CBCS SCHEME

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21MAT31

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Transform Calculus, Fourier Series and Numerical Techniques

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the Laplace transform of $te^{2t} - \frac{2\sin 3t}{t}$. **(06 Marks)**

b. Given that $f(t) = \begin{cases} E, & 0 < t < a/2 \\ -E, & a/2 < t < a \end{cases}$

where $f(t + a) = f(t)$ show that $L\{f(t)\} = \frac{E}{S}\tan h\left(\frac{as}{4}\right)$. **(07 Marks)**

c. Using convolution theorem obtain the inverse. Laplace transform of the following function : $\frac{1}{(s-1)(s^2+1)}$. **(07 Marks)**

OR

2 a. Find the inverse Laplace transform of : $\frac{s+5}{s^2-6s+13}$. **(06 Marks)**

b. Express the following function interms of unit step function and hence find their Laplace transform.

$$f(t) = \begin{cases} 1, & 0 < t < 1 \\ t, & 1 < t \le 2 \\ t^2 & t > 2. \end{cases}$$

(07 Marks)

c. Solve the following intial value problem by using Laplace transform :

$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 4y = e^{-t}, y(0) = 0, y'(0) = 0.$ **(07 Marks)**

Module-2

3 a. Obtain Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2\pi$. Hence deduce that

$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \text{------} = \frac{\pi}{4}$. **(06 Marks)**

b. Find a cosine Fourier series for $f(x) = (x-1)^2$, $0 \le x \le 1$. **(07 Marks)**

c. Obtain the Fourier series of y upto the First harmonic for the following values.

x°	45	90	135	180	225	270	315	360
y	4.0	3.8	2.4	2.0	–1.5	0	2.8	3.4

(07 Marks)

OR

4 a. Obtain Fourier series for $f(x)=\begin{cases}\pi x & \text{in } 0\le x\le 1\\ \pi(2-x) & \text{in } 1\le x\le 2\end{cases}$. **(06 Marks)**

b. Obtain the sine half range series for the function : $f(x)=1-\left(\frac{x}{\pi}\right)$ in $0\le x\le\pi$. **(07 Marks)**

c. The following values of y and x are given. Find Fourier series of upto first harmonics.

x	0	2	4	6	8	10	12
y	9.0	18.2	24.4	27.8	27.5	22.0	9.0

(07 Marks)

Module-3

5 a. If $f(x)=\begin{cases}1-x^2, & |x|<1\\ 0, & |x|\ge 1\end{cases}$. Find Fourier transform of f(x) and hence find the value of $\int_0^\infty \frac{x\cos x-\sin x}{x^3}\,dx$. **(06 Marks)**

b. Find the Fourier sine transform of $f(x)=e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2}dx,\ m>0$. **(07 Marks)**

c. Solve by using Z-Transforms $U_{n+2}+2U_{n+1}+U_n=n$ with $U_0=0=U_1$. **(07 Marks)**

OR

6 a. Obtain the Fourier cosine transform of the function : $f(x)=\begin{cases}4x, & 0<x<1\\ 4-x, & 1<x\le 4\\ 0, & x>4.\end{cases}$ **(06 Marks)**

b. Obtain the Z-transform of $\cos n\theta$ and $\sin n\theta$ **(07 Marks)**

c. Compute the inverse Z-transform of $\frac{3z^2+2z}{(5z-1)(5z+2)}$. **(07 Marks)**

Module-4

7 a. Classify the following partial differential equations :

i) $x^2u_{xx}+(1-y^2)u_{yy}=0,\ -\infty<x<\infty,-1<y<1$

ii) $(1+x^2)u_{xx}+(5+2x^2)u_{xt}+(4+x^2)u_{tt}=0$

iii) $(x+1)u_{xx}-2(x+2)u_{xy}+(x+3)u_{yy}=0$. **(10 Marks)**

b. Solve $u_t=u_{xx}$ subject to the conditions u(0, t) = 0 = u(1, t) and u(x, 0) = sin(πx) by taking h = 0.2 for 5 levels. Further write down the following values from the table

i) u(0.2, 0.04)

ii) u(0.4, 0.08)

iii) u(0.6m 0.06). **(10 Marks)**

OR

8 a. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square Mesh with boundary values as shown. Find the iterative values of u_i(1 to 9) to the nearest integer.

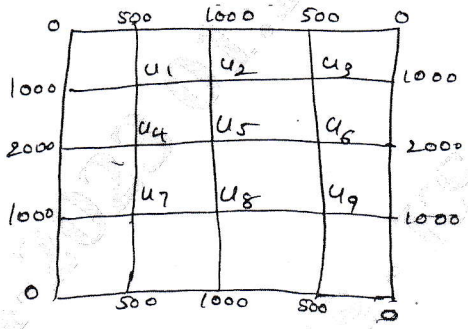

Fig.Q8(a) **(10 Marks)**

b. Solve $25u_{xx} = u_{tt}$ at the pivotal points given $u(0, t) = 0 = u(5, t)$, $u_t(x, 0) = 0$ and $u(x,0) = \begin{cases} 20x, & 0 \le x \le 1 \\ 5(5-x), & 1 \le x \le 5 \end{cases}$ by taking $h = 1$ compute $u(x, t)$ for $0 \le t \le 1$. **(10 Marks)**

Module-5

9 a. Given $y'' - xy' - y = 0$ with the initial conditions $y(0) = 1$, $y'(0) = 0$ compute $y(0.2)$ using fourth order Runge – Kutta method. **(06 Marks)**

b. Derive the Euler's equation. **(07 Marks)**

c. Find the extremal of the functional.

$$\int_{x_1}^{x_2} (y^2 + y'^2 + 2ye^x)dx .$$ **(07 Marks)**

OR

10 a. Obtain the solution of the equation $2\frac{d^2y}{dx^2} = 4x + \frac{dy}{dx}$ by computing the value of $y(1.4)$ by applying Milne's method using following data :

x	1	1.1	1.2	1.3
y	2	2.2156	2.4649	2.7514
y'	2	2.3178	2.6725	3.0657

(06 Marks)

b. Find the curve on which the functional $\int_0^1 [y']^2 + 12xy]dx$ with $y(0) = 0$ and $y(1) = 1$ can be determined. **(07 Marks)**

c. Prove that the shortest distance between two points in a plane is straight line. **(07 Marks)**

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21ME32

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Metal Casting, Forming And Joining Processes

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define pattern and explain with neat sketches any four pattern allowances. **(10 Marks)**

b. Explain with a neat sketch sand slinger. **(10 Marks)**

OR

2 a. Explain with a neat sketch investment moulding process. **(10 Marks)**

b. Explain in detail the procedure to determine the permeability member of green sand in foundry lab. **(10 Marks)**

Module-2

3 a. Explain with a neat sketch cupola furnace showing different zones. **(10 Marks)**

b. Explain with a neat sketch coreless induction furnace. **(10 Marks)**

OR

4 a. Explain with a neat sketch continuous casting process. **(10 Marks)**

b. Explain with a neat sketch any five casting defects. **(10 Marks)**

Module-3

5 a. Explain the following yield criteria :
i) Tresca yield criterion ii) Von Mises Yield criterion. **(10 Marks)**

b. Explain temperature factor in metal forming and also write the comparison between hot working and cold working process. **(10 Marks)**

OR

6 a. Derive an expression for forging pressure and load by slab analysis. **(10 Marks)**

b. Explain the following sheet metal forming processes with neat sketch.
i) Blanking ii) Piercing iii) Bending. **(10 Marks)**

Module-4

7 a. Explain with a neat sketch Oxy-Acetylene gas welding process. **(10 Marks)**

b. Explain with a neat sketch types of flames produced in Oxy – Acetylene welding process. **(10 Marks)**

OR

8 a. Explain with a neat sketch Manual metal arc welding and also mention advantages disadvantages and applications. **(10 Marks)**

b. Explain with a neat sketch Metal Inert Gas (MIG) welding, mention its advantages, disadvantages and applications. **(10 Marks)**

Module-5

9 a. Explain with neat sketch shrinkage in welded structures. **(10 Marks)**

b. Explain with a neat sketch any five welding defects. **(10 Marks)**

OR

10 a. Write short note for the following : i) Soldering ii) Brazing. **(10 Marks)**

b. Explain with a neat sketch resistance spot welding process. **(10 Marks)**

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21ME33

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Classify engineering materials and compare crystalline solids and non-crystalline solids. **(07 Marks)**

b. What are voids? Explain Tetrahedral voids and octahedral voids with suitable diagrams. **(08 Marks)**

c. Briefly explain the steps to prepare a specimen for microstructural examinations. **(05 Marks)**

OR

2 a. What is meant by imperfections in solids? Explain edge dislocation and screw dislocation. **(10 Marks)**

b. In crystallography, what is the theme of symmetry operation? Explain two fold and three fold rotation. **(06 Marks)**

c. Define Planar Atomic Density and Atomic Packing Factor. **(04 Marks)**

Module-2

3 a. Define solid solution. Describe the classification of solid solution. **(07 Marks)**

b. Draw iron-carbon equilibrium diagram. Explain various phases and locate invariant points. **(08 Marks)**

c. Explain the method of measuring hardness in Rockwell Hardness test machine. **(05 Marks)**

OR

4 a. With a neat sketch, explain Fick's 1st and 2nd law of diffusion. **(08 Marks)**

b. The solidus and liquidus temperatures for an alloy system containing two metals A and B which are completely soluble in liquid and solid states are presented in the table below. Metal 'A' melts at 1080°C and metal 'B' melts at 1450°C.

(i) Construct the phase diagram for the system and label all regions.

(ii) Predict the number, type, relative amounts and composition of phases present in an alloy containing 60% A and 40% B at 1250°C.

Sl. No.	Alloy composition (Wt %)	Solidus temp °C	Liquidus temp °C
1	90% A	1100°C	1175 °C
2	60% A	1160°C	1290 °C
3	20% A	1310°C	1400 °C

(12 Marks)

Module-3

5 a. Deduce the expression for critical radius of nucleation. **(07 Marks)**

b. Draw and explain the process of flame hardening. **(06 Marks)**

c. Explain the test procedure of creep test. **(07 Marks)**

OR

6 a. Explain normalizing heat treatment process. Also compare normalizing heat treatment with annealing. **(08 Marks)**

b. Explain the concept of mechanisms behind strengthening in metals. Also explain strengthening by grain size reduction. **(07 Marks)**

c. Explain Hardening heat treatment in brief. **(05 Marks)**

Module-4

7 a. Explain common types of coatings techniques in brief. **(10 Marks)**

b. Briefly explain different types of mechanical methods of powder production techniques. **(10 Marks)**

OR

8 a. What is meant by sintering process? Explain liquid phase and activated sintering. **(07 Marks)**

b. How the particle size and particle shape influences the characterization of metal powders? **(06 Marks)**

c. Explain the wear test and state the important of conducting wear test. **(07 Marks)**

Module-5

9 a. Explain the need for material selection process in design. **(05 Marks)**

b. What are the different types of design? Explain each type. **(07 Marks)**

c. Explain the procedure for measuring hardness by Brinell's Hardness testing equipment. **(08 Marks)**

OR

10 a. What are the different functional properties of material? Explain thermal properties. **(06 Marks)**

b. Describe in brief about the factors affecting the selection of materials. **(06 Marks)**

c. The following data is noted in a tensile test. Diameter of specimen = 200 mm, extension under a load of 10 kN = 0.035 mm, load at yield point = 110 kN, maximum load = 190 kN. Length of specimen after failure = 255 mm, Neck dia = 12.25 mm. Determine :

(i) Young's modulus (ii) Yield stress (iii) Ultimate stress

(iv) Percentage elongation (v) Percentage reduction in area **(08 Marks)**

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21ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of thermodynamic data hand book is permitted.***

Module-1

1 a. State zeroth law of thermodynamics. Explain its significance. **(06 Marks)**

b. What are the similarities and dissimilarities between work transfer and heat transfer? **(06 Marks)**

c. A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid for an initial volume of 0.05 m^3 and draw a neat PV diagram. **(08 Marks)**

OR

2 a. Define Heat and Work from thermodynamic point of view. **(06 Marks)**

b. A temperature scale of certain thermometer is given by the relation $t = a\ln p + b$ where a and b are constants and p is the thermometric property of the fluid in the thermometer. If at the ice point and steam point the thermometric properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property of 3.5 on Celsius scale. **(06 Marks)**

c. Apply steady flow energy equation to each of the following:
(i) Nozzle (ii) Boiler (iii) Turbine (iv) Pump **(08 Marks)**

Module-2

3 a. Prove that Kelvin-Plank statement and Clausius statements of second law of thermodynamic are equivalent. **(10 Marks)**

b. Two reversible heat engines A and B are arranged in series, A rejecting heat to B through the intermediate reservoir. Engine A receives 2000 kJ at a temperature of 421°C from a heat source, while engine B is in communication with a cold sink at a temperature of 4.4°C. If work output of A is twice that of B. Find :
(i) The intermediate temperature between A and B
(ii) Efficiency of each engine
(iii) The heat rejected to the cold sink **(10 Marks)**

OR

4 a. State and explain the Carnot cycle with PV and TS diagram. **(06 Marks)**

b. Obtain a relation between COP's of a refrigerator and heat pump. **(04 Marks)**

c. Define entropy. State and prove Clausius inequality. **(10 Marks)**

Module-3

5 a. Explain the following:
(i) Generalized compressibility chart
(ii) Law of corresponding states
(iii) Compressibility factor **(10 Marks)**

b. One kg of CO_2 has a volume of 1 m^3 at 100°C. compute the pressure by:
(i) Vander Waal's equation (ii) Perfect gas equation **(10 Marks)**

OR

6 a. Explain the following terms with reference to a combustion process:
(i) Enthalpy of formation (ii) Adiabatic flame temperature
(iii) Enthalpy of combustion (iv) Heat of reaction **(08 Marks)**

b. Methane is burned with atmospheric air. The analysis of the products on a dry basis is as follows: $CO_2 = 10\%$, $O_2 = 2.37\%$, $CO = 0.53\%$, $N_2 = 87.10\%$
(i) Determine the combustion equation
(ii) Calculate the air-fuel ratio
(iii) Percentage theoretical air **(08 Marks)**

c. Write Maxwell relations and explain the terms involved. **(04 Marks)**

Module-4

7 a. Explain P-T diagram for water. **(06 Marks)**

b. Explain the working of a practical regenerative Rankine cycle and derive the efficiency of the cycle. **(08 Marks)**

c. In a steam power cycle, the steam supply is at 15 bar and dry and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **(06 Marks)**

OR

8 a. Explain reheat vapour cycle and derive an expression for the reheat cycle efficiency, state the advantages. **(10 Marks)**

b. A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Find the following:
(i) The pressure (ii) The mass (iii) Specific volume
(iv) Specific enthalpy (v) Specific entropy (vi) Specific internal energy **(10 Marks)**

Module-5

9 a. Derive the expression for the air standard efficiency of a diesel cycle. State the assumptions made. **(10 Marks)**

b. Explain the different methods of improving the efficiency of Brayton cycle. **(10 Marks)**

OR

10 a. Air enters the compressor of a gas turbine plant operating on Brayton cycle at 101.325 kPa, 27°C. The pressure ratio in the cycle is 6. Calculate the max temperature in the cycle and the cycle efficiency. Assume $W_T = 2.5\ W_C$, where W_T = turbine work, W_C = compressor work. Take Y = 1.4. **(10 Marks)**

b. Derive the expression for M.E.P of Otto cycle. **(10 Marks)**

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