CBCS SCHEME

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21MAT31

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Transform Calculus Fourier Series & 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, (i) $e^{-3t}\sin 5t.\cos 3t$ (ii) $\frac{e^{at}-e^{bt}}{t}$. **(06 Marks)**

b. If a periodic function of period 'a' is defined by $f(t)=\begin{cases} E, & \text{for } 0<t<\frac{a}{2} \\ -E, & \text{for } \frac{a}{2}<t<a \end{cases}$ then show that $L\{f(t)\}=\frac{E}{S}\tanh\left(\frac{as}{4}\right)$. **(07 Marks)**

c. Using convolution theorem find the inverse Laplace transform of $\frac{s}{(s+2)(s^2+9)}$. **(07 Marks)**

OR

2 a. Express the function $f(t)=\begin{cases} \cos t & \text{for } 0<t<\pi \\ \cos 2t & \text{for } \pi<t<2\pi \\ \cos 3t & t>2\pi \end{cases}$ interms of unit step function and hence find its Laplace transform. **(07 Marks)**

b. Find the inverse laplace transform of $\frac{2s^2-6s+5}{s^3-6s^2+11s-6}$. **(06 Marks)**

c. Solve the differential equation $\frac{d^2y}{dt^2}+4\frac{dy}{dt}+4y=e^{-t}$ with $y(0)=y'(0)=0$ by using Laplace transform. **(07 Marks)**

Module-2

3 a. Find a Fourier series to represent $f(x)=|x|$ in $-\pi\le x\le\pi$. **(06 Marks)**

b. Obtain the half-range cosine series for $f(x)=x\sin x$ in $(0, \pi)$ and hence show that $\frac{\pi-2}{4}=\frac{1}{1.3}-\frac{1}{3.5}+\frac{1}{5.7}-.....\infty$ **(07 Marks)**

c. Express y as a Fourier series up to second harmonics for the following data :

x:	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
y:	1	1.4	1.9	1.7	1.5	1.2	1.0

(07 Marks)

OR

4 a. Obtain the Fourier series expansion for the function, $f(x) = 2x - x^2$ in (0, 2). **(06 Marks)**

b. Find the half range sine series for the function, $f(x) = \begin{cases} \frac{1}{4} - x & \text{for } 0 < x < \frac{1}{2} \\ x - \frac{3}{4} & \text{for } \frac{1}{2} < x < 1 \end{cases}$ **(07 Marks)**

c. The following table gives the variation of periodic current over period :

t sec :	0	$\frac{T}{6}$	$\frac{T}{3}$	$\frac{T}{2}$	$\frac{2T}{3}$	$\frac{5T}{6}$	T
A (amp) :	1.98	1.30	1.05	1.30	−0.88	−0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic. **(07 Marks)**

Module-3

5 a. Find the Fourier transform of the function $f(x) = \begin{cases} 1 - x^2 & \text{for } |x| \le 1 \\ 0 & \text{for } |x| > 1 \end{cases}$. Hence evaluate $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3} \right) dx$. **(06 Marks)**

b. Find the Fourier sine and cosine transform of $f(x) = \begin{cases} x & \text{if } 0 < x < 1 \\ 2 - x & \text{if } 1 < x < 2 \\ 0 & \text{otherwise} \end{cases}$. **(07 Marks)**

c. Find the z-transform of $\cosh\left(n\frac{\pi}{2} + \theta \right)$. **(07 Marks)**

OR

6 a. Find the Fourier sine transform of $f(x) = e^{-ax}$, a>0. **(06 Marks)**

b. Find the inverse z transform of $\frac{18z^2}{(2z-1)(4z+1)}$. **(07 Marks)**

c. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = z^n$ with $u_0 = u_1 = 0$ using z-transform. **(07 Marks)**

Module-4

7 a. Classify the following partial differential equations :

(i) $\frac{\partial^2 u}{\partial x^2} + 4\frac{\partial^2 u}{\partial x \partial y} + 4\frac{\partial^2 u}{\partial y^2} - \frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0$.

(ii) $x^2 \frac{\partial^2 u}{\partial x^2} + (1 - y^2)\frac{\partial^2 u}{\partial y^2} = 0$, $-\infty < x < \infty$, $-1 < y < 1$.

(iii) $(1 + x^2)\frac{\partial^2 u}{\partial x^2} + (5 + 2x^2)\frac{\partial^2 u}{\partial x \partial t} + (4 + x^2)\frac{\partial^2 u}{\partial t^2} = 0$.

(iv) $(x + 1)\frac{\partial^2 u}{\partial x^2} - 2(x + 2)\frac{\partial^2 u}{\partial x \partial y} + (x + 3)\frac{\partial^2 u}{\partial y^2} = 0$. **(10 Marks)**

b. Evaluate the values at the mesh points for the equation $u_{tt} = 16u_{xx}$ taking h = 1 upto t = 1.25. The boundary conditions are u(0, t) = u(5, t) = 0 and the initial conditions are $u(x, 0) = x^2(5 - x)$ and $u_t(x, 0) = 0$. **(10 Marks)**

OR

8 a. Using Schmidt two-level formula to solve the equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ under the conditions,

(i) $u(0, t) = u(1, t) = 0 \quad t \geq 0$

(ii) $u(x, 0) = \sin \pi x, \quad 0 < x < 1$ by taking $h = \frac{1}{4}$ and $\alpha = \frac{1}{6}$ co. **(10 Marks)**

b. Solve the two-dimensional Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ at the interior mesh points of the square region and the values of u at the mesh points on the foundary are shown in Fig.Q8 (b).

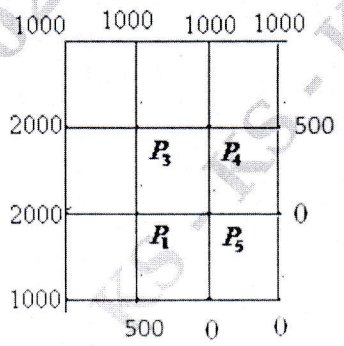

Fig. Q8 (b) **(10 Marks)**

Module-5

9 a. Using Runge-Kutta method of 4th order to solve the differential equation $\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} - 4y = 0$ with y(0) = 0.2 and $y'(0) = 0.5$ for x = 0.1. Correct to four decimal places. **(07 Marks)**

b. State and prove Euler's equation. **(07 Marks)**

c. Find the extremal of the functional $I = \int_0^{\frac{\pi}{2}} (y^2 - y'^2 - 2y\sin x)dx$ under the end conditions

$y(0) = 0, \; y\left(\frac{\pi}{2}\right) = 0$ **(06 Marks)**

OR

10 a. Apply Milne's method to compute y(0.3). Given that $\frac{d^2y}{dx^2} = 1 - 2y\frac{dy}{dx}$ and $y(0) = 0$, $y(0.2) = 0.02$, $y(0.4) = 0.0795$, $y(0.6) = 0.1762$, $y'(0) = 0$, $y'(0.2) = 0.1996$, $y'(0.4) = 0.3937$, $y'(0.6) = 0.5689$ **(07 Marks)**

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

c. Find the extremal of the functional $I = \int_{x_1}^{x_2} (y^2 + y'^2 + 2ye^x)dx$ **(06 Marks)**

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21ME32

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Metal Casting, Forming and Joining Process

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What is pattern? Classify the types of pattern explain any one pattern used in casting with sketch. **(10 Marks)**

b. List the types of base sand and explain the requirement of base sand. **(10 Marks)**

OR

2 a. Explain the jolt machine and squeeze machine used in moulding process with sketch. **(10 Marks)**

b. Discuss the CO_2 moulding process with neat sketch and list advantages and disadvantages. **(10 Marks)**

Module-2

3 a. Explain working principle of Direct electric arc furnace with neat sketch. **(10 Marks)**

b. Explain working principle of Coreless induction furnace with neat sketch. **(10 Marks)**

OR

4 a. Define pressure die casting? Explain the hot chamber die casting neat sketch. **(10 Marks)**

b. Explain the working principle of centrifugal casting and squeeze casting with neat sketch. **(10 Marks)**

Module-3

5 a. Differentiate between Hot working and Cold working of metal forming. **(10 Marks)**

b. What is forging? Explain the open die forging and closed die forging with neat sketch. **(10 Marks)**

OR

6 a. Explain Tendem Rolling mill and planetary rolling mill with neat sketch. **(10 Marks)**

b. Explain with neat sketch :
i) Direct extrusion ii) Hydrostatic extrusion. **(10 Marks)**

Module-4

7 a. Explain the oxy-acetylene gas welding and its types of flames with neat sketches. **(10 Marks)**

b. Sketch and explain Tungsten Inert Gas (TIG) welding and list its advantages and disadvantages. **(10 Marks)**

OR

8 a. Explain the manual metal arc welding with neat sketch and list its advantages, disadvantages and applications. **(10 Marks)**

b. Explain the Submerged Arc Welding (SAW) with neat sketch and list advantages, disadvantages and applications. **(10 Marks)**

Module-5

9	a.	Distinguish between Soldering, Brazing and Welding.	**(10 Marks)**
	b.	Explain the friction stir welding and resistance welding with neat sketch.	**(10 Marks)**

OR

10	a.	Explain the welding defects, causes and remedies with suitable sketches.	**(10 Marks)**
	b.	Write a short notes on: i) Concept of welding ii) Thermal effects of welding.	**(10 Marks)**

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21ME33

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
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. Clearly differentiate between Crystalline solids and Amorphous solids. **(06 Marks)**

b. What is meant by atomic packing factor? Find the atomic packing factor for hexagonal close packed unit cells. **(08 Marks)**

c. Explain clearly the classification of voids. **(06 Marks)**

OR

2 a. Explain the crystal structure analysis using X-ray diffraction method. Also define Bragg's law. **(08 Marks)**

b. Explain different types of point imperfections with neat sketches. **(06 Marks)**

c. Differentiate between edge dislocation and screw dislocations. **(06 Marks)**

Module-2

3 a. Explain different types of solid solutions with sketches. Also explain Home Rothery Rules for formation of solid solution. **(10 Marks)**

b. State and explain Fick's laws of diffusion. Also explain factors affecting diffusion. **(10 Marks)**

OR

4 a. Explain with a neat sketch solid solution phase diagram. **(08 Marks)**

b. Draw the iron-carbon diagram and label all the phases, temperatures and invariant points on it. **(08 Marks)**

c. Explain the Gibb's phase rule. **(04 Marks)**

Module-3

5 a. Define homogeneous nucleation. Derive the expression for critical radius and activation energy in homogeneous nucleation. **(10 Marks)**

b. Explain the mechanism of plaster deformation by slip and twinning. **(10 Marks)**

OR

6 Explain the following :

a. Annealing

b. Normalising

c. Hardening

d. Tempering **(20 Marks)**

Module-4

7 a. With a neat sketch, explain the physical vapor deposition technique. **(08 Marks)**

b. Discuss the different surface coating materials used for different applications. **(06 Marks)**

c. With a neat sketch, explain the electro deposition method of coating metal surfaces. **(06 Marks)**

OR

8 a. Explain briefly the production of metal powders. **(10 Marks)**

b. Explain with neat sketches the different compacting techniques. **(10 Marks)**

Module-5

9 a. Write a brief note on general procedure used in design. **(06 Marks)**

b. Briefly discuss the factors influencing the selection of suitable material for design. **(06 Marks)**

c. Discuss the important mechanical properties of engineering materials. **(08 Marks)**

OR

10 a. Draw the stress-strain curve for mild steel and explain the salient points. **(08 Marks)**

b. Briefly explain codes and standards in design. **(06 Marks)**

c. Briefly discuss the selection of manufacturing methods. **(06 Marks)**

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21ME34

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Steam tables may be permitted.

Module-1

1 a. What is meant by thermometric property? Elucidate with a neat sketch of thermocouple type and vapor pressure thermometers. **(10 Marks)**

b. Define a thermodynamic system. Differentiate between open system, closed system and an isolated system. **(06 Marks)**

c. Explain the following terms : i) State ii) Process iii) Cycle. **(04 Marks)**

OR

2 a. A fluid is contained in a cylinder by a spring loaded, friction less piston so that the pressure in the fluid is a linear function of the volume (p = a + bv). The internal energy of the fluid is given by the following equation: U = 42 + 3.6pV, where U is in kJ, P in kPa and V in cubic metre. If the fluid changes from an initial state of 190kPa, 0.035m^3 to a final state of 420 kPa, 0.07m^3, with no work other than that done on the piston. Find the direction and magnitude of the work and heat transfer. **(10 Marks)**

b. State and explicate the Steady Flow Energy Equations (S.F.E.E) with engineering applications. **(06 Marks)**

c. In an internal combustion engine, during the compression stroke the heat rejected to the cooling water is 50kJ/kg and the work input is 100kJ/kg. Calculate the change in internal energy of the working fluid stating whether it is a gain or loss. **(04 Marks)**

Module-2

3 a. Describe the working of a carnot cycle with a P-V diagram. **(10 Marks)**

b. Enumerate the Clausius inequality with a layout diagram. **(06 Marks)**

c. Define heat engine, refrigerator and heat pump. **(04 Marks)**

OR

4 a. A reversible heat engine operates between two reservoirs at temperature 727°C and 27°C, the engine drives a reversible refrigerator which working between reservoirs at temperature of 27°C and -20°C. The heat absorbed by engine is 2600kJ and the net work output of combined engine refrigerator plant is 500kJ. Determine the heat transfer to the refrigerant and the net heat transfer to the reservoir at 27°C. **(10 Marks)**

b. Define:
i) PMM I
ii) PMM II
iii) Thermal Energy Reservoirs (TET)
iv) Available energy and unavailable energy. **(06 Marks)**

c. What do you mean by the term 'Entropy'? Prove that entropy is a property of a system. **(04 Marks)**

Module-3

5 a. Derive the Maxwell's relations and explain their importance in thermodynamics. **(10 Marks)**

b. Brief about the Clausius-Clapeyron equation for evaporation of liquids. **(06 Marks)**

c. Explicate the Joule Kelvin effect and its significance in engineering applications. **(04 Marks)**

OR

6 a. With a neat sketch, expound the flue gas analysis apparatus. (Orsat apparatus). **(10 Marks)**

b. Dry exhaust gases from an oil engine have the following composition by volume carbon dioxide 8.85%, carbon monoxide 1.2%, oxygen 6.8% and nitrogen 83.15%. The fuel oil has a percentage composition of mass as carbon 82%, hydrogen 14% and oxygen 2%. Determine : i) Mass of carbon per kg of flue gas ii) Air fuel ratio. **(06 Marks)**

c. Define compressibility factor, compressibility chart and its applications. **(04 Marks)**

Module-4

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

b. What amount of heat would be required to produce 4.4kg of steam at a pressure of 6 bar and temperature of 250°C from water at 30°C? Take specific heat for super heated steam as 2.2kJ/kg K. **(06 Marks)**

c. Brief about
i) Triple point and critical point
ii) Mollier chart. **(04 Marks)**

OR

8 a. A steam turbine is fed with steam having an enthalpy of 3100kJ/kg. It moves out of the turbine with an enthalpy of 2100kJ/kg. Feed heating is done at a pressure of 3.2 bar with steam enthalpy of 2500kJ/kg. The condensate from a condenser with an enthalpy of 125kJ/kg enters into the feed heater. The quantity of bled steam is 11200 kg/h. Find the power developed by turbine. Assume that the water leaving the feed heater is saturated liquid at 3.2 bar and the heater is direct mixing type neglect pump work. **(10 Marks)**

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

c. State the advantages of regenerative cycle and reheat cycle over the simple ranking cycle. **(04 Marks)**

Module-5

9 a. Derive the Otto cycle with P-V diagram and compare with diesel and duel cycle efficiency and compression ratio. **(10 Marks)**

b. The minimum pressure and temperature in an Otto cycle are 100kPa and 27°C. The amount of heat added to the air per cycle is 1500kJ/kg.

i) Determine the pressures and temperatures at all points of the air standard otto cycle.

ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8:1.

Take for air : $C_V = 0.72$kJ/kg K, and $\gamma = 1.4$. **(06 Marks)**

c. Brief about the Ericsson cycle with applications. **(04 Marks)**

OR

10 a. Explicate briefly about the Brayton cycle. Derive expression for optimum pressure ratio. **(10 Marks)**

b. In a gas turbine power plant, the air enters the compressor at 1.0 bar and 20°C. The pressure of air leaving the compressor is 3.5 bar and the temperature at turbine inlet is 600°C. Determine per kg of air:

i) Efficiency of the cycle

ii) Heat supplied to air

iii) Work available at the shaft. **(06 Marks)**

c. What are the methods for improvement of thermal efficiency of Brayton cycle and explain any one method. **(04 Marks)**

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