CBCS SCHEME

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15MAT31

Third Semester B.E. Degree Examination, July/August 2021
Engineering Mathematics – III

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Obtain the Fourier series for the function,

$$f(x)=\begin{cases}1+\dfrac{2x}{\pi} & -\pi\le x\le 0\\ 1-\dfrac{2x}{\pi} & 0\le x\le \pi\end{cases}$$

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

b. Find the constant term and first two harmonics in the Fourier series for f(x) given by the following table:

x	0	π/3	2π/3	π	4π/3	5π/3	2π
f(x)	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(08 Marks)

2 a. Expand $f(x)=\sqrt{1-\cos x}$ in $0\le x\le 2\pi$ in a Fourier series. Evaluate $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+.....$ **(08 Marks)**

b. Obtain the Fourier series for f(x) = |x| in (–ℓ, ℓ) and hence evaluate $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+.....=\frac{\pi^2}{8}$ **(08 Marks)**

3 a. Find the Fourier transform of $f(x)=\begin{cases}1-|x| & \text{for} & |x|\le 1\\ 0 & \text{for} & |x|>1\end{cases}$ and hence deduce that $\int_0^\infty \frac{\sin^2 t}{t^2}dt$ **(06 Marks)**

b. Find the Fourier sine transform of $e^{-|x|}$. Hence show that $\int_0^\infty \frac{x\sin mx}{1+x^2}dx=\frac{\pi}{2}e^{-m}$ where m > 0. **(05 Marks)**

c. Find the z-transform of (i) $(2n-1)^2$ (ii) $\cos\left(\frac{n\pi}{2}+\frac{\pi}{4}\right)$ **(05 Marks)**

4 a. Find the Fourier transform of $f(n)=\begin{cases}1 & |x|\le 1\\ 0 & |x|>a\end{cases}$. Hence deduce $\int_0^\infty \frac{\sin ax}{x}dx$. **(06 Marks)**

b. Find the inverse z-transform of $\frac{4z^2-2z}{z^3-5z^2+8z-4}$. **(05 Marks)**

c. Solve the differential equation $u_{n+2}+6u_{n+1}+9u_n=2^n$ with $u_0 = u_1 = 0$ using z-transform method. **(05 Marks)**

5 a. Find the coefficient of correlation and the two lines of regression for the following data:

x	1	3	4	2	5	8	9	10	13	15
y	8	6	10	8	12	16	16	10	32	32

(06 Marks)

b. Fit a curve of the form $y = ae^{bx}$ to the following data:

x	77	100	185	239	285
y	2.4	3.4	7.0	11.1	19.6

(05 Marks)

c. Use Regula Falsi method, find the root of the equation $x^2 - \log_e x - 12 = 0$. (05 Marks)

6 a. The two regression equations of the variables x and y are $x = 19.13 - 0.87y$ and $y = 11.64 - 0.5x$. Find:
(i) Means of x
(ii) Means of y
(iii) The correlation coefficient (06 Marks)

b. Fit a parabola $y = a + bx + cx^2$ to the following data:

x	−3	−2	−1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.58

(05 Marks)

c. Use Newton-Raphson method to find the real root of $3x = \cos x + 1$, take $x_0 = 0.6$ perform 2 iterations. (05 Marks)

7 a. Find the cubic polynomial by using Newton forward interpolating formula which takes the following values.

x	0	1	2	3
y	1	2	1	10

(06 Marks)

b. Apply Lagrange's formula inversely to obtain a root of the equation $f(x) = 0$ given that $f(30) = -30$, $f(34) = -13$, $f(38) = 3$, $f(42) = 18$. (05 Marks)

c. Use Weddle's rule to evaluate $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ dividing the interval $\left[0, \frac{\pi}{2}\right]$ into six equal parts. (05 Marks)

8 a. A survey conducted in a slum locality reveals the following interpolating information as classified below:

Income/day in rupees : x	Under 10	10-20	20-30	30-40	40-50
Number of persons : y	20	45	115	210	115

Estimate the probable number of persons in the income group 20 to 25. (06 Marks)

b. Using Newton divided difference formula fit an interpolating polynomial for the following data:

x	0	1	4	5
f(x)	8	11	68	123

(05 Marks)

c. Using Simpson's 1/3rd rule evaluate $\int_0^1 \frac{x^2}{1+x^3} dx$ taking four equal strips. (05 Marks)

9 a. Find the extremal of the functional $I = \int_0^{\pi/2} (y^2 - y'^2 - 2y\sin x)dx$ under the conditions $y(0) = y\left(\frac{\pi}{2}\right) = 0$. (06 Marks)

b. If $\vec{F} = x^2 i + xyj$ evaluate $\int_C \vec{F}.d\vec{r}$ from (0, 0) to (1, 1) along

(i) the line $y = x$ (ii) the parabola $y = \sqrt{x}$ (05 Marks)

c. Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which when rotated about the x-axis gives a minimum surface area. (05 Marks)

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. Using divergence theorem evaluate $\int \vec{A} \cdot \hat{n}\, ds$ where $\vec{A} = x^3 i + y^3 j + z^3 k$ and s is the surface of the surface $x^2 + y^2 + z^2 = a^2$. (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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Third Semester B.E. Degree Examination, July/August 2021
Strength of Materials

Time: 3 hrs. Max. Marks: 80

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

1 a. Derive an expression for the deformation of the tapering circular cross sectional bar subjected to an axial force P. Use Standard notations. **(06 Marks)**

b. A 18mm diameter steel rod passes centrally through a copper tube of 26mm internal diameter and 38mm external diameter. The rod is 2.6m long and is closed at each end by rigid plate of negligible thickness. The nuts are tightened lightly home on projecting parts of the rod. If the temperature of the assembly is raised by 80^0, calculate the thermal stress induced in copper and steel. Also find final deformation of each material.
Take $\alpha_c = 17.5 \times 10^{-6}/^0C$, $\alpha_s = 12 \times 10^{-6}/^0C$, $E_s = 210$ GPa and $E_c = 105$ GPa. **(10 Marks)**

2 a. Draw the stress strain curve for mild steel specimen in tension. Mark the salient points on it. **(04 Marks)**

b. Derive the relationship between Young's modulus and Bulk modulus of a material **(05 Marks)**

c. A bar of 20mm diameter is tested to destruction. It is observed that when a load of 37.7 kN is applied, the extension is measured over a length of 200mm is 0.12mm and contraction in diameter is 0.0036mm. Find Poisson's ratio and Elastic constants. **(07 Marks)**

3 a. Define Principal Stresses and Principal Planes. **(04 Marks)**

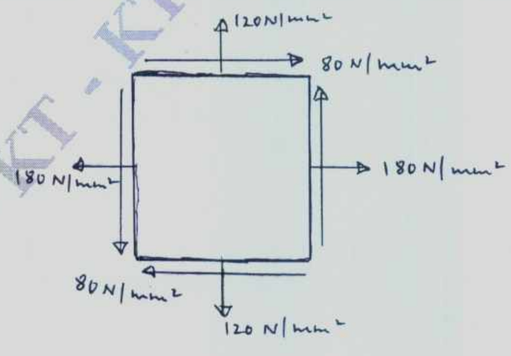
b. Explain the construction of Mohr's circle for compound stress in two dimensional systems. **(05 Marks)**

c. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand an internal fluid pressure of $8N/mm^2$. The maximum hoop stress in the section is not to increase $35N/mm^2$. **(07 Marks)**

4 a. Show that in the case of thin cylindrical shell subjected to internal fluid pressure, the volumetric strain is equal to the sum of twice the hoop strain and the longitudinal strain. **(06 Marks)**

b. The state of stress at a point in a strained material is as shown in Fig. Q4(b). Determine
i) Magnitude of principal stresses ii) Direction of principal planes
iii) Magnitude of maximum shear stress and direction. Sketch these planes. **(10 Marks)**

Fig. Q4(b)

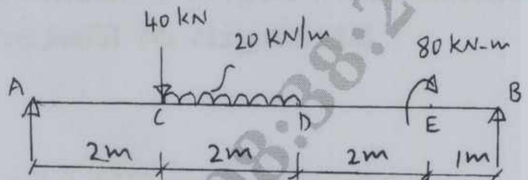


Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

5 a. Define : i) Shear force ii) Bending moment with sign conventions. **(04 Marks)**

b. Draw SFD and BMD for a simply supported beam carrying loads as shown in Fig. Q5(b). **(12 Marks)**

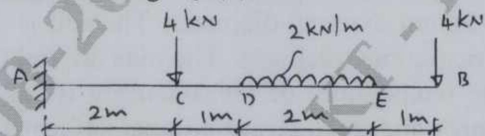
Fig. Q5(b)



6 a. For a simply supported beam of span 'L' carrying a udℓ of W N/m throughout. Obtain equations of SF and BM. Plot SFD and BMD. **(06 Marks)**

b. For the cantilever beam shown in Fig. Q6(b), obtain SFD and BMD. **(10 Marks)**

Fig. Q6(b)



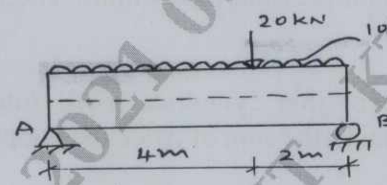
7 a. Draw the shear stress diagram for a rectangular beam section and show that maximum shear stress is 1.5 times average shear stress **(06 Marks)**

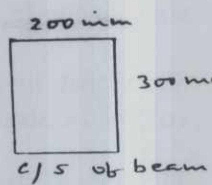
b. Compute the ratio of crippling loads by Euler's and Rankine's formula for an axially loaded column 6m high with both ends are fixed. The inner diameter of the tubular section is 50mm and it is 10mm thick. Take yield stress f_s = 415 MPa, E = 200GPa and Rankines constant $a = \frac{1}{7500}$. **(10 Marks)**

8 a. Derive the expression for Euler's Buckling load for column with both ends fixed. **(06 Marks)**

b. A simply supported rectangular beam is loaded as shown in Fig. Q8(b). Determine the maximum flexural stresses and maximum shearing stress at a cross section located 2m from the left support. Sketch the flexural and shearing stress distribution at the specified cross section. **(10 Marks)**

Fig. Q8(b)





9 a. Derive the torsion equation for circular member $\frac{T}{J} = \frac{q_s}{R} = \frac{G\theta}{L}$, with usual notations. **(08 Marks)**

b. A solid shaft has to transmit 150 kw of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1^0 in a length of 4m. Find the suitable diameter of solid circular shaft. Take G = 84 GPa. **(08 Marks)**

10 a. Write short notes on :
i) Maximum Principal Stress theory ii) Maximum Shear Stress theory. **(06 Marks)**

b. Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. **(10 Marks)**

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15CV33

Third Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

1 a. Explain the following terms with their units : i) Relative density ii) Capillarity. **(04 Marks)**

b. An oil of film of thickness 1.5mm is used for lubrication between a square plate of size 0.9m × 0.9m and an inclined plane having an angle of inclination 20^0. The weight of square is 392.4N and it slides down the plane with uniform velocity of 0.2m/s. Find the dynamic viscosity of oil. **(06 Marks)**

c. The dynamic viscosity of soil used for lubrication between shaft and sleeve is 5 Poise. The diameter of shaft is 40cm and it rotates at 200 rpm. Calculate the power lost in bearing for a sleeve length of 100mm. The thickness of film is 2mm. **(06 Marks)**

2 a. Derive an expression for pressure variation in a fluid at rest. **(04 Marks)**

b. What are pressure gauges? Explain working of Bowdon's pressure gauge, with neat sketch. **(06 Marks)**

c. An U – tube differential manometer is attached to two points A and B in a horizontal pipeline carrying water 5m apart. The pressure at A is $7N/cm^2$ and pressure head at B is 150mm of mercury. Find the mercury level differences in manometer. **(06 Marks)**

3 a. Define Total Pressure and Centre of Pressure. **(02 Marks)**

b. Derive an expression for depth of centre of pressure from the free surface of liquid of an inclined plane surface submerged in the liquid. **(06 Marks)**

c. An equilateral triangular plate of 6m side is immersed in water with its base at 5m below free surface. Determine the total pressure and centre of pressure below free surface. **(08 Marks)**

4 a. Differentiate between :
i) Laminar and Turbulent flow ii) Steady and Uniform flow. **(02 Marks)**

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

c. If two dimensional potential flow, the velocity potential is given by $\phi = x[2y - 1]$, determine the velocity at point P(4, 5). Determine also the value of stream function ψ at point P. **(08 Marks)**

5 a. Derive Bernoulli's equation from Euler's equation of motion ; also state assumptions and limitations of Bernoulli's equation. **(08 Marks)**

b. A venturimeter has its axis vertical , the inlet and throat diameter being 15cm and 7.5cm respectively. The throat is 22.5cm above inlet and $C_d = 0.96$. The fluid is petrol of specific gravity 0.78 and it flows up through the meter at a rate of $0.029m^3/s$. Find the pressure difference between inlet and throat. **(08 Marks)**

6 a. What is Momentum principle? Explain. **(04 Marks)**

b. What is Static Pitot tube? Explain with neat sketch. **(06 Marks)**

c. A pitot static tube placed in centre of 20cm dia pipe has an orifice pointing upstream and other perpendicular to it. If the pressure difference between two orifices is 5cm of water, when the discharge through the pipe is 25.5lit/s. Calculate the coefficient of meter. Take mean velocity of pipe to be 0.83 times central velocity. **(06 Marks)**

7 a. Explain classification of Orifices. (04 Marks)

b. Derive an expression for experimental determination of coefficient of velocity of an orifice. (06 Marks)

c. A vertical sharp edged orifice 120mm in diameter is discharging water at the rate of 98.2 lit/s under a constant head of 10 meters. A point on the jet, measured from the vena contracta of the jet has co-ordinates 4.5m horizontal and 0.54 meter vertical. Find the following for the orifice. i) Co-efficient of velocity ii) Co-efficient of discharge. (06 Marks)

8 a. Explain classification of Weirs. (04 Marks)

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

c. Water is flowing in a rectangular channel of 1m wide and 0.75m deep. Find the discharge over a rectangular weir of crest length 60cm if the head of water over the crest is 20cm and water from channel flows over weir. Take $C_d = 0.62$. Neglect and contractions. Take velocity of approach into consideration. (06 Marks)

9 a. What are the different types of losses in pipe flow? (04 Marks)

b. Derive an expression for equivalent pipe. (06 Marks)

c. A pipe system consists of three pipes arranged in series, the length of pipes are 1200m , 750m and 600m and diameters 750mm, 600mm and 450mm respectively.

i) Transform the system into an equivalent 450mm diameter pipe and

ii) Determine equivalent diameter of pipe, 2250 m long. (06 Marks)

10 a. What is the phenomenon of Water hammer? Explain. (04 Marks)

b. Derive an expression for rise of pressure due to sudden closure of valve when pipe is elastic. (06 Marks)

c. The water is flowing with a velocity of 1.5m/s in a pipe of length 2500m of diameter 500mm. At end of pipe a valve is provided. If the valve is closed in 2 seconds, find the rise of pressure behind the valve. Assume the pipe to be rigid and take bulk modulus of water $K = 19.62 \times 10^4 N/cm^2$. (06 Marks)

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CBCS SCHEME

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Third Semester B.E. Degree Examination, Aug./Sept.2020
Building Materials and Construction

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any 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. Explain the characteristics of good building stones. **(04 Marks)**
b. What is meant by dressing of a stone? Describe its various varieties. **(08 Marks)**
c. Briefly explain the terms used in bricks : i) Compressive strength ii) Water absorption. **(04 Marks)**

OR

2 Distinguish between :
a. Concrete blocks and stabilized mud blocks.
b. Fine Aggregate and Coarse Aggregate.
c. Flakiness Index and Elongation Index.
d. Moisture content and Deleterious materials. **(16 Marks)**

Module-2

3 a. Write the objectives of the foundations. **(04 Marks)**
b. Explain in detail the plate load test for determining safe bearning capacity of soil. **(06 Marks)**
c. List the types of foundations. Explain any one of them. **(06 Marks)**

OR

4 a. With neat sketches, discuss the features of English and Flemish Bond Brick Masonry. **(08 Marks)**
b. List any four commonly used building stones and state their suitability in construction. **(04 Marks)**
c. Write a short note on Cavity wall. **(04 Marks)**

Module-3

5 a. Explain the functions of Chejja , Canopy and Balcony. **(06 Marks)**
b. How do you select the flooring materials? Explain it. **(04 Marks)**
c. List the classification of Arches. Explain with neat sketches of any one method. **(06 Marks)**

OR

6 a. Draw a neat sketch of Typical RCC Floor and explain its functions. **(06 Marks)**
b. With the help of neat sketch, explain components of king post truss. **(06 Marks)**
c. Write a short note on Pitched roof. **(04 Marks)**

Module-4

7 a. What are the functions and applications of doors , windows and ventilators? **(08 Marks)**
b. What is Form work? Write the essential requirements of form work. **(04 Marks)**
c. Give a brief note on Applications of Scaffoldings. **(04 Marks)**

OR

8 a. State briefly the requirement of a good stair. Discuss them in detail. (04 Marks)
b. Discuss the types of stair with sketches. (08 Marks)
c. Write a short note on :
i) Shoring ii) Underpinning. (04 Marks)

Module-5

9 a. Explain the purpose of plastering. Explain the various types of mortars used for plastering. (08 Marks)
b. Discuss the defects in plastering. How to minimize the defects in plastering work? (08 Marks)

OR

10 a. What is Damp proof course? Explain its necessity in building. (08 Marks)
b. Mention the characteristics of an ideal paint. (04 Marks)
c. Describe the procedure of painting on New and Old wood work. (04 Marks)

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CBCS SCHEME

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15MATDIP31

Third Semester B.E. Degree Examination, July/August 2021
Additional Mathematics - I

Time: 3 hrs. Max. Marks: 80

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

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.

1 a. Express $\frac{(3+i)(1-3i)}{(2+i)}$ in the form x + iy. **(06 Marks)**

b. Find the modulus and amplitude of the complex number $1+\cos\alpha + i\sin\alpha$. **(05 Marks)**

c. If $\vec{a} = \hat{i} + 2\hat{j} - 2\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, $\vec{c} = \hat{i} - 2\hat{j} + 2\hat{k}$, then find $\vec{a} \times (\vec{b}\times\vec{c})$. **(05 Marks)**

2 a. Prove that $\left[\frac{1+\cos\theta + i\sin\theta}{1+\cos\theta - i\sin\theta}\right]^n = \cos n\theta + i\sin n\theta$. **(06 Marks)**

b. Find the cube root of $1 + i\sqrt{3}$. **(05 Marks)**

c. Show that the vectors $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = -2\hat{i} + 3\hat{j} - 4\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 5\hat{k}$ are coplanar. **(05 Marks)**

3 a. Find the n^{th} derivative of $e^{ax}\sin(bx+c)$. **(06 Marks)**

b. With usual notations prove that $\tan\phi = r \cdot \frac{d\theta}{dr}$. **(05 Marks)**

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

4 a. Find the n^{th} derivative of $\frac{x}{(x-2)(x-3)}$. **(06 Marks)**

b. Find the angle between the curves $r = a(1+\cos\theta)$ and $r = b(1-\cos\theta)$. **(05 Marks)**

c. Given $u = x^2+y^2+z^2$, $v = xy+yz+zx$, $w = x+y+z$, find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. **(05 Marks)**

5 a. Obtain the reduction formula for $\int_0^{\pi/2} \sin^n x \, dx$. **(06 Marks)**

b. Evaluate $\int_0^{\pi/16} \cos^5(8x)\sin^6(16x)\,dx$. **(05 Marks)**

c. Evaluate $\int_1^2\int_1^3 x y^2 \, dx\, dy$. **(05 Marks)**

6 a. Evaluate $\int_0^{2a} x^2\sqrt{2ax - x^2}\,dx$. **(06 Marks)**

b. Evaluate $\int_0^{\pi} \frac{\sin^4\theta}{(1+\cos\theta)^2}\,d\theta$. **(05 Marks)**

c. Evaluate $\int_{-3}^{3}\int_0^1\int_1^2 (x+y+z)\,dx\,dy\,dz$. **(05 Marks)**

7 a. Find velocity and acceleration of a particle moving along the curve $\vec{r} = e^{-2t}\,\hat{i} + 2\cos 5t\,\hat{j} + 5\sin t\,\hat{k}$ at anytime t. Find their magnitudes at t = 0. **(06 Marks)**

b. If $\phi = x^3 + y^3 + z^3 - 3xyz$ find $\nabla\phi$ at (1, -1, 2). **(05 Marks)**

c. Show that $\vec{F} = (x + 3y)\,\hat{i} + (y - 3z)\,\hat{j} + (x - 2z)\,\hat{k}$ is Solenoidal. **(05 Marks)**

8 a. Find the unit tangent vector of the space curve $\vec{r} = \cos t\,\hat{i} + \sin t\,\hat{j} + t\,\hat{k}$. **(06 Marks)**

b. If $\vec{F} = x^2y\,\hat{i} + yz^2\,\hat{j} + zx^2\,\hat{k}$, then find div (curl $\vec{F}$). **(05 Marks)**

c. Find the constants a, b and c such that the vector $\vec{F} = (x + y + az)\,\hat{i} + (x + cy + 2z)\,\hat{j} + (bx + 2y - z)\,\hat{k}$ is irrotational. **(05 Marks)**

9 a. Solve $\dfrac{dy}{dx} = 1 + y/x + \left(y/x\right)^2$. **(06 Marks)**

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

c. Solve $\dfrac{dy}{dx} = \dfrac{x^2 - 2xy}{x^2 - \sin y}$. **(05 Marks)**

10 a. Solve $(2x^3 - xy^2 - 2y + 3)dx - (x^2y + 2x)dy = 0$. **(06 Marks)**

b. Solve $(1 + xy)y\,dx + (1 - xy)\,x\,dy = 0$. **(05 Marks)**

c. Solve $x\dfrac{dy}{dx} + y = x^3y^6$. **(05 Marks)**

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