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10MAT31

Third Semester B.E. Degree Examination, June/July 2015

Engineering Mathematics - III

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Expand $f(x) = x \sin x$ as a Fourier series in the interval $(-\pi, \pi)$, Hence deduce the following:

i) $\frac{\pi}{2} = 1 + \frac{2}{1.3} - \frac{2}{3.5} + \frac{2}{5.7}$

ii) $\frac{\pi - 2}{4} = \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - + \ \ldots$ **(07 Marks)**

b. Find the half–range Fourier cosine series for the function

$$f(x) = \begin{cases} kx, & 0 \le x \le \ell/2 \\ k(\ell - x), & \ell/2 < x \le \ell \end{cases}$$

Where k is a non-integer positive constant. **(06 Marks)**

c. Find the constant term and the first two harmonics in the Fourier series for f(x) given by the following table.

x :	0	π/3	2π/3	π	4π/3	5π/3	2π
F(x) :	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(07 Marks)

2 a. Find the Fourier transform of the function $f(x) = xe^{-a|x|}$ **(07 Marks)**

b. Find the Fourier sine transforms of the

Functions $f(x) = \begin{cases} \sin x, & 0 < x < a \\ 0, & x \ge a \end{cases}$ **(06 Marks)**

c. Find the inverse Fourier sine Transform of

$F_x(\alpha) = \frac{1}{\alpha} e^{-a\alpha} \quad a > 0.$ **(07 Marks)**

3 a. Find various possible solution of one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = C^2 \frac{\partial^2 u}{\partial x^2}$ by separable variable method. **(07 Marks)**

b. Obtain solution of heat equation $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial t^2}$ subject to condition $u(0,t) = 0$, $u(\ell, t) = 0$, $u(x, 0) = f(x)$. **(06 Marks)**

c. Solve Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to condition $u(0, y) = u(\ell, y) = 0$, $u(x, 0) = 0$, $u(x, a) = \sin\left(\frac{\pi x}{\ell}\right)$. **(07 Marks)**

4 a. The pressure P and volume V of a gas are related by the equation $PV^r = K$, where r and K are constants. Fit this equation to the following set of observations (in appropriate units)

P :	0.5	1.0	1.5	2.0	2.5	3.0
V:	1.62	1.00	0.75	0.62	0.52	0.46

(07 Marks)

b. Solve the following LPP by using the Graphical method :

Maximize : $Z = 3x_1 + 4x_2$

Under the constraints $4x_1 + 2x_2 \le 80$

$2x_1 + 5x_2 \le 180$

$x_1, x_2 \ge 0$. **(06 Marks)**

c. Solve the following using simplex method

Maximize : $Z = 2x + 4y$, subject to the

Constraint : $3x + y \le 2z$, $2x + 3y \le 24$, $x \ge 0$, $y \ge 0$. **(07 Marks)**

PART – B

5 a. Using the Regular – Falsi method, find a real root (correct to three decimal places) of the equation cos x = 3x – 1 that lies between 0.5 and 1 (Here, x is in radians). **(07 Marks)**

b. By relaxation method

Solve : - x + 6y + 27z = 85, 54x + y + z = 110, 2x + 15y + 6z = 72. **(06 Marks)**

c. Using the power method, find the largest eigen value and corresponding eigen vectors of the

matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$

taking $[1, 1, 1]^T$ as the initial eigen vectors. Perform 5 iterations. **(07 Marks)**

6 a. From the data given in the following Table ; find the number of students who obtained

(i) Less than 45 marks ii) between 40 and 45 marks.

Marks	30 – 40	40 – 50	50 – 60	60 – 70	70 - 80
No. of Students	31	42	51	35	31

(07 Marks)

b. Using the Lagrange's formula, find the interpolating polynomial that approximates to the function described by the following table:

x	0	1	2	3	4
f(x)	3	6	11	18	27

Hence find f (0.5) and f (3.1). **(06 Marks)**

c. Evaluate $\int_0^1 \frac{x}{1+x^2} dx$ by using Simpson's $\left(\frac{3}{8}\right)^{th}$ Rule, dividing the interval into 3 equal parts.

Hence find an approximate value of $\log\sqrt{2}$. **(07 Marks)**

7 a. Solve the one – dimensional wave equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$

Subject to the boundary conditions u (0, t) = 0, u (1, t) = 0, t ≥ 0 and the initial conditions

$u(x, 0) = \sin \pi x$, $\frac{\partial u}{\partial t}(x, 0) = 0$, $0 < x < 1$. **(07 Marks)**

b. Consider the heat equation $2\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ under the following conditions:

i) $u(0, t) = u(4, t) = 0,\ t \geq 0$

ii) $u(x, 0) = x(4 - x),\ 0 < x < 4.$

Employ the Bendre – Schmidt method with $h = 1$ to find the solution of the equation for $0 < t \leq 1$. **(06 Marks)**

c. Solve the two – dimensional Laplace equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial y^2} = 0$ at the interior pivotal points of the square region shown in the following figure. The values of u at the pivotal points on the boundary are also shown in the figure. **(07 Marks)**

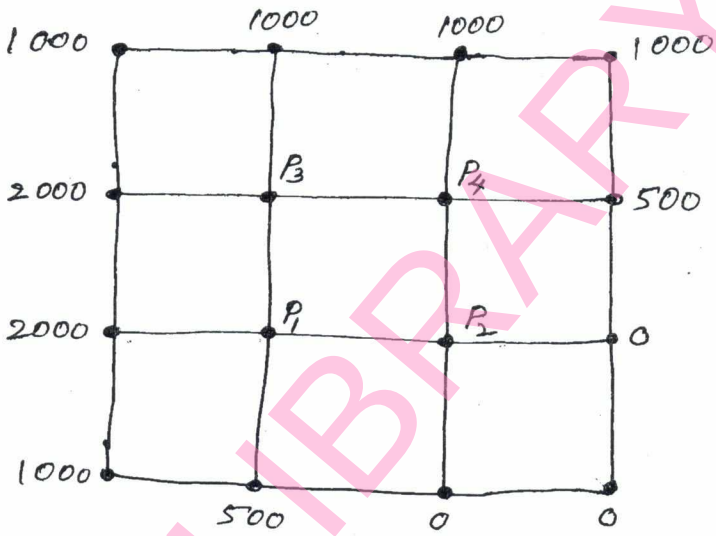

Fig. Q7 (c)

8 a. State and prove the recurrence relation of Z – Transformation hence find $Z_T(n^p)$ and $Z_T\left[\cosh\left(\frac{n\pi}{2} + \theta\right)\right]$. **(07 Marks)**

b. Find $Z_T^{-1}\left[\frac{z^3 - 20z}{(z-2)^3(z-4)}\right]$ **(06 Marks)**

c. Solve the difference equation

$y_{n+2} - 2y_{n+1} - 3y_n = 3^n + 2n$

Given $y_0 = y_1 = 0$. **(07 Marks)**

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10ME32A/AU32A/MT32/TL32

Third Semester B.E. Degree Examination, June/July 2015
Material Science and Metallurgy

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define APF and calculate APF for FCC crystal structure. **(06 Marks)**

b. Cesium crystallizes in a certain type of cubic structure with lattice constant 6.14A°. Identify the exact type of crystal structure in which cesium crystallizes. The atomic weight and density of cesium are 132.91 and 1900 kg/m^3 respectively. Also determine the total number of cesium atoms per cubic meter in the crystal structure. **(05 Marks)**

c. Differentiate between edge dislocation and screw dislocation. **(05 Marks)**

d. State and briefly explain the factors affecting diffusivity (any 4). **(04 Marks)**

2 a. A cylindrical specimen of aluminum having a diameter of 20mm and length 200mm is deformed elastically in tension with a force of 48800N. Determine the following:

i) The amount by which the specimen will elongate in the direction of applied stress.

ii) The charge in diameter of specimen.

iii) Will the diameter increase or decrease.

(Given: E = 69 GPa and Poisson's ratio = 0.33 for A*l*). **(07 Marks)**

b. What is true stress and engineering stress and obtain the mathematical equation showing the relation between true stress and engineering stress. **(07 Marks)**

c. Explain plastic deformation by twining with a neat sketch. **(06 Marks)**

3 a. Differentiate between ductile fracture and brittle fracture. **(05 Marks)**

b. What is stress relaxation? Obtain the mathematical expression for it. **(08 Marks)**

c. What is fatigue? With neat sketches explain the typical fatigue stress cycles briefly. **(07 Marks)**

4 a. Define solidification and explain nucleation and grain growth of a metal or alloy with neat sketches. **(08 Marks)**

b. Briefly explain the factors by Hume-Rothery that governs the formation of a solid solution. **(05 Marks)**

c. Define solid solution and explain different types of solid solution with neat sketches. **(07 Marks)**

PART – B

5 a. What are cooling curves? And draw the cooling curves for i) Pure metal ; ii) Binary solid solution. **(05 Marks)**

b. Draw the Iron-Carbon equilibrium diagram, show all the phases on the diagram and briefly explain it. **(10 Marks)**

c. What is an invariant reaction in the Iron-Carbon phase diagram? Explain the Eutectic reaction and peritectic reaction. **(05 Marks)**

6 a. Draw the TTT diagram for eutectoid steel (0.83% C) and explain briefly different microstructures obtained at various cooling rates. **(10 Marks)**

b. Differentiate between Austempering and Mar tempering. **(05 Marks)**

c. Explain induction hardening with a neat sketch. **(05 Marks)**

7 a. Give the composition, micro structure and applications of

i) Low carbon steel (mild steel)

ii) Medium carbon steel

iii) High carbon steel. **(09 Marks)**

b. Write a note on brasses. **(06 Marks)**

c. Explain briefly SAE-AISI designation of steels. **(05 Marks)**

8 a. What is a composite material and explain the

i) Role of matrix

ii) Role of interface and

iii) Role of reinforcement in a composite material. **(10 Marks)**

b. With a neat sketch, explain the resin transfer moulding process. **(06 Marks)**

c. What are the applications of composites (any 4). **(04 Marks)**

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10ME32B/10AU32B

Third Semester B.E. Degree Examination, June/July 2015
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the term metrology. List and explain the objectives of metrology. **(10 Marks)**

b. Explain with neat sketch : i) Imperial standard yard ii) International prototype meter. **(10 Marks)**

2 a. Determine the tolerances on the hole and the shaft for a precision running bit designated by $50H_7G_6$. Given : **(12 Marks)**

i) 50mm lies between 30-50mm ii) $i(\text{microns}) = 0.45(D)^{1/3} + 0.001D$

iii) Fundamental deviation for 'g' shaft $= -2.5D^{0.34}$ iv) $IT_7 = 16i$ v) $IT_6 = 10i$.

b. Explain with neat sketches hole basis system and shaft basis system. **(08 Marks)**

3 a. Explain with a neat sketch the working of sigma comparator. **(10 Marks)**

b. Explain with a neat sketch the construction and working of a LVDT. **(10 Marks)**

4 a. Explain with a neat sketch, Auto collimator. **(10 Marks)**

b. What are the various characteristics that you would measure in a screw thread? Explain 3 wire method of measuring effective diameter of screw thread. **(10 Marks)**

PART – B

5 a. With a block diagram, explain generalized measuring system with examples. **(10 Marks)**

b. Define the following terms : i) Calibration ii) Sensitivity iii) Hysterisis iv) Repeatability v) Accuracy. **(10 Marks)**

6 a. With a neat sketch, explain the working principle of a CRO. **(10 Marks)**

b. With a neat sketch, explain X – Y plotter and list the advantages. **(10 Marks)**

7 a. With a neat sketch, explain 'Hydraulic Dynomometer'. **(10 Marks)**

b. With a neat sketch McLeod gauge. **(10 Marks)**

8 a. What is a Thermocouple? State the laws of Thermocouple. **(08 Marks)**

b. Sketch and explain the working principle of optical pyrometer. **(12 Marks)**

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10ME/AU33

Third Semester B.E. Degree Examination, June/July 2015
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. What do you mean by thermodynamic equilibrium? How does it differ from thermal equilibrium? **(05 Marks)**

b. State zeroth law of thermodynamics. Write its importance in thermodynamics. **(04 Marks)**

c. Consider a particular celsius scale assigned the value of 0°C to steam point and 100°C to ice point.

i) Using ideal gas as the thermometer medium, setup a relationship between 0°C and pressure for a constant volume thermometer, proceed to derive the correction between the two Celsius scales. At what temperature are the two scales are numerically equal?

ii) What is the numerical value of absolute zero for the particular scale? What is 200 K in °C? **(07 Marks)**

d. Two Celsius thermometers A and B with temperature readings T_A and T_B agree at ice point and steam point, but else where they are related by $T_A = p + qT_B + rT_B^2$, where p, q and r are constants. When the thermometers are immersed in an oil bath, A shows a temperature of 51°C, while B shows 50°C. Determine the temperature T_A, when T_B is 25°C. **(04 Marks)**

2 a. Define work and heat. Write the similarities and dissimilarities between them. **(06 Marks)**

b. An automobile vehicle of 1500 kg is running at a speed of 60 km/hr. The brakes are suddenly applied and the vehicle is brought to rest. Calculate the rise in temperature of brake shoes, if their mass is 15 kg. Take the specific heat of brake shoe material as 0.46 KJ/kgK. **(06 Marks)**

c. A quantity of gas is compressed in a piston-cylinder from a volume of 0.8611 m^3 to a final volume of 0.17212 m^3. The pressure (in bar) as a function of volume (m^3) is given by,

$$P = \frac{0.86110}{V} - \frac{8.60673 \times 10^{-5}}{V^2}$$

i) Find the amount of work done in KJ.

ii) If the atmospheric pressure, i.e., 1 bar acting on the other side of piston is considered, find the net work done in KJ. **(06 Marks)**

d. State direction of heat transfer and work transfer in a viscous fluid is stirred by a paddle wheel in an insulated closed tank. **(02 Marks)**

3 a. What is a perpetual motion machine of first kind? Why is it impossible? **(03 Marks)**

b. Apply steady flow energy equation to each of the following:
i) Boiler ii) Nozzle iii) Centrifugal pump. **(06 Marks)**

c. 1200 kg car cruising steadily on a level road at 90 km/hr. Now the car starts climbing a hill that is sloped 30° from the horizontal. If the velocity of the car is to remain constant during climbing, determine the additional power that must be delivered by the engine. **(04 Marks)**

d. A centrifugal pump delivers 50 kg of water per second. The inlet and outlet pressure are 1 bar and 4.2 bar respectively. 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 200 mm and 100 mm, respectively. Determine the capacity of electric motor to run the pump. **(07 Marks)**

4 a. Prove that a reversible engine is more efficient than an irreversible engine operating between the same temperature limits. **(06 Marks)**

b. A house hold refrigerator maintains a space at a temperature of 0°C. Every time the door is opened, warm material is placed inside, introducing an average 400 KJ of heat, but making only a small change in temperature of the refrigerator. The door is opened 25 times a day and the refrigerator operates at 25% and ideal COP. The cost of work is 3.50 per kWh. What is the monthly bill of this refrigerator? The atmospheric temperature is at 30°C. **(06 Marks)**

c. Explain the second law of thermodynamics with reference to Kelvin Planck's statement and Clausius statement hence prove that both the statements are equivalent to each other although they appear to be different. **(08 Marks)**

PART – B

5 a. Prove that for a system executing a cyclic process $\oint \frac{\delta Q}{T} \leq 0$, hence define entropy. **(08 Marks)**

b. In a certain heat exchanger, 50 kg of water is heated per minute from 50°C to 110°C by hot gases which enter the heat exchanger at 250°C. If the flow rate of gases is 100 kg/min, estimate the net change of entropy.
$C_p(\text{water}) = 4.186\ \text{KJ/kgK}$, $C_p(\text{gas}) = 1\ \text{KJ/kgK}$. **(06 Marks)**

c. A piston-cylinder arrangement contains 0.03 m^3 of nitrogen at 1 bar and 290 K. The piston moves inwards and the gas is compressed isothermally and reversibly until the pressure becomes 4 bar. Determine change in entropy and work done. Assume nitrogen to be a perfect gas. **(06 Marks)**

6 a. Define the following : i) Tripple point ii) Critical temperature iii) Dryness fraction iv) Saturation temperature. **(04 Marks)**

b. Sketch and explain the construction and working of a separting and throttling calorimeter used for determining the dryness fraction of steam in a boiler. **(08 Marks)**

c. Identify the type of steam in the following three cases, using the steam tables and giving necessary calculations supporting your claim.
i) 2 kg of steam at 8 bar with an enthalpy of 5538.0 KJ at a temperature of 170.4°C.
ii) 1 kg of steam at 2550 kPa occupies a volume of 0.2742 m^3. Also find the steam temperature.
iii) 1 kg and steam at 60 bar with an enthalpy of 2470.73 kJ/kg. **(08 Marks)**

7 a. Write notes on the following: i) Clausius-Clapeyron equation. ii) Maxwells equations. **(08 Marks)**

b. Derive an expression for change in entropy for an ideal gas undergoing i) an isobaric process and ii) a polytropic process. **(06 Marks)**

c. One kg of air undergoes a cycle composed of the following three reversible processes.:
i) Constant pressure expansion from 0.1 MPa and 300 K to 400 K.
ii) Constant volume cooling to 300 K.
iii) An isothermal compression to restore the gas to 0.1 MPa.
Sketch the P-V diagram for the above cycle and estimate the entropy changes for the three processes. **(06 Marks)**

8 a. Write notes on the following: i) Compressibility factor ii) Compressibility chart iii) Law of corresponding states. **(09 Marks)**

b. A volumetric analysis of a gaseous mixture yields the following results:
$CO_2 = 12\%$, $O_2 = 4\%$, $N_2 = 82\%$, $CO = 2\%$.
Determine the analysis on a mass basis, and the molecular weight and the gas constant on a mass basis for the mixture. Assume ideal gas behavior. **(08 Marks)**

c. Define the terms partial pressure mole fraction, volume fraction of a gas constituent in a mixture. **(03 Marks)**

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10ME/AU34

Third Semester B.E. Degree Examination, June/July 2015
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. State Hooke's law and define Poisson's ratio. **(03 Marks)**

b. Explain stress – strain diagram for mild steel with salient features. **(07 Marks)**

c. A member ABCD is subjected to point loads P_1, P_2, P_3 & P_4 as shown in fig.Q1(c). Calculate the force P_2 necessary for equilibrium. If P_1 = 45kN. P_3 = 450kN & P_4 = 130kN. Determine stresses in each member also determine the total elongation of the member assuming the E to be $2.1 \times 10^5 N/mm^2$. **(10 Marks)**

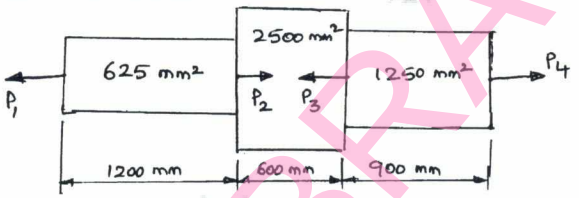


Fig.Q1(c)

2 a. Derive an expression for volumetric strain of a rectangular bar, subjected to normal stress σ along its axis. **(06 Marks)**

b. Define 3 modulii of elasticity and write the relationship between them . **(04 Marks)**

c. A composite bar consisting of steel and aluminum components shown in fig. Q2(c) is held firmly between two grips at the ends at a temperature of 60^0C. Find the stresses in the two rods, when temperature falls to 20^0C. If i) The ends do not yield ii) The ends yield by 0.25mm. Take $E_S = 2 \times 10^5 N/mm^2$ $\alpha_S = 1.17 \times 10^{-5}/^0C$
$E_A = 0.7 \times 10^5 N/mm^2$ $\alpha_A = 2.34 \times 10^{-5}/^0C$ **(10 Marks)**

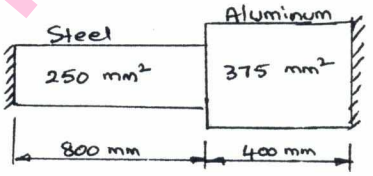


Fig.Q2(c)

3 a. Define the principal stresses and principal planes. **(03 Marks)**

b. Explain the construction of Mohr's circle and represent principal stress. **(07 Marks)**

c. At a certain point in a strained material the stress condition shown in fig.Q3(c) exists. Find i) The normal and shear stress on the inclined plane AB ii) Principal stresses and principal planes iii) Maximum shear stress. **(10 Marks)**

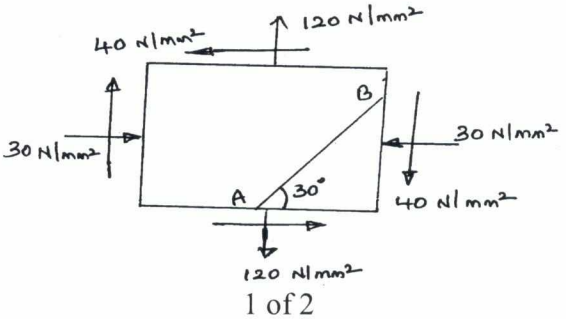


Fig.Q3(c)

4 a. Derive an expression for strain energy, when a member subjected to impact loads. **(06 Marks)**

b. Derive an expression for circumferential stress of a thin cylinder. **(04 Marks)**

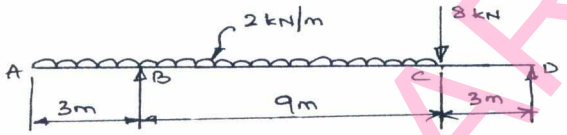
c. A C.I pipe has 200mm internal diameter and 50mm metal thickness and carries water under a pressure of $5N/mm^2$. Calculate the maximum and minimum intensities of circumferential stress and sketch the distribution of circumferential stress intensity and intensity of radial pressure across the section. **(10 Marks)**

PART - B

5 a. Establish relationship between distributed load, shear force and bending moment at a cross – section of a beam. **(06 Marks)**

b. For the beam shown in fig. Q5(b), draw SFD and BMD and mark the values at the salient points. **(14 Marks)**

Fig.Q5(b)



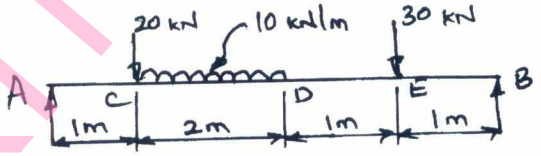
6 a. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. A beam of an I – section consists of 180mm × 15mm flanges and a web of 280mm × 15mm thickness. It is subjected to a shear force of 60kN. Sketch the shear stress distribution along the depth of the section. **(10 Marks)**

7 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$, with usual notations. **(10 Marks)**

b. Determine the deflection at points C, D and E in the beam shown in fig. Q7(b). Take $E = 200kN/mm^2$ and $I = 60 \times 10^6 mm^4$. **(10 Marks)**

Fig.Q7(b)



8 a. A hollow shaft of diameter ratio 3/8 is required to transmit 588KW at 110 rpm, the maximum torque being 120% of the mean. Shear stress is not to exceed $63N/mm^2$ and twist in a length of 3m not to exceed 1.4 degrees. Calculate external diameter of shaft which would satisfy these conditions. Take modulus of rigidity = 84 GPa. **(12 Marks)**

b. Define slenderness ratio and derive Euler's expression for buckling load for column with both ends hinged. **(08 Marks)**

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10ME/AU35

Third Semester B.E. Degree Examination, June/July 2015

Manufacturing Process - I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. List and explain different steps involved in making sound casting. **(10 Marks)**
b. Define pattern explain with neat sketch 'sweep' pattern. **(10 Marks)**

2 a. List the different properties of moulding sand, and explain any four. **(10 Marks)**
b. With a neat sketch explain sand slinger. **(10 Marks)**

3 a. Explain with neat sketch 'shell moulding' process. **(12 Marks)**
b. Explain with neat sketch true centrifugal casting. **(08 Marks)**

4 a. How melting furnaces are classified? Explain cupola furnace with neat sketch. **(14 Marks)**
b. Differentiate oil fired crucible furnace over a coke fired furnace. **(06 Marks)**

PART – B

5 a. Define welding. List the advantages, disadvantages and applications. **(10 Marks)**
b. Explain with a neat sketch 'TIG' welding and list its applications. **(10 Marks)**

6 a. Explain with a neat sketch Laser beam welding process. **(10 Marks)**
b. What is the principle of Resistance welding? With a neat sketch Explain 'Thermit' welding. **(10 Marks)**

7 Write a short notes on the following
i) Heat affected zone (HAZ).
ii) Welding defects.
iii) Residual stresses.
iv) Electrodes. **(20 Marks)**

8 a. Explain the following NDT with sketches.
i) Radiography inspection.
ii) Magnetic particle inspection. **(14 Marks)**
b. Differentiate between Soldering and Brazing . **(06 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, June/July 2015
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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

1 a. Express the complex number $\frac{(5-3i)(2+i)}{4+2i}$ in the form x + iy. **(06 Marks)**

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

c. Find the cube roots of 1 + i. **(07 Marks)**

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

b. Find the n^{th} derivative of $\frac{x}{(x+1)(2x+3)}$. **(07 Marks)**

c. If $x = \tan(\log y)$ prove that $(1 + x^2)\, y_{n+1} + (2nx - 1)\, y_n + n(n-1)\, y_{n-1} = 0$. **(07 Marks)**

3 a. Find the angle of intersection of the curves $r^n = a^n\cos n\theta$, $r^n = b^n \sin n\theta$. **(06 Marks)**

b. Find the Pedal equation of the curve $r = a(1 - \cos\theta)$. **(07 Marks)**

c. Using Maclcaurin's series expand $\log(1 + x)$ upto the term containing x^4. **(07 Marks)**

4 a. If $u = f(x + ct) + g(x - ct)$ show that $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$. **(06 Marks)**

b. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$ prove that $xu_x + yu_y + zu_z = 0$. **(07 Marks)**

c. If $u = x + y$, $v = y + z$, $w = z + x$ find the value of $\frac{\partial(u,v,w)}{\partial(x,y,z)}$. **(07 Marks)**

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

b. Evaluate $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}}\,dx$. **(07 Marks)**

c. Evaluate $\int_0^a \int_0^x \int_0^{x+y} e^{x+y+z}\, dz\,dy\,dx$. **(07 Marks)**

6 a. Define beta and gamma functions and prove that $\Gamma(n + 1) = n\Gamma(n)$. **(06 Marks)**

b. Show that $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{1}{\sqrt{\sin\theta}}\, d\theta = \pi$. **(07 Marks)**

c. Prove that $\beta(m, n) = \frac{\Gamma(m).\Gamma(n)}{\Gamma(m+n)}$. **(07 Marks)**

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

b. Solve : $(x^2 - y^2)\,dx - xydy = 0$. **(07 Marks)**

c. Solve : $\frac{dy}{dx} + y\cot x = 4x\,\text{cosec}\,x$. **(07 Marks)**

8 a. Solve : $(D^3 - 6D^2 + 11D - 6)\,y = 0$. **(06 Marks)**

b. Solve : $(D^2 + 2D + 1) = x^2 + e^{+x}$. **(07 Marks)**

c. Solve : $(D^2 + D + 1)y = \sin 2x$. **(07 Marks)**

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