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MATDIP301

Third Semester B.E. Degree Examination, December 2011

Advanced Mathematics - I

Time: 3 hrs. Max. Marks:100

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

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

b. Find the modulus and amplitude of $\frac{(3-\sqrt{2}i)^2}{1+2i}$. **(07 Marks)**

c. Find the real part of $\frac{1}{1+\cos\theta+i\sin\theta}$. **(07 Marks)**

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

b. If $y=(\sin^{-1}x)^2$, show that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$. **(07 Marks)**

c. Find the nth derivative of $\frac{x+2}{x+1}+\log\left(\frac{x+2}{x+1}\right)$. **(07 Marks)**

3 a. State and prove Euler's theorem. **(06 Marks)**

b. Given $u=\sin\left(\frac{x}{y}\right)$, $x=e^t$, $y=t^2$, find $\frac{du}{dt}$ as a function of t. **(07 Marks)**

c. If $x=r\cos\theta$, $y=r\sin\theta$, find $\frac{\partial(x,y)}{\partial(r,\theta)}$ and $\frac{\partial(r,\theta)}{\partial(x,y)}$. **(07 Marks)**

4 a. Find the angle of intersection of the curves $r=a(1+\cos\theta)$ and $r=b(1-\cos\theta)$. **(06 Marks)**

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

c. Expand $e^{\sin x}$ by Maclaurin's series upto the term containing x^4. **(07 Marks)**

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

b. Evaluate : $\int_1^5\int_1^{x^2}x(x^2+y^2)dx\,dy$. **(07 Marks)**

c. Evaluate : $\int_0^1\int_0^2\int_1^2 x^2yz\,dx\,dy\,dz$. **(07 Marks)**

6 a. Prove that $\beta(m, n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$. **(06 Marks)**

b. Show that $\Gamma(n) = \int_0^1 \left(\log\dfrac{1}{x}\right)^{n-1} dx$. **(07 Marks)**

c. Express $\int_0^{\pi/2} \sqrt{\tan\theta}\, d\theta$ in terms of Gamma function. **(07 Marks)**

7 a. Solve : $\dfrac{dy}{dx} = \dfrac{x(2\log x + 1)}{\sin y + y\cos y}$. **(06 Marks)**

b. Solve : $(1 + e^{x/y})dx + e^{x/y}\left(1 - \dfrac{x}{y}\right)dy = 0$. **(07 Marks)**

c. Solve : $(x^2 - ay)dx = (ax - y^2)dy$. **(07 Marks)**

8 a. Solve : $\dfrac{d^4y}{dx^4} + 8\dfrac{d^2y}{dx^2} + 16y = 0$. **(06 Marks)**

b. Solve : $(D-2)^2 y = 8(e^{2x} + \sin 2x)$. **(07 Marks)**

c. Solve : $(D^3 + 4D)y = \sin 2x$. **(07 Marks)**

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10MAT/PM/TL/MA31

Third Semester B.E. Degree Examination, December 2011
Engineering Mathematics – III

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Missing data will be suitably assumed.***

PART – A

1 a. Obtain the Fourier series for the function $f(x)=\begin{cases}\pi x & : 0\le x\le 1\\ \pi(2-x) & : 1\le x\le 2\end{cases}$ and deduce that $\frac{\pi^2}{8}=\sum_{n=1}^{\infty}\frac{1}{(2n-1)^2}$. **(07 Marks)**

b. Obtain the half range Fourier sine series for the function. **(07 Marks)**

$f(x)=\begin{cases}1/4-x\ ;\ 0<x<1/2\\ x-3/4\ ;\ 1/2<x<1\end{cases}$.

c. Compute the constant term and the first two harmonics in the Fourier series of f(x) given by the following table. **(06 Marks)**

x	:	0	1	2	3	4	5
f(x)	:	4	8	15	7	6	2

2 a. Find the Fourier transform of $f(x)=\begin{cases}1-x^2 & \text{for } |x|\le 1\\ 0 & \text{for } |x|>1\end{cases}$ and hence evaluate $\int_0^{\infty}\left(\frac{x\cos x-\sin x}{x^3}\right)\cos\frac{x}{2}dx$. **(07 Marks)**

b. Find the Fourier cosine transform of $f(x)=\frac{1}{1+x^2}$. **(07 Marks)**

c. Solve the integral equation $\int_0^{\infty}f(\theta)\cos\alpha\theta d\theta=\begin{cases}1-\alpha\ ;\ 0\le\alpha\le 1\\ 0\ ;\ \alpha>1\end{cases}$. Hence evaluate $\int_0^{\infty}\frac{\sin^2 t}{t^2}dt$. **(06 Marks)**

3 a. Solve two dimensional Laplace equation $u_{xx}+u_{yy}=0$, by the method of separation of variables. **(07 Marks)**

b. Solve the one dimensional heat equation $\frac{\partial u}{\partial t}=\frac{c^2\partial^2 u}{\partial x^2}$, $0<x<\pi$ under the conditions :

i) $u(0,+)=0, u(\pi,t)=0$ ii) $u(x,0)=u_0\sin x$ where u_0 = constant $\neq 0$. **(07 Marks)**

c. Obtain the D` Alembert's solution of one dimensional wave equation. **(06 Marks)**

4 a. Fit a curve of the form $y=ae^{bx}$ to the following data : **(07 Marks)**

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

b. Using graphical method solve the L.P.P minimize $z=20x_1+10x_2$ subject to the constraints $x_1+2x_2\le 40$; $3x_1+x_2\ge 0$; $4x_1+3x_2\ge 60$; $x_1\ge 0$; $x_2\ge 0$. **(06 Marks)**

c. Solve the following L.P.P maximize $z=2x_1+3x_2+x_3$, subject to the constraints $x_1+2x_2+5x_3\le 19$, $3x_1+x_2+4x_3\le 25$, $x_1\ge 0$, $x_2\ge 0$, $x_3\ge 0$ using simplex method. **(07 Marks)**

PART – B

5 a. Using the Regula – falsi method, find the root of the equation $xe^x = \cos x$ that lies between 0.4 and 0.6. Carry out four iterations. **(07 Marks)**

b. Using relaxation method solve the equations :
$10x - 2y - 3z = 205$; $-2x + 10y - 2z = 154$; $-2x - y + 10z = 120$. **(07 Marks)**

c. Using the Rayleigh's power method, find the dominant eigen value and the corresponding eigen vector of the matrix. $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ starting with the initial vector $[1,1,1]^T$.

(06 Marks)

6 a. From the following table, estimate the number of students who have obtained the marks between 40 and 45 : **(07 Marks)**

Marks	:	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Number of students	:	31	42	51	35	31

b. Using Lagrange's formula, find the interpolating polynomial that approximate the function described by the following table : **(07 Marks)**

x	:	0	1	2	5
f(x)	:	2	3	12	147

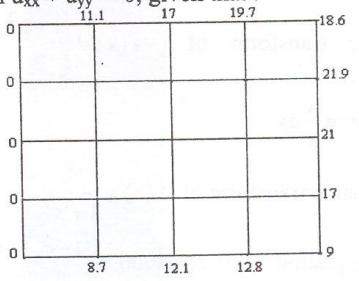
Hence find f(3)

c. A curve is drawn to pass through the points given by the following table :

x	:	1	1.5	2	2.5	3	3.5	4
y	:	2	2.4	2.7	2.8	3	2.6	2.1

Using Weddle's rule, estimate the area bounded by the curve, the x – axis and the lines $x = 1$, $x = 4$. **(06 Marks)**

7 a. Solve the Laplace's equation $u_{xx} + u_{yy} = 0$, given that : **(07 Marks)**



b. Solve $\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}$ subject to $u(0, t) = 0$; $u(4, t) = 0$; $u(x, 0) = x(4 - x)$. Take $h = 1$, $k = 0.5$. **(07 Marks)**

c. Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(x, 0) = \sin \pi x$, $0 \le x \le 1$; $u(0\ t) = u(1, t) = 0$ using Schmidt's method. Carry out computations for two levels, taking $h - 1/3$, $k = 1/36$. **(06 Marks)**

8 a. Find the Z – transform of : i) $(2n-1)^2$ ii) $\cos\left(\frac{n\pi}{2} + \pi/4\right)$ **(07 Marks)**

b. Obtain the inverse Z – transform of $\frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}$. **(07 Marks)**

c. Solve the difference equation $y_{n+2} + 6y_{n+1} + 9y_n = 2n$ with $y_0 = y_1 = 0$ using Z transforms. **(06 Marks)**

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10ME/IP/IM/MA/AU/PM/TL/AE32A

Third Semester B.E. Degree Examination, December 2011
Materials Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Sketch the unit cell of a HCP crystal structure. Calculate the number of atoms per unit cell. Derive an expression for the density of atomic packing. (Given C = 1.633a). **(06 Marks)**

b. Copper has an atomic radius of 1.28×10^{-8} cm, a FCC crystal structure and an atomic weight of 63.5. Calculate its density (Avogadro number = 6.023×10^{23}). **(05 Marks)**

c. Explain the different types of surface imperfections, with neat sketches. **(06 Marks)**

d. State and explain the Fick's second law of diffusion. **(03 Marks)**

2 a. Draw the stress-strain diagram of mild steel and describe how the following properties can be obtained from the diagram:
i) Elastic modulus ii) Ductility iii) Toughness. **(07 Marks)**

b. A cylindrical specimen of steel having an original diameter of 12.8mm is tensile tested to fracture and found to have an engineering fracture strength σ_f of 460 MPa. If its cross-sectional diameter at the fracture is 10.7mm, determine
i) The ductility in terms of percent area reduction ii) The true stress at fracture. **(06 Marks)**

c. Differentiate between the slip and twinning, with neat sketches. **(07 Marks)**

3 a. Explain with a sketch, the ductile to brittle transition in the materials. **(04 Marks)**

b. If the specific surface energy for Al_2O_3 is 0.9 J/m^2, calculate the critical stress required for propagation of an internal crack of length 0.4mm. (E = 393 GPa for Al_2O_3). **(05 Marks)**

c. Draw and explain the S-N curve for steel and aluminium alloy. **(05 Marks)**

d. Define stress relaxation. Derive the corresponding expression. **(06 Marks)**

4 a. Explain the homogeneous nucleation. Discuss the significance of critical radius of the nuclei. **(08 Marks)**

b. Describe the different types of solid solution. **(06 Marks)**

c. State the Gibb's phase rule and explain with a simple example. **(06 Marks)**

PART – B

5 a. Construct a phase diagram for two metals completely soluble in the liquid state but partially soluble in solid state. **(04 Marks)**

b. Draw the iron-carbon equilibrium diagram and label all the parts. **(08 Marks)**

c. With the help of the diagram in 5(b), explain the cooling of steel with 0.6% carbon, showing the microstructure at different stages. **(08 Marks)**

6 a. Draw the TTT diagram for plain carbon eutectoid steel and explain the critical cooling rate. **(07 Marks)**

b. Explain any one type of surface hardening, with sketches. **(06 Marks)**

c. Differentiate between the normalizing and annealing, with sketches. **(07 Marks)**

7 a. Explain the different types of cast iron, with microstructures. **(08 Marks)**

b. Write a short note on the copper alloys. **(08 Marks)**

c. Explain the modification of Al - Si alloy. **(04 Marks)**

8 a. What is a composite material? How is it classified? **(08 Marks)**

b. With a neat sketch, explain any one method for production of fiber reinforced plastic. **(06 Marks)**

c. Briefly discuss the advantages & applications of metal matrix composites(MMCs). **(06 Marks)**

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10ME/IP/IM/MA/AU/TL/PM/AE33

Third Semester B.E. Degree Examination, December 2011
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamic data hand book is allowed.

PART – A

1 a. Distinguish between :
i) Open system and closed system.
ii) Macroscopic and microscopic approaches.
iii) Point function and path function.
iv) Intensive and extensive properties.
v) Diathermic and adiabatic walls. **(10 Marks)**

b. A thermocouple with test junction and T°C as a gas thermometer scale and reference junction at ice point given e.m.f. as $e = 0.20t - 5 \times 10^{-4} t^2$ mV. The milli voltmeter is calibrated at ice and steam point. What will b e the reading on this thermometer, where the gas thermometer reads 70°C? **(10 Marks)**

2 a. Distinguish between heat and work in thermodynamics. **(04 Marks)**

b. A system undergoes a process in which the pressure and volume are related by an equation of the form pv^n = a constant. Derive an expression for displacement work during this process. **(06 Marks)**

c. A cylinder contains 1 kg of certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversible behind a piston according to a law $pv^2 = c$ until the volume is doubled, the fluid is then cooled reversibly at constant pressure until the piston regains its original positions, heat is then supply reversibly with the piston firmly locked in position until the pressure rises to the original value. Calculate the net work done by the fluid for an initial volume of 0.05 m^3. **(10 Marks)**

3 a. Starting from the first law of thermodynamics for a closed system undergoing a non – cyclic process derive the steady state, steady flow energy equation for a control volume (open system). **(06 Marks)**

b. The work and heat transfer per degree temperature change for a system executes a steady non – flow process are given by $\frac{dW}{dT} = \frac{1}{8}$ kJ/°C and $\frac{dQ}{dT} = 0.4$ kJ/°C. Determine the change in internal energy of the system, when the temperature increases from 100°C to 260°C. **(05 Marks)**

c. A fluid contained in a cylinder by a spring loaded frictionless piston so that the pressure in the fluid is the linear function of volume, P = a + bv. The internal energy of the fluid is given by u = 34 + 3.15 PV, where u is in kJ, p is in kPa and v is in m^3. If the fluid changes from 170 kPa, 0.03m^3 to a final state of 400 kPa and 0.06m^3 with no work other than that done on the piston. Find the magnitude and direction of heat and work transfers. **(09 Marks)**

4 a. State and prove that Kelvin planck and Clausius statements of second law of thermodynamics are equivalent. **(10 Marks)**

b. A reversible engine working in a cycle takes 4800 kg/min of heat from a source at 800 K and develops 20 kW power. The engine rejects heat to two reservoirs at 300 K and 360 K. Determine the heat rejected to each sink. **(10 Marks)**

PART – B

5 a. Show that entropy is a property. **(05 Marks)**

b. State and prove Clausius inequality. **(08 Marks)**

c. A heat engine absorbs 200 kJ/sec of heat at 227°C and rejects heat at 27°C. Three separate case of heat rejection are reported.

i) 180 kJ/sec heat is rejected.

ii) 120 kJ/sec heat is rejected.

iii) 60 kJ/sec heat is rejected.

Classify each cycle. **(07 Marks)**

6 a. Define the following :

i) Pure substance

ii) Triple point

iii) Critical point

iv) Quality and

v) Subcooled liquid. **(10 Marks)**

b. A vessel of volume $0.04m^3$ contains a mixture of saturated water and saturated steam at a temperature of 240°C. The mass of the liquid present is 8 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **(10 Marks)**

7 a. Show that the change in entropy when a perfect gas undergoes a polytropic change pv^n = constant is given by the expression $s_2 - s_1 = \frac{\gamma - n}{n-1} c_v \ln\left(\frac{T_1}{T_2}\right)$. **(10 Marks)**

b. One kg of air initially at 1 bar and 160°C is compressed isothermally till the volume reduces to 0.28 m^3. Determine the work done, heat transfer, change in internal energy and the entropy. **(10 Marks)**

8 a. Obtain expressions for the constants 'a', 'b' and 'R' in terms of the critical properties for a vander waal gas. **(08 Marks)**

b. Write a note on compressibility factor and compressibility chart. **(06 Marks)**

c. Determine the pressure exerted by CO_2 in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C using i) Ideal gas equation ; ii) Vander waals equation constants a and b are $365.6kN\text{-}m^2/(kg\ mol)^2$ and $b=0.0428m^3/kg\text{-}mol$, $\overline{R}$ =universal gas constant = 8.3143 kJ/kg mol k. **(06 Marks)**

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10ME/IP/IM/MA/AU/PM/TL/AE34

Third Semester B.E. Degree Examination, December 2011
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data, if any, may be assumed suitably.

PART – A

1 a. State the Hooke's law. Neatly draw the stress-strain diagram for steel indicating all salient points and zones on it. **(05 Marks)**

b. A compound bar consisting of Bronze, Aluminium and Steel segments is loaded axially as shown in Fig.Q1(b). Determine the maximum allowable value of 'P', if the change in length of the bar is not to exceed 2mm and the working stresses in each material of the bar, indicated in table below is not to be exceeded. **(15 Marks)**

Material	Area $A(mm^2)$	Elastic modulus E(MPa)	Working stress σ_w (MPa)
Bronze	450	0.83×10^5	120
Aluminium	600	0.70×10^5	80
Steel	300	2×10^5	140

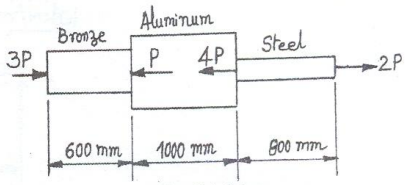

Fig.Q1(b)

2 a. With standard notations, derive an expression to relate the Modulus of Elasticity E, Bulk Modulus K and the Poisson's ratio μ. **(05 Marks)**

b. When a bar of 25mm diameter is subjected to a pull of 61 kN, the extension on a 50mm gauge length is 0.1mm and decrease in diameter is 0.013mm. Calculate the value of elastic constants E, G, K and μ. **(08 Marks)**

c. The bronze bar 3m long with $320mm^2$ cross sectional area is placed between two rigid walls. At –20°C there is a gap Δ = 2.5mm as shown in Fig.Q2(c). Find the magnitude and the type of stress induced in the bar when it is heated to a temperature 50.6°C. For bronze bar, take $\alpha_B = 18.0\times10^{-6}$/°C and E = 80 GPa. **(07 Marks)**

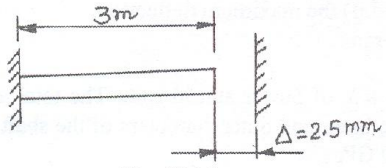

Fig.Q2(c)

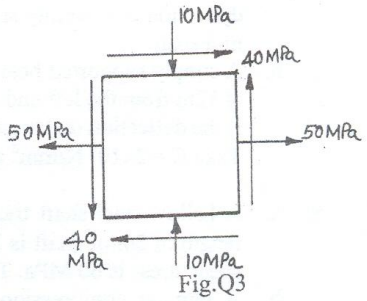

Fig.Q3

3 For the state of stress shown in Fig.Q3, determine:
i) The principal stresses and principal planes.
ii) Maximum inplane shear stress and plane on which it is acting. Also find the normal stress on the maximum shear plane.
iii) Sketch the element aligned with planes of principal stresses and planes of maximum shear. Also draw the Mohr's circle for the above stress state. **(20 Marks)**

4 a. Define the work and strain energy. **(02 Marks)**

b. A rectangular copper bar 50mm×75mm in cross-section is subjected to an axial energy input of 200 Nm. Determine the minimum length of bar to limit the axial stress in the bar to 80MPa. The modulus of elasticity of bar is 1.15×10^5 N/mm^2. **(06 Marks)**

c. A thin cylinder of 75mm internal diameter and 250mm long has 2.5mm thick walls. The cylinder is subjected to an internal pressure of 7 MN/m^2. Determine the change in internal diameter and change in the length of the cylinder. Also, compute the Hoop stress and Longitudinal stress in the cylinder. Take E = 2×10^5N/mm^2 and $\mu = 0.3$. **(12 Marks)**

PART – B

5 a. Derive an expression to establish a relationship between the intensity of load ω, shear force F and bending moment M in the beam. **(06 Marks)**

b. A beam 25m long is supported at A and B and is loaded as shown in Fig.Q5(b). Draw the shear force and bending moment diagrams for the beam computing shear force and bending moments at A, E, D, B and C. Find the position and magnitude of the maximum bending moment. Also, determine the point of contraflexure. **(14 Marks)**

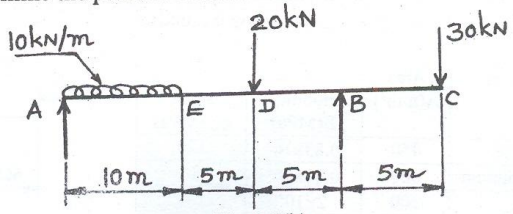

Fig.Q5(b)

6 a. State the assumptions made in the simple bending theory. **(05 Marks)**

b. A uniform I-section beam is 100mm wide and 150mm deep with a flange thickness of 25mm and web thickness of 12mm. The beam is simply supported over a span of 5m. It carries a uniformly distributed load of intensity 83.4 kN/m throughout its length. Determine the bending stress in the beam and plot the stress distribution across its cross-section. **(15 Marks)**

7 a. Using the standard notations, derive an expression for deflection, slope and maximum deflection of a simply supported beam of span 'L' subjected to a concentrated load W at its mid span. **(10 Marks)**

b. A simply supported beam of span 20m carries two concentrated load 4 kN at 8m and 10 kN at 12m from the left end support. Calculate
i) the deflection under each load, and ii) the maximum deflection.
Take E = 2×10^5 N/mm^2 and I = 10^9 mm^4. **(10 Marks)**

8 a. A hallow steel shaft transmits 200 kW of power at 150 rpm. The total angle of twist in a length of 5m of shaft is 3°. Find the inner and outer diameters of the shaft if the permissible shear stress is 60 MPa. Take G = 80 GPa. **(10 Marks)**

b. A circular compression member is of 25mm diameter and 950mm long. Calculate the maximum buckling load. What will be the value of allowable load if a factor of safety of 3 is expected? Take for material of the column, σ_y = 441 MPa, E = 2.07×10^5 N/mm^2. **(10 Marks)**

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10ME/IP/IM/MA/AU/TL/PM35

Third Semester B.E. Degree Examination, December 2011

Manufacturing Process - I

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define manufacturing process and explain primary and secondary manufacturing process. **(06 Marks)**

b. Define moulding and casting. **(03 Marks)**

c. What is pattern? Explain in detail various allowances given to pattern and reasons to provide the allowances. **(11 Marks)**

2 a. With a neat figure, explain the terminologies of sand mould. **(08 Marks)**

b. Explain with a neat sketch, the working principle of Jolt type moulding machine. **(06 Marks)**

c. Explain the elements involved in gating system. **(06 Marks)**

3 a. Explain with neat sketches, shell moulding process and Investment moulding process. **(14 Marks)**

b. Explain with a neat figure Hot chamber die casting process. **(06 Marks)**

4 a. With respect to different zones and their chemical reaction, explain Cupola furnace with a neat figure. **(10 Marks)**

b. Explain high frequency induction furnace. **(05 Marks)**

c. Mention the advantages of oil fired crucible furnace over coke fired furnace. **(05 Marks)**

PART – B

5 a. Define welding. Broadly classify welding process with examples in each. **(05 Marks)**

b. Write a note on cleaning and edge preparation in welding. **(05 Marks)**

c. Explain Tungsten wiest gas welding process with a neat figure and mention its advantages and limitations. **(10 Marks)**

6 a. Explain with a neat figure, Thermit welding process with advantages. **(10 Marks)**

b. Explain with a neat sketch, laser beam welding process mentioning clearly the formation of laser beam. **(10 Marks)**

7 Write short notes on :

a. Electrodes

b. Residual stresses

c. HAZ in welding

d. Welding defects. **(20 Marks)**

8 a. Explain magnetic particle inspection method to test welded part with advantages and limitations. **(10 Marks)**

b. Explain Induction Brazing and mention advantages and limitations. **(05 Marks)**

c. Differentiate Soldering and Brazing. **(05 Marks)**

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