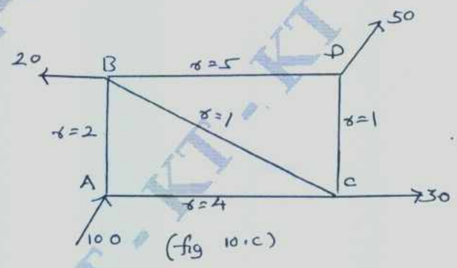

Fig.Q.10(c)

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CBCS SCHEME

USN

15MATDIP31

Third Semester B.E. Degree Examination, Jan./Feb. 2021

Additional Mathematics – I

Time: 3 hrs. Max. Marks: 80

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

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.

Module-1

1 a. Find the real and imaginary parts of $\frac{2+i}{3-i}$ and express in the form of x + iy. **(05 Marks)**

b. Reduce $1 - \cos\alpha + j\sin\alpha$ to the modulus amplitude form $[r(\cos\theta + i\sin\theta)]$ by finding r and θ. **(06 Marks)**

c. If $\vec{a} = 4i + 3j + k$ and $\vec{b} = 2i - j + 2k$ find the unit vector perpendicular to both the vectors $\vec{a}$ and $\vec{b}$. Hence show that $\sin\theta = \frac{\sqrt{185}}{3\sqrt{26}}$ where 'θ' is angle between $\vec{a}$ and $\vec{b}$. **(05 Marks)**

OR

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

b. Find 'a' such that the vectors 2i – j + k, i + 2j – 3k and 3i + aj + 5k are coplanar. **(06 Marks)**

c. Show that for any three vectors $\bar{a}, \bar{b}, \bar{c}$ $[\bar{b}\times\bar{c}, \bar{c}\times\bar{a}, \bar{a}\times\bar{b}] = [\bar{a}, \bar{b}, \bar{c}]^2$. **(05 Marks)**

Module-2

3 a. Find the n^{th} derivative of sin (5x) cos (2x). **(05 Marks)**

b. If y = a cos (log x) + b sin (log x) prove that $x^2y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0$. **(06 Marks)**

c. If $u = \sin^{-1}\frac{x+y}{\sqrt{x}-\sqrt{y}}$ show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$. **(05 Marks)**

OR

4 a. Expand $e^{\sin x}$ by Maclaurin's series upto the term containing x^4. **(05 Marks)**

b. Give $u - \sin\left(\frac{x}{y}\right)$ $x = e^t$ $y = t^2$ find $\frac{du}{dt}$ as a function of t. **(06 Marks)**

c. If x = r cos θ, y = r sin θ find $\frac{\partial(x,y)}{\partial(r,\theta)}$ and $\frac{\partial(r,\theta)}{\partial(x,y)}$. **(05 Marks)**

Module-3

5 a. State reduction formula for $\int_0^{\pi/2}\sin^n x\,dx$ and evaluate $\int_0^{\pi/2}\sin^9 x\,dx$. **(05 Marks)**

b. Evaluate $\int_0^\infty \frac{dx}{(1+x^2)^{7/2}}$. **(06 Marks)**

c. Evaluate : $\int_0^1\int_0^2\int_0^2 x^2yz\,dx\,dy\,dz$. **(05 Marks)**

OR

6 a. Evaluate : $\int_0^{\pi} \sin^4 x \ \cos^6 x \, dx$. **(05 Marks)**

b. Evaluate : $\int_0^5 \int_0^{x^2} y(x^2 + y^2) dx\, dy$. **(06 Marks)**

c. Evaluate : $\int_0^1 \int_0^2 \int_1^2 x^3 y^2 z^3 \, dx\, dy\, dz$. **(05 Marks)**

Module-4

7 a. A particle moves along the curve $x = t^3 + 1$, $y = t^2$, $z = 2t + 3$ where t is the time. Find the velocity and acceleration at time t = 1. **(05 Marks)**

b. Find the unit normal vector to the surface $xy^3z^2 = 4$ at the point (–1,–1, 2). **(06 Marks)**

c. What is solenoid vector field? Demonstrate that vector $\overline{F}$ given by $\overline{F} = 3y^2z^3 i + 8x^2 \sin(z) j + (x + y)k$ is solenoidal. **(05 Marks)**

OR

8 a. Find div F and Curl F if $\overline{F} = (3x^2 - 3yz)i + (3y^2 - 3xz)j + (3z^2 - 3xy)k$. **(05 Marks)**

b. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, –1, 2). **(06 Marks)**

c. Show that the fluid motion $\vec{V} = (y + z)i + (z + x)j + (x + y)k$ is irrotational. **(05 Marks)**

Module-5

9 Find the solution of :

a. $(x^2 + 2e^x)dx + (\cos y - y^2)dy = 0$. **(05 Marks)**

b. $\dfrac{dy}{dx} = \dfrac{y/x}{1 + y/x}$. **(06 Marks)**

c. $(x^2 - ay)dx + (y^2 - ax)dy = 0$. **(05 Marks)**

OR

10 a. Find the solution of :

$\dfrac{dy}{dx} = \dfrac{x^3}{y^3}$. **(05 Marks)**

b. $(x^2y^3 + \sin x)dx + (x^3y^2 + \cos y)dy = 0$. **(06 Marks)**

c. $\cos y \dfrac{dy}{dx} + \sin y = 1$. **(06Marks)**

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