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 (-π , π) and hence deduce $\frac{\pi^2}{8} = \sum_1^{\infty} \frac{1}{(2n-1)^2}$. **(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, π). **(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 θ 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)**

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. 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 | | | | | | | | | | | **15ME32**

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

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. Define Atomic Packing Factor (APF). Calculate the APF for FCC Lattice. **(08 Marks)**

b. What are Imperfections? Explain briefly edge and screw dislocation, with the neat sketches. **(08 Marks)**

OR

2 a. From the tensile stress strain behavior for the brass specimen shown in fig. Q2(a), determine the following : i) The modulus of elasticity.

ii) The yield strength at a strain offset of 0.002.

iii) The maximum load that can be sustained by a cylindrical specimen having an original diameter of 12.7mm.

iv) The change in length of the specimen originally 250mm long which is subjected to a tensile stress of 350 MPa. **(08 Marks)**

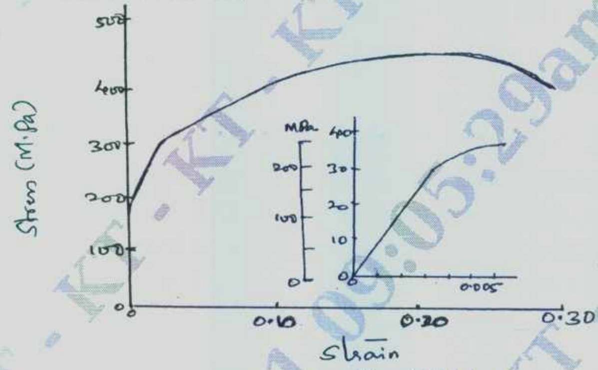

Fig. Q2(a)

b. What is Fatigue? Draw the SN curves for i) a material that displays a fatigue limit ii) a material that does not display fatigue limit. **(08 Marks)**

Module-2

3 a. Explain Homogeneous and Heterogeneous nucleation and crystal growth with neat sketches. **(08 Marks)**

b. Explain Hume Rothery rules , lever rule and Gibb's phase rule. **(08 Marks)**

OR

4 a. Two metals A and B are used to form an alloy containing 75% A and 25% B. 'A' melts at 600^0C and 'B' melts at 400^0C. When alloyed together these metals form no compounds (or) solid solutions but form "Eutectic" at 40% A and 60% B. Assume that the liquids and solids lines as straight. The eutectic solidifies at 250^0C. The specific gravity of A is 2.0 and that of B is 6.0. Find the following :

i) The temperature at which alloy begins to crystallize from the melt and at which at melt will be completely solid.

ii) The percentage of eutectic in the alloy at room temperature.

iii) The percentage of solid in the alloy at 300^0C.

iv) Specific gravity of the alloy. **(10 Marks)**

b. Draw Iron carbon Equilibrium diagram and label all fields. **(06 Marks)**

Module-3

5 a. Draw the TTT diagram of austenite for eutectoid steel. Explain the various transformation product of austenite. (08 Marks)

b. Compare annealing and normalizing heat treatments adopted for steels. (04 Marks)

c. What is Carburizing and Flame hardening? (04 Marks)

OR

6 a. In annealing, explain recovery , recrystallization and grain growth in detail. (08 Marks)

b. Explain properties , composition and uses of grey cast irons. (08 Marks)

Module-4

7 a. List and explain any two types of Ceramic structures with their properties and applications. (06 Marks)

b. Explain Dry pressing and Isostatic pressing of ceramic forming. (05 Marks)

c. Write a note on Polyamides and polycarbonate thermoplastics. (05 Marks)

OR

8 Explain the following :

a. Shape memory alloys with biological applications. (06 Marks)

b. Fiber optic materials. (05 Marks)

c. Residual life assessment. (05 Marks)

Module-5

9 a. Define Composite material and explain their classification. (08 Marks)

b. A FRP consists of continuous glass fibres of 70 GPa Young's Modulus, reinforcing Epoxy resin matrix of 3.5 GPa Young's modulus. If the volume fraction of fiber is 0.35, find the Young's modulus of composite in longitudinal direction and transverse direction. (08 Marks)

OR

10 a. With neat sketch, explain the Sheet Molding Compound (SMC) process for fiber reinforced plastic composite material. (08 Marks)

b. Write a note on characterization and application of Composite Materials. (08 Marks)

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CBCS SCHEME

USN | | | | | | | | | | 15ME33

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

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics Hand Book is permitted.
3. Assuming missing data suitably (if any).

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. Define the following: i) State ii) Thermodynamic equilibrium iii) Process and path **(06 Marks)**

b. Define: i) Ice point ii) Steam point on temperature scales
What do you understand by Thermodynamic temperature scale? **(06 Marks)**

c. The temperature t on a scale is defined in terms of a property K by the relation t = a ln k + b (where a and b are constants). The values of K are found to be 1.83 and 6.78 at the ice point and the steam point, the temperature of which are assigned numbers 0 and 100 respectively. Determine the temperature corresponding to a reading of K equal to 2.42 on the thermometer. **(04 Marks)**

OR

2 a. List similarities between Heat and Work. **(04 Marks)**

b. Obtain expressions for thermodynamic work for i) PV = C ii) $PV^n = C$. **(06 Marks)**

c. A piston cylinder device operates 1 kg of fluid at 20atm pressure. The initial volume is $0.04m^3$. The fluid is allowed to expand reversibly following a process $PV^{1.45} = C$ so that the volume doubles. Fluid is then cooled at constant pressure until the piston comes back to the original position. Keeping the piston position unaltered head is added reversibly to restore it to the initial pressure calculate the work done in the cycle. **(06 Marks)**

Module-2

3 a. State first law of Thermodynamics for a closed system undergoing a cycle. Explain Joule's experiment. **(06 Marks)**

b. Show that energy is a properly and a point function. **(04 Marks)**

c. In a gas turbine the gas enters at the rate of 5kg/s with a velocity of 50m/s and enthalpy of 900kJ/kg and leaves the turbine with a velocity of 150m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25kJ/kg. Assume R for gas = 0.285kJ/kg K and C_p = 1.004 kJ/kg K and the inlet conditions to be at 100kPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe. **(06 Marks)**

OR

4 a. State the two classical statements of the second law of thermodynamics. Indicate all processes on i) P-V and ii) T-S diagrams for a reversible carnot heat engine. **(06 Marks)**

b. A car engine with a power output of 48.47kW has a thermal efficiency of 24%. Determine the fuel consumption rate of this car if the fuel has a heating value of 44000kJ/kg. Express fuel consumption in both kg/s and kg/h. **(05 Marks)**

c. A heat pump is used to maintain the temperature of a house at 20°C. On a day when the outdoor air temperature drops to -2°C, the house is estimated to lose heat at a rate of 80000kJ/h. If the heat pump under these conditions has a COP of 2.5, determine: i) The power consumed by the heat pump ii) The rate at which heat is absorbed from the cold outdoor air. **(05 Marks)**

Module-3

5 a. What are internally and externally reversible processes? List the factors causing irreversibilities. **(04 Marks)**

b. Explain "The reversed carnot cycle" on a P-V diagram. State "Carnot Principles" pertaining to thermal efficiency of reversible and irreversible (actual) heat engines. **(06 Marks)**

c. A heat source at 800K loses 2000kJ of heat of a sink at i) 500K and ii) 750K. Determine which heat transfer process is more irreversible. **(06 Marks)**

OR

6 a. State and prove Clausius in equality. **(05 Marks)**

b. Discuss "The increase of entropy principle" and entropy generation applying Clausius inequality to a cyclic process. **(05 Marks)**

c. One kg steam at 2.0 bar and quality 0.9 is heated in a rigid vessel to a temperature of 400°C. Calculate the final pressure and change in entropy of steam. **(06 Marks)**

Module-4

7 a. Define:

i) Available energy
ii) Unavailable energy
iii) Dead state
iv) Maximum useful work
v) Second law efficiency. **(10 Marks)**

b. In a certain process, a vapour while condensing at 420°C, transfers heat to water evaporating at 250°C. The resulting steam is used in a power cycle which rejects heat at 35°C. What is the fraction of the available energy in the heat transferred from the process vapour at 420°C that is lost due to the irreversible heat transfer at 250°C? Represent the process on a T-S diagram. **(06 Marks)**

OR

8 a. Define: i) Triple point ii) Subcooled liquid. **(04 Marks)**

b. Sketch and explain throttling calorimeter. Also plot throttling process on T-S and h-s plots. **(06 Marks)**

c. A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **(06 Marks)**

Module-5

9 a. State Dalton's law of partial pressures and define

i) Mole fraction ii) Gas constant for the mixture iii) Density of the mixture. **(08 Marks)**

b. A certain gas has $C_p = 1.968$ and $C_v = 1.507$ kJ/kg K. Find its molecular weight and the gas constant. A constant volume chamber of $0.3m^3$ capacity contains 2kg of this gas at 5°C. Heat is transferred to the gas until the temperature is 100°C. Find the work done, the heat transferred, and the changes in internal energy, enthalpy and entropy. **(08 Marks)**

OR

10 a. Plot generalized compressibility chart and explain. **(06 Marks)**

b. Show that for an ideal gas $C_p - C_v = R$ **(04 Marks)**

c. Define i) Relative Humidity ii) Specific humidity iii) Wet bulb temperature. **(06 Marks)**

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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.*

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 $x = r\cos\theta$, $y = r\sin\theta$ 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. $\frac{dy}{dx} = \frac{y/x}{1 + y/x}$. (06 Marks)

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

OR

10 a. Find the solution of : $\frac{dy}{dx} = \frac{x^3}{y^3}$. (05 Marks)

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

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

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