CBCS SCHEME

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17MAT31

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

Time: 3 hrs. Max. Marks: 100

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. Obtain the Fourier series for the function

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

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

b. Find the Fourier series for the function $f(x) = 2x - x^2$ in $0 < x < 3$. **(06 Marks)**

c. Obtain the constant term and the first sine and cosine terms of the Fourier for y using the following table :

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

(06 Marks)

2 a. Obtain the Fourier series for the function $f(x) = |\cos x|$, $-\pi < x < \pi$. **(08 Marks)**

b. Find the Half range cosine series for $f(x) = x(\ell - x)$, $0 \le x \le \ell$. **(06 Marks)**

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

x :	0	$\pi/3$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
y :	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

(06 Marks)

3 a. If $f(x) = \begin{cases} 1 - x^2, & |x| < 0 \\ 0, & |x| \ge 1 \end{cases}$

Find the Fourier transform of f(x) and hence find the value of $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3}\right) dx$ **(08 Marks)**

b. Find the Fourier sine transform of $f(x) = e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x \sin mx}{1 + x^2} dx \ (m > 0)$ **(06 Marks)**

c. Find $Z_T^{-1}\left[\frac{3z^2 + 2z}{(5z-1)(5z+2)}\right]$. **(06 Marks)**

4 a. Find the Fourier transform of

$$f(x) = \begin{cases} 1 - |x|, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$$ and hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2} dt$. **(08 Marks)**

b. Find the Z – transform of $2n + \sin\left(\frac{n\pi}{4}\right) + 1$. **(06 Marks)**

c. Solve by using Z – transforms $Y_{n+2} - 4\ Y_n = 0$ given that $Y_0 = 0$, $Y_1 = 2$. **(06 Marks)**

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

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

(08 Marks)

b. Fit a Second degree parabola in the least Square sense for the following data:

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

(06 Marks)

c. Use the Regula-Falsi method to obtain the real root of the equation $\cos x = 3x - 1$ correct to 3 decimal places in (0, 1). (06 Marks)

6 a. Given the equation of the regression lines $x = 19.13 - 0.87y$, $y = 11.64 - 0.5x$. Compute the mean of x's , mean of y's and the coefficient of correlation. (08 Marks)

b. Fit a curve of the form, $y = a e^{bx}$ for the data:

x :	0	2	4
y :	8.12	10	31.82

(06 Marks)

c. Using Newton-Raphson method to find a real root of $x \log_{10}^{x} = 1.2$ upto 5 decimal places near $x = 2.5$. (06 Marks)

7 a. Given Sin 45° = 0.7071, Sin 50° = 0.7660, Sin 55° = 0.8192, Sin 60° = 0.8660, find Sin 57° using an Backward Interpolation formula. (08 Marks)

b. Applying Lagrange's Interpolation formula inversely find x when y = 6 given the data

x :	20	30	40
y :	2	4.4	7.9

(06 Marks)

c. Using Simpson's $\frac{1}{3}^{rd}$ rule with Seven ordinates to evaluate $\int_2^8 \frac{dx}{\log_{10} x}$. (06 Marks)

8 a. Fit an Interpolating polynomial for the data $u_{10} = 355$, $u_0 = -5$, $u_8 = -21$, $u_1 = -14$, $u_4 = -125$ by using Newton's Divided difference formula and hence find u_2. (08 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. (06 Marks)

c. Evaluate $\int_4^{5.2} \log_e x \, dx$ taking six equal strips by applying Weddle's rule. (06 Marks)

9 a. Using Green's theorem, evaluate $\int_C [(y - \sin x)dx + \cos x \; dy]$, where C is the plane triangle enclosed by the lines $y = 0$, $x = \frac{\pi}{2}$ and $y = \frac{2}{\pi}x$. (08 Marks)

b. Using Divergence theorem evaluate $\int_S \vec{F} \cdot ds$, where $\vec{F} = 4x\,i - 2y^2 j + z^2 K$ and S is the surface bounding the region $x^2 + y^2 = 4$, z = 0 and z = 3. (06 Marks)

c. Show that the Geodesics on a plane are straight lines. (06 Marks)

10 a. Verify Stoke's theorem for the vector field $\vec{F} = (2x - y)i - yz^2 j - y^2 z\ K$ over the upper half surface of $x^2 + y^2 + z^2 = 1$ bounded by its projection on the xy - plane. **(08 Marks)**

b. Derive Euler's equation in the standard form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left[\frac{\partial f}{\partial y^1}\right] = 0$. **(06 Marks)**

c. Find the Extremals of the functional
$\int_{x_0}^{x_1} \frac{y^{1^2}}{x^3} dx.$ **(06 Marks)**

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17ME32

Third Semester B.E. Degree Examination, July/August 2021
Material Science

Time: 3 hrs. Max. Marks: 100

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.

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1 a. Define APF. Calculate APF for HCP cell. **(06 Marks)**
b. Distinguish between Edge and Screw dislocations. **(06 Marks)**
c. Explain the salient features of stress – strain curve for mild steel for tensile loading. **(08 Marks)**

2 a. Define Fracture. Explain the different types of fracture with neat sketches. **(07 Marks)**
b. Explain the factors affecting the fatigue life of metallic components. **(05 Marks)**
c. Define Creep. Explain the creep curve, with example. **(08 Marks)**

3 a. Explain the rules govern the formation of solid solution. **(05 Marks)**
b. Explain the mechanism of solidification for pure metals and binary metallic solution. **(08 Marks)**
c. Define Solid Solution. Explain the different types of solid solution. **(07 Marks)**

4 a. Write a note on Cast Metal structure. **(05 Marks)**
b. Obtain an expression for critical radius of Nucleation. **(05 Marks)**
c. Two metals A and B have their melting points at 600^0C and 400^0C respectively. These metals do not form any compound (or) inter-metallic phase. The maximum solubility in each other is 4% which remains the same until 0^0C. An eutectic reaction takes place between 65% A and 35% B at 300^0C.
i) Draw the phase diagram and label all the phases and fields.
ii) Find the temperature at which 20% A and 80% B starts and ends solidification.
iii) Find the temperature at which the same alloy contains 50% liquid and 50% solid. **(10 Marks)**

5 a. Draw TTT diagram for eutectoid steel and explain briefly. **(06 Marks)**
b. Define Heat treatment. Give its classification. **(06 Marks)**
c. Differentiate clearly between Normalizing and Annealing. Discuss Spheroidising Annealing with applications. **(08 Marks)**

6 a. Explain the Composition, Structure , Properties and Applications of 4 types of cast iron. **(08 Marks)**
b. With a neat sketch, explain the Induction hardening process. Discuss the advantages , limitations and applications of the process. **(08 Marks)**
c. Explain Age hardening of AL – CU alloys. **(04 Marks)**

7 a. State and explain the Mechanical and Electrical properties of Ceramic Materials. **(08 Marks)**
b. What are Ceramics? Explain the types of Ceramics. **(06 Marks)**
c. Define Smart Materials. Explain briefly the types of Smart Materials. **(06 Marks)**

8 a. Describe Shape Memory Alloys. Explain briefly the applications of shape memory alloys. **(08 Marks)**
b. Differentiate between Thermo – Plastics and Thermoset Plastics. **(06 Marks)**
c. Explain briefly the Fibre Optic Materials and use of non – destructive testing. **(06 Marks)**

9 a. Define Composites. Give the complete classification of composites. **(07 Marks)**
b. What is the role of matrix and reinforcement in Composite materials? **(06 Marks)**
c. With a neat sketch, explain the Injection Moulding process. **(07 Marks)**

10 a. List the advantages and applications of Composite Materials. **(08 Marks)**
b. Explain the Pultrusion process with a neat sketch. List the merits and demerits. **(08 Marks)**
c. Calculate the fraction of the load carried by the glass fiber reinforced epoxy resin composite, containing 60% by volume of E_{glass} fibers. Take $E_f = 72$ GPa and $E_{matrix} = 3$ GPa. **(04 Marks)**

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17ME33

Third Semester B.E. Degree Examination, July/August 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of thermodynamic data book is 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.

1 a. Differentiate between open system and control volume. Give examples. **(06 Marks)**
b. With examples, define the following :
(i) Intensive property (ii) Extensive property
(iii) Path function (iv) Point function **(08 Marks)**
c. A constant volume gas thermometer containing a gas gives the reading of gas pressure of 1 bar and 1.5 bar at ice point and steam point respectively. Assuming T = a + bP, where P is in N/m^2, express the gas thermometer Celsius temperature T in terms of gas pressure. What is the temperature recorded by the thermometer when it registers a pressure of 1.2 bar. **(06 Marks)**

2 a. List out the similarities and dissimilarities between work and heat. **(06 Marks)**
b. Derive the work done expression for, (i) Isothermal process (ii) Isentropic process. **(06 Marks)**
c. A fluid is heated reversibly at a constant pressure of 1.013 bar until it has a specific volume of 0.1 m^3/kg. It is then compressed reversibly according to a law PV = C to a pressure of 4.2 bar, then allowed to expand reversibly according to a law $PV^{1.3} = C$ to the initial conditions. The work done in the constant pressure process is 515 Nm and the mass of fluid present is 0.2 kg. Calculate the net work done on or by the fluid in the process. Sketch the cycle on P-V diagram. **(08 Marks)**

3 a. Describe Joule's experiment to verify First law of thermodynamics. **(06 Marks)**
b. Why PMMKI and PMMKII are impossible? **(06 Marks)**
c. A centrifugal pump delivers 50 kg of water per second. The inlet and outlet pressures are 1 bar and 4.2 bar. The suction is 2.2 m below the centre of the pump and delivery is 8.5 m above the centre of the pump. The suction and delivery pipe diameters are 20 cm and 10 cm respectively. Determine the capacity of the electric motor to run the pump if pump efficiency is 85%. **(08 Marks)**

4 a. Show that reversible heat engine has higher efficiency than irreversible heat engine. **(10 Marks)**
b. A refrigerator produces 2 tonnes of ice at 0°C per day from water maintained at 0°C. It rejects heat to atmosphere at 27°C. The power to the refrigerator is supplied by an engine which absorbs heat from a source, which is maintained at 227°C by burning fuel of calorific value 20×10^3 KJ/kg. Find the consumption of fuel per hour and the power developed by the engine. Assume both the devices to run on Carnot cycle. Take latent heat of ice as 335 KJ/kg. **(10 Marks)**

5 a. Clearly explain the factors that make a process irreversible. **(10 Marks)**
b. What is internal and external irreversibility? **(04 Marks)**
c. Show that entropy change is an irreversible process. **(06 Marks)**

6 a. State and prove Clausius inequality. **(08 Marks)**

b. The heat engine receives 300 kJ/min of heat from a source at 327°C and rejects heat to a sink at 27°C. Three hypothetical amounts of heat rejections are given below:

(i) 200 kJ/min, (ii) 150 kJ/min (iii) 100 kJ/min

Using entropy concept, state which of these cases is a reversible, irreversible or an impossible one. **(06 Marks)**

c. A perfect gas of mass 1.7 kg and volume 1.5 m^3/kg are compressed reversibly and polytropically from pressure 1 bar to 7.5 bar in a cylinder. The index of compression is 1.25, $R = 0.540$ kJ/kg K, $C_V = 1.687$ kJ/kgK. Calculate the work done, heat transfer and change in entropy. **(06 Marks)**

7 a. Define the following:

(i) Available and Unavailable energy.

(ii) Availability.

(iii) II law efficiency. **(06 Marks)**

b. Draw pressure-temperature diagram for a pure substance. Explain its salient features. **(07 Marks)**

c. 15 kg of water is heated in an insulated tank by a churning process from 300 K to 340 K. If the surrounding temperature is 300 K, find the loss in availability for the process. **(07 Marks)**

8 a. With a neat sketch, explain the working of Throttling calorimeter. What are its advantages and disadvantages? **(10 Marks)**

b. A certain quantity of steam in a closed vessel of fixed volume of 0.14 m^3 exerts pressure of 10 bar and 250°C. If the vessel is cooled so that the pressure falls to 3.6 bar, determine (i) final quality of steam (ii) final temperature (iii) change in internal energy (iv) heat transferred during the process. Take $C_P = 2.1$ kJ/kgK. **(10 Marks)**

9 a. State the following :

(i) Dalton's law of additive pressures.

(ii) Amagat's law of volume additives. **(04 Marks)**

b. Define the psychrometric properties given below:

(i) Wet bulb temperature

(ii) Dew point temperature.

(iii) Specific humidity

(iv) Relative humidity

(v) Degree of saturation

(vi) Dry bulb depression. **(09 Marks)**

c. A mixture of ideal gases consists of N_2 of 3 kg and CO_2 of 5 kg at a pressure of 300 KPa and temperature of 20°C. Find (i) Mole fraction of each constituent (ii) Gas constant of mixture (iii) Molecular weight of mixture (iv) Partial pressures and volumes. **(07 Marks)**

10 a. Write a note on : (i) Law of corresponding states (ii) Compressibility chart. **(06 Marks)**

b. With usual notations, write the Vander-Waal's equation of state. What is the significance of constants 'a' and 'b'. **(06 Marks)**

c. Determine the pressure in a steel vessel having a volume of 15 lit and containing 3.4 kg of N_2 at 400°C using,

(i) Ideal gas equation (ii) Vanderwaal's equation.

Also calculate the compressibility factor by using the answer obtained from the Vanderwaal's equation of state. **(08 Marks)**

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17MATDIP31

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

Time: 3 hrs. Max. Marks: 100

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. Find the modulus and amplitude of $\frac{4+2i}{2-3i}$. **(06 Marks)**

b. Find a unit vector normal to both the vectors $4i-j+3k$ and $-2i+j-2k$. Find also sine of the angle between them. **(07 Marks)**

c. Show that $\left[\vec{a}+\vec{b}, \vec{b}+\vec{c}, \vec{c}+\vec{a}\right] = 2\left[\vec{a}, \vec{b}, \vec{c}\right]$. **(07 Marks)**

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

b. Find the modulus and amplitude of $1+\cos\theta+i\sin\theta$. **(07 Marks)**

c. Find λ so that $\vec{a}=2\hat{i}-3\hat{j}+\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{c}=\hat{j}+\lambda\hat{k}$ are coplanar. **(07 Marks)**

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

b. Find the angle of intersection of the curves $r=\sin\theta+\cos\theta$ and $r=2\sin\theta$. **(07 Marks)**

c. If, $z=f(x,y)$ where $x=e^u+e^{-v}$, $y=e^{-u}-e^v$. Prove that $x\frac{\partial z}{\partial x}-y\frac{\partial z}{\partial y}=\frac{\partial z}{\partial u}-\frac{\partial z}{\partial v}$. **(07 Marks)**

4 a. If $y=\tan^{-1}x$, then show that $(1+x^2)y_{n+2}+2(n+1)xy_{n+1}+n(n+1)y_n=0$. **(06 Marks)**

b. Find the pedal equation for the curve $\frac{2a}{r}=1+\cos\theta$. **(07 Marks)**

c. If, $u=x^2+y^2+z^2$, $v=xy+yz+zx$, $w=x+y+z$, then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. **(07 Marks)**

5 a. Obtain the reduction formula for $\int \cos^n x\,dx$. **(06 Marks)**

b. Using reduction formula, find the value of $\int_0^1 x^2(1-x^2)^{\frac{3}{2}}dx$. **(07 Marks)**

c. Evaluate $\int_{-1}^{1}\int_{0}^{2}\int_{x-z}^{x+z}(x+y+z)\,dx\,dy\,dz$. **(07 Marks)**

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6 a. Evaluate $\int_0^{\pi} x\sin^8 x\,dx$. **(06 Marks)**

b. Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} x^3 y\,dx\,dy$. **(07 Marks)**

c. Evaluate $\int_0^{\pi} x\sin^2 x\cos^4 x\,dx$. **(07 Marks)**

7 a. A particle moves along the curve $\vec{r} = 3t^2\hat{i} + (t^3 - 4t)\hat{j} + (3t+4)\hat{k}$. Find the component of velocity and acceleration at $t = 2$ in the direction of $\hat{i} - 2\hat{j} + 2\hat{k}$. **(06 Marks)**

b. Find the angle between the tangents to the surface $x^2y^2 = z^4$ at $(1, 1, 1)$ and $(3, 3, -3)$. **(07 Marks)**

c. Find $\operatorname{div}\vec{F}$ and $\operatorname{curl}\vec{F}$ where $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$. **(07 Marks)**

8 a. Find the angle between the tangents and to the curve $\vec{r} = \left(t - \frac{t^3}{3}\right)\hat{i} + t^2\hat{j} + \left(t + \frac{t^3}{3}\right)\hat{k}$ at $t = \pm 3$. **(06 Marks)**

b. Find the directional derivative of $f = x^2yz + 4xz^2$ at $(1,-2,-1)$ along $2\hat{i} - \hat{j} - 2\hat{k}$. **(07 Marks)**

c. Prove that $\operatorname{div}(\operatorname{curl}\vec{F}) = 0$. **(07 Marks)**

9 a. Solve $\frac{dy}{dx} = e^{3x-2y} + x^2 e^{-2y}$. **(06 Marks)**

b. Solve $x^2y\,dx - (x^3 + y^3)\,dy = 0$. **(07 Marks)**

c. Solve $\frac{dy}{dx} - \frac{2y}{x} = x + x^2$. **(07 Marks)**

10 a. Solve $x\,dy - y\,dx = \sqrt{x^2 + y^2}\,dx$. **(06 Marks)**

b. Solve $(5x^4 + 3x^2y^2 - 2xy^3)\,dx + (2x^3y - 3x^2y^2 - 5y^4)\,dy = 0$. **(07 Marks)**

c. Solve $\frac{dy}{dx} - \frac{y}{x+1} = e^{3x}(x+1)$. **(07 Marks)**

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