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VTU Question Papers

BE - ME

III to VIII Semester

Jun/Jul-2023

2018 & 2021 Scheme

Maharaja Institute of Technology Thandavapura

Just of NH-766,Mysore-ooty highway,Thandavapura(Vill & Post),Nanjangud Taluk,Mysore District-571302.

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CBCS SCHEME

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18MAT31

Third Semester B.E. Degree Examination, June/July 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 $L\left(\frac{\cos at - \cos bt}{t}\right)$. **(06 Marks)**

b. Express the function in terms of unit step function and hence find Laplace transform of

$$f(t) = \begin{cases} \sin t & 0 < t < \frac{\pi}{2} \\ \cos t & \frac{\pi}{2} < t < \pi \end{cases}$$ **(07 Marks)**

c. Solve $y''(t) + 4y'(t) + 3y(t) = e^t$, $y(0) = y'(0) = 1$ by using Laplace transform method. **(07 Marks)**

OR

2 a. Find : (i) $L^{-1}\left(\log\left(\frac{s+b}{s+a}\right)\right)$ (ii) $L^{-1}\left(\frac{s+3}{s^2-4s+13}\right)$ **(06 Marks)**

b. Find $L^{-1}\left(\frac{s}{(s^2+a^2)^2}\right)$ by using convolution theorem. **(07 Marks)**

c. Given $f(t) = \begin{cases} t & 0 < t < a \\ 2a - t & a < t < 2a \end{cases}$

where f(t) = f(t + 2a) then show that $L(f(t)) = \frac{1}{s^2}\tan h\left(\frac{as}{2}\right)$ **(07 Marks)**

Module-2

3 a. Obtain Fourier series for $f(x) = \frac{\pi - x}{2}$, $0 < x < 2\pi$. **(06 Marks)**

b. Find Fourier series for $f(x) = 2x - x^2$, $0 < x < 2$. **(07 Marks)**

c. Find half range Fourier cosine series for

$$f(x) = \begin{cases} x, & 0 < x < \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} < x < \pi \end{cases}$$ **(07 Marks)**

OR

4 a. Find Fourier series for $f(x) = |x|$, $-\pi < x < \pi$. **(06 Marks)**

b. Obtain Fourier series for $f(x) = \begin{cases} 0 & -2 < x < 0 \\ 1 & 0 < x < 2 \end{cases}$. **(07 Marks)**

c. Find the Fourier series upto first harmonic from the following table:

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

(07 Marks)

Module-3

5 a. Find Fourier transform of f(x), given:

$$f(x)=\begin{cases}1, & |x|\le 1\\ 0, & |x|>1\end{cases}$$ and hence deduce that $\int_0^\infty \frac{\sin x}{x}dx=\frac{\pi}{2}$. **(06 Marks)**

b. Find the Fourier cosine transform of

$$f(x)=\begin{cases}4x & 0<x<1\\ 4-x & 1<x<4\\ 0 & x>4\end{cases}$$ **(07 Marks)**

c. Solve $u_{n+2}+4u_{n+1}+3u_n=3^n$, given $u_0=0$, $u_1=1$ using Z - transform. **(07 Marks)**

OR

6 a. Find the Fourier sine transform of $e^{-|x|}$ and hence evaluate $\int_0^\infty \frac{x\sin mx}{1+x^2}dx$. **(06 Marks)**

b. Find Z-transform of $\cos n\theta$ and $a^n\cos n\theta$. **(07 Marks)**

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

Module-4

7 a. Find the value of y at x = 0.1 and x = 0.2 given $\frac{dy}{dx}=x^2y-1$, y(0) = 1 by using Taylor's series method. **(06 Marks)**

b. Compute y(0.1), given $\frac{dy}{dx}=\frac{y-x}{y+x}$, y(0) = 1 taking h = 0.1, by using Runge-Kutta 4th order method. **(07 Marks)**

c. Find the value of y at x = 0.4, given $\frac{dy}{dx}=2e^x-y$ with initial conditions y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.04, y(0.3) = 2.09 by using Milne's predictor and corrector method. **(07 Marks)**

OR

8 a. Using modified Euler's method, find the value of y at x = 0.1, given $\frac{dy}{dx}=-xy^2$, y(0) = 2 taking h = 0.1. **(06 Marks)**

b. Solve $\frac{dy}{dx}=3e^x+2y$, y(0) = 0 at x = 0.1 taking h = 0.1, by using Runge-Kutta 4th order method. **(07 Marks)**

c. Find the value y at x = 0.8 given $\frac{dy}{dx}=x-y^2$ and

x	0	0.2	0.4	0.6
y	0	0.0200	0.0795	0.1762

By using Adam's Bashforth predictor and corrector method. **(07 Marks)**

Module-5

9 a. Solve $\frac{d^2y}{dx^2} = x\left(\frac{dy}{dx}\right)^2 - y^2$ for x = 0.2 given x = 0, y = 1 and $\frac{dy}{dx} = 0$ by using Runge-Kutta method. **(07 Marks)**

b. Derive Euler's equation in the standard form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(06 Marks)**

c. Find the extremal of the function $\int_0^1 [(y')^2 + 12xy]dx$ with y(0) = 0 and y(1) = 1. **(07 Marks)**

OR

10 a. Find the value of y at x = 0.8, given $\frac{d^2y}{dx^2} = 2y\frac{dy}{dx}$ and

x	0	0.2	0.4	0.6
y	1	0.2027	0.4228	0.6841
y′	1	1.041	1.179	1.468

by using Milne's method. **(07 Marks)**

b. Prove that the shortest between two points in a plane is a straight line. **(06 Marks)**

c. Find the curve on which the functional $\int_0^1 [x + y + (y')^2]dx$ with y(0) = 1, y(1) = 2. **(07 Marks)**

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18ME32

Third Semester B.E. Degree Examination, June/July 2023
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain with neat sketch, stress-strain diagram of mild steel indicating it's salient points. **(06 Marks)**

b. Define : (i) Hooke's law (ii) Modulus of rigidity (iii) Volumetric strain (iv) Poisson's ratio **(04 Marks)**

c. A steel bar ABCD of varying sections is subjected to axial forces as shown in Fig. Q1 (c). Find the value of 'P' necessary for equilibrium. If E = 210 kN/mm^2, determine
  (i) Stress in various segments
  (ii) Total elongation of bar
  (iii) Total strain in the bar.

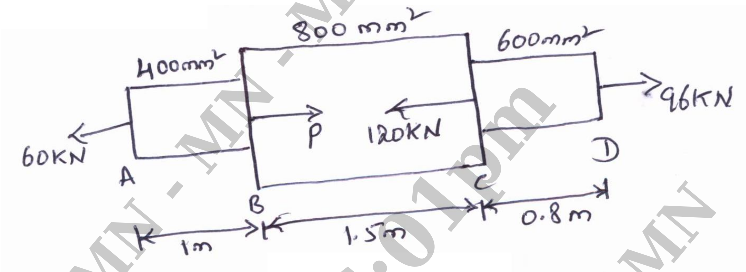

Fig. Q1 (c) **(10 Marks)**

OR

2 a. Derive a relation between young's modulus (E) and modulus of rigidity (G). **(10 Marks)**

b. A composite bar shown in Fig. Q2 (b) is 0.2 mm short a distance between the rigid supports at room temperature. What is maximum temperature rise which will not produce stress in the bar? Find stresses induced when temperature rise is 40 °C. Given $\alpha_s = 12\times10^{-6}$ per °C, $\alpha_C = 17.5\times10^{-6}$ per °C, $E_S = 2\times10^5$ N/mm^2, $E_C = 1.2\times10^5$ N/mm^2, $A_S : A_C = 4 : 3$

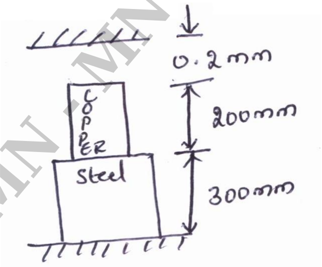

Fig. Q2 (b) **(10 Marks)**

Module-2

3 a. Derive an expression for normal stress, shear stress and resultant stress on an oblique plane inclined at an angle 'θ'. With vertical axis (x-plane) in a bi-axial stress system subjected to σ_1 and σ_2 also find angle of obliquity ϕ. **(10 Marks)**

b. A point in a strained material, the stress on two planes at right angles to each other are 80 N/mm^2(tensile) and 40 N/mm^2 (tensile). Each of above stresses is accompanied by a shear stress of 60 N/mm^2. Determine (i) Normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of 45° to the axis of minor tensile stress. Also find major principal stress , minor principal stress and their location, maximum shear stress and its location.

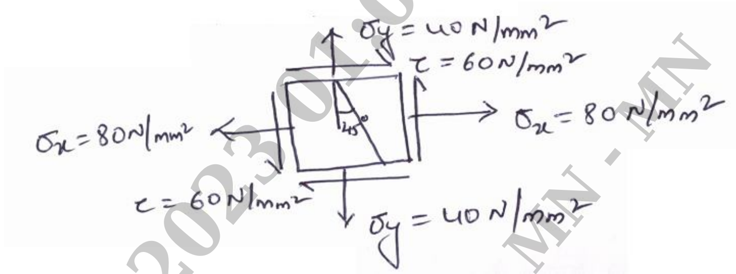

Fig.Q3 (b) **(10 Marks)**

OR

4 a. Derive expression for hoop stress and longitudinal stress for thin cylinder subjected to internal fluid pressure. **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300 mm and internal diameter 200 mm is subjected to an internal fluid pressure of 20 N/mm^2 and external fluid pressure of 5 N/mm^2. Determine the maximum hoop stress developed. Draw the variation of hoop stress and radial stress across the thickness indicating the values at every 25 mm interval. **(10 Marks)**

Module-3

5 a. Deduce the relationship between relating load (W), Shear Force (F) and Bending moment (M). **(06 Marks)**

b. For the beam shown in Fig. Q5 (b), draw SFD and BMD. Locate the point of contraflexure, if any.

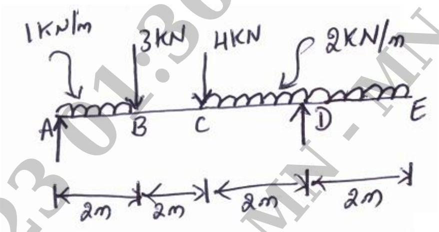

Fig. Q5 (b) **(14 Marks)**

OR

6 a. Prove that in case of a rectangular section of a beam the maximum shear stress is 1.5 times the average shear stress. **(08 Marks)**

b. A beam of an I-section consists of 180mm × 15mm flanges and
a web of 280 mm depth × 15 mm thickness.
It is subjected to a bending moment of 120 kN-m and a shear force of 60 kN. Sketch the bending and shear stress distributions along the depth of the section.

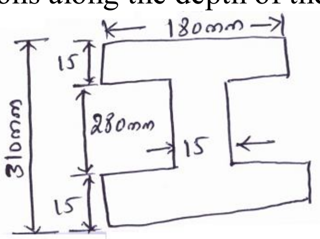

Fig. Q6 (b) **(12 Marks)**

Module-4

7 a. Write a note on the following :
   (i) The maximum principal stress theory.
   (ii) The maximum shear stress theory. **(08 Marks)**

b. A solid circular shaft is subjected to a bending moment of 9000 Nm and a twisted moment of 12000 Nm. In a simple uniaxial tensile test of the same material, it gives the following particulars. Stress at yield point 300 N/mm^2. Assume factor of safety = 3. Estimate the least diameter required using, (i) Maximum principal stress theory
   (ii) Maximum shear stress theory. **(12 Marks)**

OR

8 a. Derive the torsion equation with usual notation $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$. State the assumption made in the derivation. **(10 Marks)**

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm. Find the diameter of the shaft, if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained, if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same? **(10 Marks)**

Module-5

9 a. State the assumption made while deriving Euler's column formula. Also derive Euler's expression of buckling load, for column with both ends fixed. **(10 Marks)**

b. A 1.5 m long columns has a circular cross section of 50 mm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3. Calculate the safe load using :
   (i) Rankine's formula, take yield stress $\sigma_c = 560$ N/mm^2 and $\alpha = \frac{1}{1600}$ for pinned ends.
   (ii) Euler's formula, young's modulus for CI = 1.2×10^5 N/mm^2 **(10 Marks)**

OR

10 a. Explain the following :
   (i) Castigliano's Ist and IInd theorem.
   (ii) Strain energy due to bending and torsion
   (iii) Strain energy due to shear. **(15 Marks)**

b. The bar with circular cross section as shown in Fig. Q10 (b) is subjected to a load of 10 kN. Determine the strain energy stored in it. Take $E = 2.1 \times 10^5$ N/mm^2.

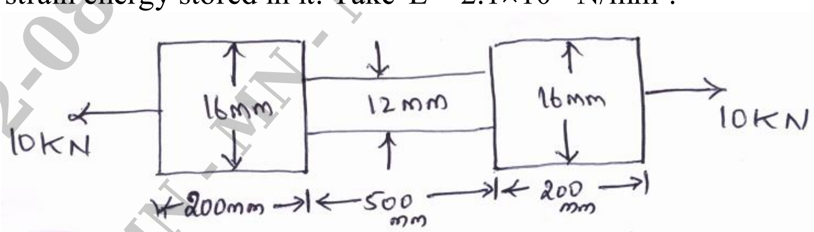

Fig. Q10 (b) **(05 Marks)**

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CBCS SCHEME

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18ME33

Third Semester B.E. Degree Examination, June/July 2023
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Thermodynamics handbook is permitted.***

Module-1

1 a. Define the following :
i) Closed system ii) Open system iii) Isolated system iv) Thermodynamics state **(08 Marks)**

b. State the Zeroth law of Thermodynamic and briefly explain its significance. **(04 Marks)**

c. The reading t_A and t_B of two Celsius thermometers A and B agree at the ice point (0ºC) and the steam point (100ºC) and are related by the equations $t_A = \ell + mt_B + t_B^2$. Between these two point ℓ, m, n are constants. When both are immersed in an oil bath. A indicates 55ºC and B indicates 50ºC. Determine the value of ℓ, m, n and also find the reading on A if B reads 25ºC. **(08 Marks)**

OR

2 a. Mention the characteristics of thermodynamic properties. **(04 Marks)**

b. Classify the differences between microscopic and macroscopic approaches. **(06 Marks)**

c. The temperature t on a certain Celsius thermometer scale is given by means of a property through a relations t = a ℓn (P) + b where a and b are constant P is the property of the fluid. If, at the ice point and steam points the values of P are found to be 4 and 20 respectively. What will be temperature reading corresponding to a reading of P = 16? **(10 Marks)**

Module-2

3 a. List the difference between work and heat. **(06 Marks)**

b. Explain the path function and point functions. **(06 Marks)**

c. A stationary mass of a gas is compressed in a friction less way from 1 bar and $0.1m^3$ to 5 bar and $0.03m^3$. Assuming that the pressure and volume are related by Pr^n = constant, find the workdone on the gas. **(08 Marks)**

OR

4 a. Show that energy is a property of system. **(06 Marks)**

b. Derive the steady flow energy equations [SFEE] for a single stream of fluid entering and a single stream of fluid leaving the control volume. **(06 Marks)**

c. Air flows steadily through a rotary compressor. At entry the air is 20ºC and 101KPa at exit the some air is at 200ºC and 600KPa. Assuming the flow to be adabatic i) Evaluate the work done per unit mass of air if the velocities at inlet and exit are negligible ii) What would be the increase in work input if the velocities at inlet and exit are 50m/s and 110m/s. **(08 Marks)**

Module-3

5 a. State the limitation of first law of thermodynamics illustrate with example. **(04 Marks)**

b. State the Kelvin – Planks and Claudius statement of the second law of thermodynamics and prove their equivalence. **(08 Marks)**

c. A reversible heat engine operates between two reservoirs at temperature of 600ºC and 40ºC the engine drives a reversible refrigerator, which operates between 40ºC and 20ºC. The heat transfer to the engine is 2000kJ and network output from combined engine and refrigerator system is 360kJ. Calculate heat transfer and net heat transfer to the reservoir at 40ºC. **(08 Marks)**

OR

6 a. State and prove Clasius inequality. **(06 Marks)**

b. Show that entropy is a property. **(06 Marks)**

c. $1.2m^3$ of air is heated reversibly at constant pressure from 300K and 600K and is then cooled reversibly at constant volume back to initial temperature. If the initial pressure is 1 bar, calculate net heat flow and overall change in entropy. Also represent the processes on T-S diagram. Take $C_p = 1.005kJ/Kg\ K$ and $R = 0.287kJ/Kg\ K$. **(08 Marks)**

Module-4

7 a. Explain briefly available and unavailable energies referred to a cyclic process. **(04 Marks)**

b. Derive an expression for available energy from a finite energy source at temperature T_1 when the surrounding temperature is T_0. **(08 Marks)**

c. A Carnot engine works between the temperature limits of 225ºC and 25ºC in which water issued as the working fluid, if heat is supplied to the saturated liquid water at 225ºC until it is converted into saturated Vapoun, determine per Kg of water.

i) The amount of heat absorbed by the fluid
ii) The available energy
iii) The unavailable energy. **(08 Marks)**

OR

8 a. Draw a neat sketch of throttling calorimeter and explain how dryness fraction of steam is determined. Clearly explain its limitations. **(10 Marks)**

b. Define the following :
i) Triple point ii) Critical temperature iii) Dryness fraction iv) Saturation temperature v) Pure substances. **(10 Marks)**

Module-5

9 a. State and explain Amagat's law and Dalton's law of partial pressures. **(06 Marks)**

b. A tank of $0.1m^3$ capacity contains 1Kg of O_2, 0.9Kg of N_2, 1.5Kg CO_2, and 0.1 Kg of CO at 30ºC. Determine :
i) The total pressure ii) Mole fractions of each gas iii) Gas constant "R" and Molecular weight M of the mixture. **(06 Marks)**

c. A gas mixture consists of 0.5Kg of Carbon monoxide and 1Kg of CO_2. Determine :
i) Mass fractions ii) Mole fraction of each component iii) The Avg. Molecular weight iv) the Gas constant of the mixture. **(08 Marks)**

OR

10
i) Compressibility factor
ii) Law of corresponding
iii) Compressibility chart
iv) Vender Waals equations of state
v) Beattie Bridge Man- equations. **(20 Marks)**

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CBCS SCHEME

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18ME35B/MEB305

Third Semester B.E. Degree Examination, June/July 2023
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the factors to be considered in the selection of a process for production. **(07 Marks)**
b. Explain : i) Shrinkage allowance ii) Machining allowance **(05 Marks)**
c. List the different types of patterns. Explain any two types of pattern with neat sketches. **(08 Marks)**

OR

2 a. With a neat sketch, explain the working of Jolt moulding machine. **(06 Marks)**
b. With a neat sketch, explain the process, application and limitation of shell moulding process. **(08 Marks)**
c. With neat sketch, explain i) Open Riser ii) Blind Riser **(06 Marks)**

Module-2

3 a. With a neat sketch, explain resistance-furnace. **(06 Marks)**
b. Draw a neat sketch of cupola furnace showing various zones and explain the chemical reactions involved. **(08 Marks)**
c. With a neat sketch, explain centrifugal casting process. **(06 Marks)**

OR

4 a. Explain the process of gravity die casting with neat sketch, **(06 Marks)**
b. Explain with neat sketch indirect arc electric furnace. **(06 Marks)**
c. With a neat sketch, explain slush casting process. List the advantages and disadvantages. **(08 Marks)**

Module-3

5 a. Define solidification. Explain the variables in the metal solidification process. **(06 Marks)**
b. List the sources of gases in liquid metals. Explain vacuum degassing process. **(08 Marks)**
c. With a neat sketch, explain stream droplet degassing method. **(06 Marks)**

OR

6 a. Explain any five casting defects with neat sketch, also suggest remedies for defects. **(10 Marks)**
b. What is meant by fettling? Briefly explain the various steps involved in fettling. **(06 Marks)**
c. List the advantages and limitations of aluminium castings. **(04 Marks)**

Module-4

7 a. With a neat sketch, explain Flux Shielded Metal Arc Welding (FSMAW) process. State its advantages and limitations. **(10 Marks)**
b. With a neat sketch, explain explosive welding process. State its advantages and limitations. **(10 Marks)**

OR

8 a. With a neat sketch, explain atomic hydrogen welding process. List its advantages and limitations. **(10 Marks)**

b. With a neat sketch, explain electron beam welding process. List the advantages and disadvantages. **(10 Marks)**

Module-5

9 a. What is Heat Affected Zone (HAZ)? Explain the parameters affecting HAZ. **(07 Marks)**

b. Differentiate brazing and soldering. **(06 Marks)**

c. With neat sketch, explain X-ray radiography inspection process. **(07 Marks)**

OR

10 a. What are the functions of flux in welding process. **(04 Marks)**

b. Explain Oxy-acetylene gas welding process with neat sketch. State its advantages and disadvantages. **(08 Marks)**

c. With a neat sketch, explain ultrasonic inspection method. State its advantages and disadvantages. **(08 Marks)**

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Fourth Semester B.E. Degree Examination, June/July 2023
Complex Analysis, Probability and Statistical Methods

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find analytic function u + iv, where u is given to be $u = e^x[(x^2 - y^2)\cos y - 2xy \sin y]$. **(06 Marks)**

b. Derive Cauchy Reimann equations in polar form. **(07 Marks)**

c. Show that $u = e^{2x}[x\cos 2y - y\sin 2y]$ is harmonic. Find the analytic function f(z) = u + iv. **(07 Marks)**

OR

2 a. Derive Cauchy Reimann equation in Cartesian form. **(06 Marks)**

b. Determine analytic function f(z) = u + iv if $u - v = e^x[\cos y - \sin y]$. **(07 Marks)**

c. Show that $w = z^n$ is analytic and hence find its derivative. **(07 Marks)**

Module-2

3 a. Discuss the transformation $w = z + \frac{1}{z}, z \neq 0$. **(06 Marks)**

b. Find the Bilinear transformation which maps the points z = 1, i, -1 onto w = 0, 1, ∞. **(07 Marks)**

c. Evaluate $\int_0^{2+i} (\bar{z})^2 \, dz$ along i) line y = x/2 ii) real axis to 2 and then vertically to 2 + iy. **(07 Marks)**

OR

4 a. Discuss the transformation $w = z^2$. **(06 Marks)**

b. State and prove Cauchy's integral formula $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{(z-a)} dz$. **(07 Marks)**

c. Evaluate using Cauchy's integral formula.

$$\int_C \frac{e^{2z}}{(z-1)(z-2)} dz \quad C : |z| = 3.$$ **(07 Marks)**

Module-3

5 a. Define: i) Random variable ii) Discrete probability distribution with an example. **(06 Marks)**

b. The probability that man aged 60 will live upto 70 is 0.65. What is the probability that out of 10 men, now aged 60 i) Exactly 9 ii) atmost 9 iii) Atleast 7 will live up to age of 70 years. **(07 Marks)**

c. In a normal distribution, 3% of items are under 45 and 8% are over 64. Find the mean and standard deviation, given that A(0.5) = 0.19 and A(1.4) = 0.42. **(07 Marks)**

OR

6 a. The probability distribution of a finite random variable X is given by

X :	-2	-1	0	1	2	3
P(x) :	0.1	K	0.2	2K	0.3	K

Find 'K', mean and variance of X. **(06 Marks)**

b. If probability of bad reaction from certain injection is 0.001. Determine the chance that out of 2000 individuals more than two will get bad reaction, and less than two will get bad reaction. **(07 Marks)**

c. The frequency of accidents per shift in a factory is shown in the following table:

Accidents per shift	0	1	2	3	4
Frequency	192	100	24	3	1

Calculate mean numbers of accidents per shift. Find the corresponding Poisson distribution. **(07 Marks)**

Module-4

7 a. Fit a second degree parabola $y = a + bx + cx^2$ for the following data:

x	0	1	2	3	4	5
y	1	3	7	3	21	31

(06 Marks)

b. Find the coefficient of correlation, lines of regression of x on y and y on x. Given,

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

(07 Marks)

c. If θ is an acute angle between line of regression, then show that $\tan\theta = \frac{\sigma x}{\sigma_x^2 + \sigma_y^2}\left(\frac{1-r^2}{r}\right)$.

Indicate the significance of the cases r = 0 and r = ±1. **(07 Marks)**

OR

8 a. Fit the curve of the form ax^b and hence estimate y when x = 8.

x	5	10	15	20	25	30	35
y	2.76	3.17	3.44	3.64	3.81	3.95	4.07

(06 Marks)

b. Find the rank correlation coefficient for the following data:

x	93	44	53	08	71	81	6	10	32	31
y	45	62	12	28	92	84	73	3	51	32

(07 Marks)

c. With the usual notations compute $\bar{x}$, $\bar{y}$ and r from the following lines of regression:
$y = 0.516x + 33.73$ and $x = 0.512y + 32.52$. **(07 Marks)**

Module-5

9 a. The joint probability distribution for following data

X / Y	-2	-1	4	5
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Determine the marginal distributions of X and Y also calculate E(x), E(y), COV (xy). **(06 Marks)**

b. Define: i) Null hypothesis ii) Confidence limits iii) Type I, Type II errors. **(07 Marks)**

c. The following table gives the distribution of digits in the numbers chosen at random from a telephone directory:

Digits	0	1	2	3	4	5	6	7	8	9
Frequency	1026	1107	997	966	1075	933	1107	972	964	853

Test whether the digits may be taken to occur equally frequently in the directory. (given $\chi^2_{0.05} = 16.92$ at n = 9). **(07 Marks)**

OR

10 a. A fair coin is tossed thrice. The random variable X and Y are defined as follows. X = 0 or 1 according as head or tail occurs on first loss, Y = number of heads.
i) Determine distribution of X and Y.
ii) Joint probability distribution of X and Y.
iii) Expectation of X, Y and XY. **(06 Marks)**

b. It is claimed that a random sample of 49 tyres has a mean life of 15200km. Is the sample drawn from population whose mean is 15,150km and standard deviation is 200km? Test the significance level at 0.05 level. **(07 Marks)**

c. Ten individuals are choosen at random from the population and their height in inches are found to be 63, 63, 66, 67, 68, 69, 70, 70, 71, 71. Test the hypothesis that the mean height of universe is 66′ (value of $t_{0.05}$ = 2.262 for 9.D.F). **(07 Marks)**

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18ME42

Fourth Semester B.E. Degree Examination, June/July 2023
Applied 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. Define the following terms :
(i) Compression ratio.
(ii) Cut off ratio.
(iii) Thermal efficiency.
(iv) Relative efficiency. **(04 Marks)**

b. Derive an expression for air standard efficiency of a diesel cycle. **(08 Marks)**

c. Calculate the loss in the ideal efficiency of a diesel engine with compression ratio 14 if the cut off ratio is delayed from 5% to 8%. **(08 Marks)**

OR

2 a. What do you mean by detonation? Name the factors affecting detonation. **(04 Marks)**

b. With a P- θ diagram describe the stages of combustion in CI engine. **(08 Marks)**

c. During a 60 minutes trial on a single cylinder oil engine having cylinder dia 300 mm, stroke 450 mm and working on two stroke cycle. The following observations were made :
Total fuel used = 9.6 ltr, Heating value of fuel = 45000 kJ/kg,
Total number of revolution = 12624, Gross mep = 7.24 bar,
Pumping mep = 0.34 bar, Net brake load = 3150 N
Brake drum dia = 1.78 m, Rope dia = 40 mm
Cooling water circulated = 545 ltr
Cooling water temperature rise = 25 $^\circ$C
Specific gravity of oil = 0.8
Determine : IP, BP, mechanical efficiency and Draw the Heat balance sheet. **(08 Marks)**

Module-2

3 a. Explain Brayton cycle with line diagram, P-V diagram and derive an expression for pressure ratio for maximum work. **(10 Marks)**

b. A gas turbine unit has a pressure ratio of 6 : 1 and maximum cycle temperature of 610 $^\circ$C. The Isentropic efficiencies of compressor and Turbine are 0.8 and 0.82 respectively. Calculate the power output in kW of an electric generator geared to the turbine when the air enters the compressor at 15 $^\circ$C at the rate of 16 kg/sec.
Take C_P = 1.005 kJ/kg, γ = 1.4 for air.
C_P = 1.11 kJ/kg, γ = 1.333 for gas. **(10 Marks)**

OR

4 a. Explain the methods for the improvement of thermal efficiency of a open cycle gas turbine. **(10 Marks)**

b. Explain the following jet propulsion system :
(i) Ramjet Engine (ii) Rocket Engine. **(10 Marks)**

Module-3

5 a. Why Carnot cycle is practically not possible? **(04 Marks)**

b. State the advantages of regenerative cycle over Rankine cycle. **(04 Marks)**

c. Explain with sketch, the parameters affecting the Rankine cycle. **(12 Marks)**

OR

6 a. Explain with sketch, T-S and S-H diagram, the regenerative Rankine cycle. **(10 Marks)**

b. A simple Rankine Cycle works between pressure 30 bar and 0.04 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency, work ratio and specific steam consumption. **(10 Marks)**

Module-4

7 a. For a reversed Brayton cycle show that $COP = \frac{1}{r_P^{\gamma-1}} - 1$. **(10 Marks)**

b. With neat diagram, explain steam jet refrigeration. **(10 Marks)**

OR

8 a. Define the following terms :
- (i) Dry bulb temperature
- (ii) Dew point temperature
- (iii) Specific humidity
- (iv) Relative humidity
- (v) Degree of saturation **(10 Marks)**

b. The atmospheric conditions are $20^\circ C$ and specific humidity of 0.0095 kJ/kg of dry air. Calculate :
- (i) Partial pressure of water vapour
- (ii) Relative humidity **(10 Marks)**

Module-5

9 a. Derive an expression for isothermal efficiency of a single stage air compressor. **(10 Marks)**

b. An air compressor takes in air at 1 bar and $30^\circ C$ compresses it according to the law $PV^{1.2} = C$. Air is delivered to a receiver at a constant pressure of 10 bar, determine temperature at the end of compression, WD and Heat transferred during compression/kg air. Neglect clearance. Take R = 0.287 kJ/kgK. **(10 Marks)**

OR

10 a. Define steam Nozzle and Name the types of nozzle. **(04 Marks)**

b. With a neat sketch, describe the working of a steam injector. **(06 Marks)**

c. Steam approaches a nozzle with a velocity of 250 m/s, 3.5 bar and dryness fraction 0.95. If the back pressure is 2 bar, assuming flow to be isentropic, find the final condition of steam and drop in Enthalpy. Also find the exit velocity and the area at exit of steam nozzle if the flow rate is 2700 kg/h. **(10 Marks)**

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CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, June/July 2023
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following properties of fluids and write their SI units:
(i) Specific weight (ii) Kinematic viscosity (iii) Specific volume **(06 Marks)**

b. Define surface tension of a fluid. Derive an expression for surface tension of a :
(i) liquid droplet (ii) Liquid jet **(06 Marks)**

c. The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4 m. It rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. **(08 Marks)**

OR

2 a. State and prove Pascal's law. **(06 Marks)**

b. Derive an expression for total pressure and depth of centre of pressure for a vertical surface submerged in water. **(06 Marks)**

c. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4 m and altitude 4m when it is immersed vertically in an oil of specific gravity 0.9. The base of the plate coincides with the free surface of oil. **(08 Marks)**

Module-2

3 a. Define:
(i) Buoyancy (ii) Centre of Buoyancy
(iii) Meta centre (iv) Meta centric height **(08 Marks)**

b. Explain the method to find the metacentric height experimentally. **(06 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the metacentric height of the block if its size is 2m × 1m × 0.8m. **(06 Marks)**

OR

4 a. Differentiate between:
(i) Steady and unsteady flow
(ii) Laminar and turbulent flow
(iii) Compressible and incompressible flow **(06 Marks)**

b. Derive the continuity equation in three dimensional Cartesian coordinates for a steady, incompressible fluid flow. **(08 Marks)**

c. The diameter of a pipe at sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water at section 1 is 5 m/s. Determine also the velocity at section 2. **(06 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line. Deduce Bernoulli's equation from Euler's equation. State the assumptions made. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.87 changes in diameter from 200 mm at a position A to 500 mm at a position B which is 4 m at higher level. If the pressure at A and B are 10 N/cm^2 and 6 N/cm^2 respectively and the discharge is 200 litres/s. determine the loss of head and the direction of fluid flow. **(10 Marks)**

OR

6 a. Derive Hagen-Posseuille's equation for laminar flow through a circular pipe. **(12 Marks)**

b. Water at 15°C flows between two parallel plates at a distance of 1.6 mm apart. Determine: (i) Maximum velocity (ii) Pressure loss per unit length (iii) Shear stress at the plate if the average velocity is 0.2 m/s. Viscosity of water at 15°C is 0.01 Poise. Take unit width of the plate. **(08 Marks)**

Module-4

7 a. Define the following with respect to boundary layer:
(i) Boundary layer thickness (ii) Displacement thickness
(iii) Momentum thickness (iv) Energy thickness **(08 Marks)**

b. Define Drag and Lift. **(04 Marks)**

c. A flat plate 2m × 2m movers with a velocity of 50 km/hr in air of density 1.15 kg/m^3. If the coefficient of list and drag are 0.75 and 0.15 respectively, calculate:
(i) Drag force (ii) Lift force
(iii) Resultant force (iv) Power exerted on the plate **(08 Marks)**

OR

8 a. Explain the following similarities:
(i) Geometric similarity
(ii) Kinematic similarity
(iii) Dynamic similarity **(10 Marks)**

b. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = \rho N^2 D^5 \phi\left[\frac{\mu}{\rho N D^2}\right]$. Prove this by using Buckingham's π - theorem method. **(10 Marks)**

Module-5

9 a. Define Mach number. Explain the significance of Mach number in compressible fluid flow. **(06 Marks)**

b. Derive an expression for the velocity of a sound wave in a compressible fluid in terms of change of pressure and change of density. **(08 Marks)**

c. A projectile travel in air of pressure 10.1043 N/cm^2 at 10°C at a speed of 1500 km/hr. Find the Mach number and Mach angle. Take $\gamma = 1.4$ and $R = 287$ J/kgK. **(06 Marks)**

OR

10 a. Define stagnation temperature and stagnation pressure. Derive the relation between them in terms of Mach number. **(08 Marks)**

b. What is CFD? Mention the applications of CFD. **(06 Marks)**

c. List any six limitations of CFD. **(06 Marks)**

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CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, June/July 2023
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following :
i) Link ii) Kinematic pair iii) Mechanism iv) Degree of freedom v) Inversion **(10 Marks)**

b. Explain with a neat sketch, the crank and slotted lever mechanism. **(10 Marks)**

OR

2 a. What is completely constrained motion and partially constrained motion? Explain with example. **(05 Marks)**

b. State Grashoff's law and list inversions of Grashoff's chain. **(05 Marks)**

c. With a neat sketch explain, Ackermann steering gear mechanism. **(10 Marks)**

Module-2

3 a. In a slider crank mechanism, the crank OB is 30mm long and the connecting rod BC is 120mm long. The crank rotates at a uniform speed of 300 rpm clockwise about center 'O'. For a crank position ∠BOC equal to 60° draw the configuration and find

(i) Velocity of piston C and angular velocity of connecting rod BC.
(ii) Acceleration of piston C and angular acceleration of connecting rod BC. **(16 Marks)**

b. Define instantaneous center and state the types of instantaneous centers. **(04 Marks)**

OR

4 a. State and prove Kennedy's theorem. **(08 Marks)**

b. A four bar mechanism ABCD has AB = 20cm, BC = 30cm, CD = 32 cm and AD = 60cm. Crank AB rotates at a uniform speed of 300 r.p.m in anticlockwise direction. When the crank AB has turned 60°, locate all the instantaneous centers and find the angular velocity of link BC, where AD is fixed. **(12 Marks)**

Module-3

5 a. What is meant by Loop-Closure equation? Deduce the loop closure equation for the closed loop of a four bar mechanism. **(10 Marks)**

b. The crank of an engine is 50 cm long and the connecting rod length to crank radius is 4. Determine the velocity of the piston, when the crank has turned through 40° from top dead center position. The crank is rotating at 100 rad/sec in clockwise direction. By complex algebra analysis method, find out the velocity of the piston. **(10 Marks)**

OR

6 a. Explain the following with a diagram wherever required:
i) Function generation
ii) Precision points
iii) Structural error
iv) Mechanical error **(08 Marks)**

b. A schematic of a four bar mechanism with input link 'a' and output link 'c' is shown in Fig.Q6(b). The angles θ and ϕ for three successive positions are given in the table below:

Angles	1	2	3
θ	55	25	-25
ϕ	110	40	-50

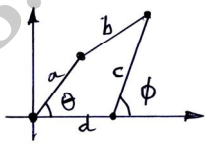

Fig.Q6(b)

If the length of the grounded link 'd' is 40mm, using Frendenstein's equation, find out length of other links to satisfy the given positional conditions. **(12 Marks)**

Module-4

7 A cam with 30mm as minimum radius is rotating clockwise at a uniform speed of 1200 rpm and has to give the motion to the knife edge follower as follows:

i) Follower to move outward through 30mm during 120° of CAM rotation with SHM.
ii) Dwell for the next 60°.
iii) Follower to return to its starting position during the next 90° with SHM.
iv) Dwell for the remaining period.

Draw the CAM profile when the follower axis passes through CAM axis. Also find the maximum velocity and acceleration during the outward and return stroke. **(20 Marks)**

OR

8 A cam rotating clockwise at uniform speed of 300 rpm operates a reciprocating follower through a roller 1.5 cm diameter. The follower motion is defined as below:

i) Outward during 150° with UARM
ii) Dwell for next 30°
iii) Return during next 120° with SHM.
iv) Dwell for the remaining period.

Stroke of the follower is 3cm. Minimum radius of cam is 3cm. Draw the cam profile when the follower axis passes through cam axis. **(20 Marks)**

Module-5

9 a. State and prove the law of gearing for constant velocity ratio. **(10 Marks)**

b. Two involute gears with number of teeth 28 and 45 are in mesh. If they have standard addendum of 3 mm and pressure angle is 20°, find the following ;
i) Path of approach ii) Path of recess iii) Contact ratio
Assume module is 3mm. **(10 Marks)**

OR

10 The arm C of an epicyclic gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the center of wheel A. Find the speed of wheel B. What will be the speed of B, if wheel A instead of being fixed makes 200 rpm clockwise? **(20 Marks)**

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CBCS SCHEME

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18ME45A/18MEA405

Fourth Semester B.E. Degree Examination, June/July 2023
Metal Cutting & Forming

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the orthogonal and oblique cutting with a neat sketch and also explain the meaning of tool signature. **(10 Marks)**

b. Draw Merchant's circle diagram and state the assumption made in establishing the relationship among the various forces. **(10 Marks)**

OR

2 a. Explain the parts of a Lathe machine with a neat sketch. **(10 Marks)**

b. Deriving an orthogonal cutting process the following observations where made chip thickness = 0.45mm, Width of cut = 2.5mm, Feed = 0.25mm/rev, cutting force = 113Kg, Thrust force = 29.5Kg. The cutting speed was 150m/min and the rake angle was 10º. Calculate the following :

i) Chip thickness ratio
ii) Chip reduction coefficient
iii) Shear angle
iv) Velocity of the chip along the tool face
v) Frictional force along the tool force
vi) Shear stress
vii) Power required for cutting. **(10 Marks)**

Module-2

3 a. Explain any four operations can perform in a milling machine. Differentiate between drilling, boring and reaming. **(10 Marks)**

b. Explain Radial Drilling machine with sketch. **(10 Marks)**

OR

4 a. Explain the working of planning machine with sketch. **(10 Marks)**

b. Define indexing. Explain the method of indexing. **(10 Marks)**

Module-3

5 a. Define tool life. List out the factors affecting on tool life and also explain the effect of machining parameters on surface finish. **(10 Marks)**

b. Explain the types of cutting fluids. **(10 Marks)**

OR

6 a. List out the types of tool wear and explain the mechanism of tool wear. **(10 Marks)**
b. Write short note on economics of machining process and Taylor's tool life equation. **(10 Marks)**

Module-4

7 a. Explain briefly the classification of the metal forming process. **(10 Marks)**
b. Explain the types of rolling mills with neat sketch. **(10 Marks)**

OR

8 a. Explain the indirect and Hydrostatic extrusion processes with sketch. **(10 Marks)**
b. Differentiate between the hot cooking and cold cooking processes. **(10 Marks)**

Module-5

9 a. Explain any five operations that can perform in the sheet metal with sketches. **(10 Marks)**
b. Explain the compound die and combination die with sketch. **(10 Marks)**

OR

10 a. Explain the calculations for the force requirement in the bending and drawing force in a sheet metal operation. **(10 Marks)**
b. Define LDR (Limiting Drawing Ratio) in drawing. Explain the parameters affecting the drawabilty. **(10 Marks)**

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CBCS SCHEME

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18ME51

Fifth Semester B.E. Degree Examination, June/July 2023
Management and Economics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Management. Explain the nature and characteristics of management. **(10 Marks)**

b. Write about roles of management and what are different level of management. **(10 Marks)**

OR

2 a. Explain the modern management approaches. **(10 Marks)**

b. State and explain importance and purpose of planning process. **(10 Marks)**

Module-2

3 a. State and explain the principle of organization. **(10 Marks)**

b. Explain with sketch line and staff organization. **(10 Marks)**

OR

4 a. Explain the techniques of selection of staffing. **(10 Marks)**

b. Define controlling? Explain the methods of establishing sound controlling. **(10 Marks)**

Module-3

5 a. Explain how the problem solving process leading ultimately to a decision is carried out. **(06 Marks)**

b. Define elasticity and explain the factors that influence elasticity of demand. **(06 Marks)**

c. A person takes a loan of Rs.10,000/- from a Bank at Interest of 10% PA. Find the amount if,
(i) Interest is compounded annually. (ii) Interest is compounded half yearly.
(iii) Interest is compounded quarterly. (iv) Interest is compounded monthly. **(08 Marks)**

OR

6 a. Draw the cash flow diagram for Lender and Borrowers. **(04 Marks)**

b. An amount of Rs.1200 per year is to be paid into an account each for the next five years. Using Nominal Interest of 12% determine the total amount. The account will have at the end of 5^{th} year under the following condition :
(i) Deposit made at the end of each year with interest compounded monthly.
(ii) Deposit made at the end of each year with interest compounded continuously. **(08 Marks)**

c. The rights to a patent have been sold under an agreement in which annual year end payment of Rs.100,000 are to be made for the next 10 years what is the future sum of this annuity? What is the present worth of the annuity at an Interest rate 7 percent? **(08 Marks)**

Module-4

7 a. Briefly explain the condition for present worth comparision. **(05 Marks)**

b. Explain IRR (Interest Rate of Return) and MARR (Minimum Acceptable rate of Return). **(05 Marks)**

c. Two holiday cottage are under consideration compare the present worth of the cost of 24 years service at an Interest rate of 5 percent, when neither cottage has a realizable salvage value.

Particular	Cottage-1	Cottage-2
First cost	Rs.4500	Rs.10,000
Estimated life	12 year	24 year
Annual maintenance cost	Rs.1000	Rs.720

(10 Marks)

OR

8 a. Stand by lighting generator is require for a shop. Two types are available.

Particular	Type-1	Type-2
First cost	Rs.5000	Rs.3200
Salvage value	Rs.1000	Nil
Annual operating cost	Rs.780	Rs.950

If both generator have a life of 4 years and the interest rate is 15 percent per year which offers the lowest equivalent annual cost? **(10 Marks)**

b. Farm house can be purchased for Rs.90,000 and the expected resale value after 20 years is Rs.60,000. If the annual rental income is Rs.11,800 and expenses Rs.4700. What will be the rate of return earned on this farm house? **(10 Marks)**

Module-5

9 a. Briefly explain the contents of element of cost. **(05 Marks)**

b. A firm is producing 100 units per day. The direct material cost is fund to be Rs.160. The direct labour cost is Rs.200 and Factory over heads chargeable to it is Rs.250. If the selling expenses are 40% of the factory cost. What must be selling price of each unit to realize a profit of 15% of the selling price? **(07 Marks)**

c. A mild steel component as shown in a Fig. Q9 (c) below is to be manufactured. Find the Total cost of material the density of material is 7.81 gm/cm^3. The cost of material is Rs.60/kg. All dimensions are in cm.

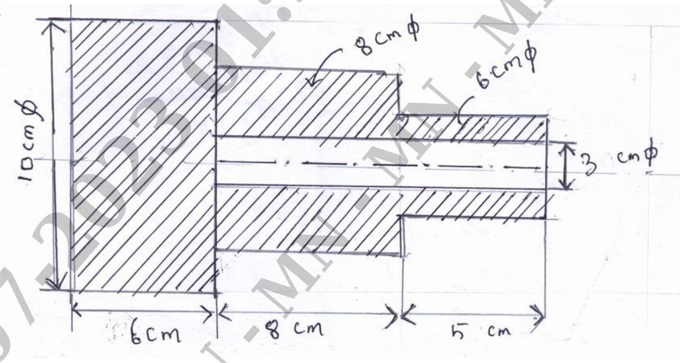

Fig. Q9 (c) **(08 Marks)**

OR

10 a. Briefly explain the following methods of depreciation:

(i) Diminishing balance method

(ii) Sinking fund method. **(10 Marks)**

b. A CNC machine costs Rs.30,00,000 is estimated to serve 8 years after which its salvage value is estimated to be Rs.2,50,000. Find

(i) Depriciation fund at the end of the 5th year by fixed percentage method and declining balance method.

(ii) Book value of the machine after 4th year and 6th year by declining balance method. **(10 Marks)**

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CBCS SCHEME

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18ME52

Fifth Semester B.E. Degree Examination, June/July 2023
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What are the factors to be considered for the selection for a machine component? **(06 Marks)**

b. Explain the codes and standards used in Machine Design. **(04 Marks)**

c. A point in a structural member subjected to a plane stress as shown in Fig.Q1(c). Determine the following :

i) Normal and Tangential stress on a plane inclined at 45°.
ii) Principal stresses and their direction
iii) Maximum shear stress and the direction of the plane on which it occurs.

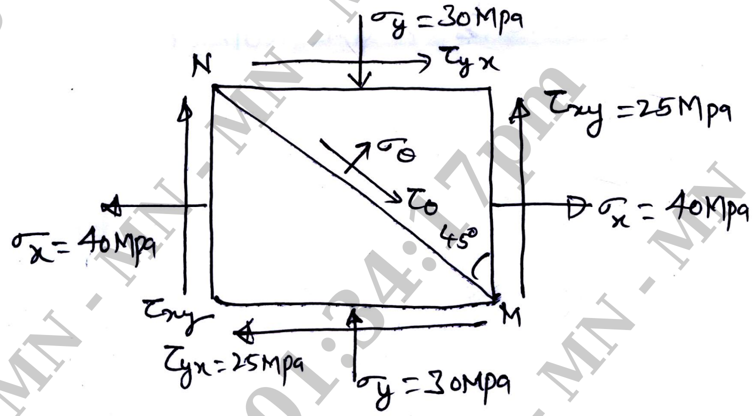

Fig.Q1(c) **(10 Marks)**

OR

2 a. Define stress concentration factor and discuss about the methods to reduce stress concentration factor. **(08 Marks)**

b. A circular rod shaft of diameter of 50mm is subjected to load as shown in Fig.Q2(b). Determine the nature and magnitude of stresses at the critical points A and B.

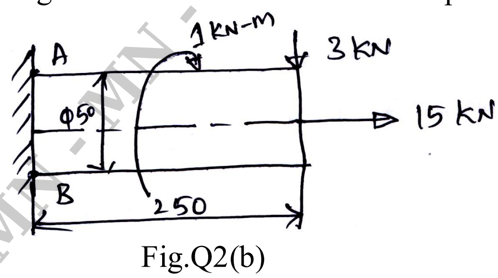

Fig.Q2(b) **(12 Marks)**

Module-2

3 a. Define Impact Stresses. Derive an expression for impact stresses in a axial bar of c/s ‘A’ and length ‘L’ due to the impact load of ‘W’ falling from a height ‘h’ from the collar. **(08 Marks)**

b. A cantilever beam made of cold drawn carbon steel (σ_u = 550 MPa, σ_y = 470 MPa, σ_{-1} = 275 MPa) of circular cross-section is subjected to load which varies from – F to 3F. Determine the maximum load that this member can withstand for an infinite life using a factor of safety of 2. [Refer Fig.Q3(b)] **(12 Marks)**

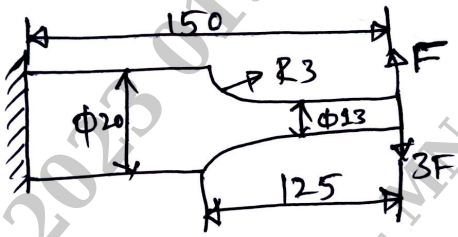

Fig.Q3(b)

OR

4 a. Define Endurance limit. Explain the effect of factors on Endurance limit. **(08 Marks)**

b. A hot rolled steel shaft is subjected to a torsional load that varies from 330 N-m (CW) to 110 Nm (CCW) as an applied bending moment at the critical section varies from +440 N-m to – 220 Nm. The shaft is of uniform cross section and no key way is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and yield strength of 410 MN/m^2. Factor of safety = 1.5 size and surface correction are 0.85 and 0.62 respectively. Take the Endurance limit as half the ultimate strength. **(12 Marks)**

Module-3

5 A shaft is supported by two bearings placed 1m apart. A 500mm diameter pulley is mounted at a distance of 200mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000N. The pulley weighs 1000N. Another pulley 300mm diameter is placed 300mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weighs 500 N. The angle of contact for both the pulley is 180° and μ = 0.24. Determine suitable diameter for a solid shaft, assuming torque on one pulley is equal to torque on other pulley. Choose C15 steel (σ_y = 235.4 MPa, σ_u = 425 MPa) as the shaft material and use ASME code for the design of shaft, assume minor shock condition. **(20 Marks)**

OR

6 a. With neat sketch, explain the different types of keys. **(08 Marks)**

b. Design a flange coupling to connect the shafts of a motor and the centrifugal pump for the following specifications:
Pump output = 3000 liters/minute
Total head = 20 m
Pump speed = 600 rpm
Pump Efficiency = 70%
Select C-40 steel (σ_y = 328.6 MPa) for the shaft and C-35 steel (σ_y = 304 MPa) for bolts with factor of safety 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2. **(12 Marks)**

Module-4

7 a. Design a triple riveted Lap Zig-Zag type, for a pressure vessel of 1.5m diameter. The maximum pressure inside the vessel is 1.5 MPa. The allowable stresses in tension, crushing and shear are 100, 125 and 75 MPa respectively. **(10 Marks)**

b. A bracket is supported by means of 4 rivets of same size as shown in Fig.Q7(b). Determine the diameter of rivet, if the maximum shear stress is 140 N/mm^2.

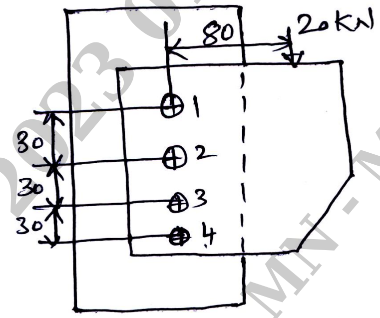

Fig.Q7(b) **(10 Marks)**

OR

8 a. A plate of 80mm wide and 10mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading. **(12 Marks)**

b. A solid circular shaft 25mm in diameter is welded to a support by means of a fillet weld as shown in Fig.Q8(b). Determine the Leg dimensions of the weld, if the permissible shear stress is 95 N/mm^2.

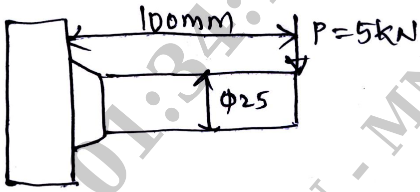

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses $\sigma_f = 100$ N/mm^2, $\sigma_c = 150$ N/mm^2 and $\tau = 60$ N/mm^2. **(14 Marks)**

b. Explain self locking and over hauling in power screws. **(06 Marks)**

OR

10 a. Derive an equation for torque required to lift the load on square threaded screw. **(10 Marks)**

b. A split nut used with a lead screw is propelled at a speed of 5 m/min, against a load of 20 kN, along the spindle of a square thread (single start) having nominal diameter of 30mm and pitch of 6mm. The axial thrust is absorbed by collar of 100mm outside diameter and 70mm insider diameter. Determine, (i) Power required (ii) Height of bronze nut required if allowable bearing pressure is 17 MPa. (iii) Efficiency of the drive. **(10 Marks)**

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CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, June/July 2023
Dynamics of Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the following terms with neat diagrams:
(i) Equilibrium of three force system
(ii) Equilibrium of two force and a torque **(06 Marks)**

b. A four-link mechanism with the following dimensions is acted upon by a force 100 N ∠150° N on the link DC [Fig.Q1(b)]. AD = 500 mm, AB = 400 mm, BC = 900 mm and DC = 750 mm, DE = 350 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration.

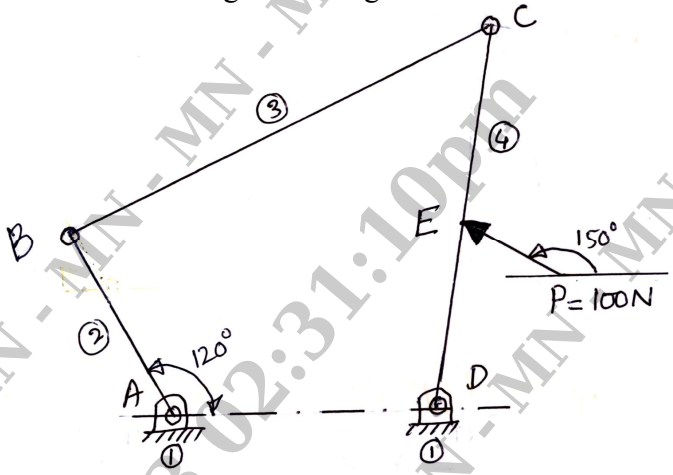

Fig.Q1(b) **(14 Marks)**

OR

2 a. State and explain D'Alembert's principle. **(06 Marks)**

b. The following data relate to a horizontal reciprocating engine:
Mass of reciprocating parts = 120 kg
Crank length = 90 mm
Engine speed = 900 rpm
Connecting rod:
Mass = 90 kg
Length between centers = 450 mm
Distance of center of mass from big end center = 180 mm
Radius of gyration about an axis through center of mass = 150 mm
Find the magnitude and the direction of the inertia torque on the crankshaft when the crank has turned 30° from inner dead center. **(14 Marks)**

Module-2

3 a. What do you mean by static balancing and dynamic balancing? Explain. **(06 Marks)**

b. Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90° and 195° respectively with that of mass B in the counter clockwise direction. The rotating masses have the following properties:

Mass of B = 25 kg Radius of mass A at A plane = 150 mm
Mass of C = 40 kg Radius of mass B = 200 mm
Mass of D = 35 kg Radius of mass D = 180 mm

Planes B and C are 250 mm apart. Determine the :

(i) Mass A and its angular position with that of mass B
(ii) Positions of all the planes relative to plane of mass A. **(14 Marks)**

OR

4 a. Explain complete balancing of reciprocating parts. **(05 Marks)**

b. The cranks of a foul-cylinder marine oil engine. Cranks are arranged at angular intervals of 90°. The engine speed is 70 rpm, and the reciprocating mass per cylinder is 800 kg. The inner cranks are 1 m apart and the outer are 2.6 m apart. The inner cranks are symmetrically arranged between the outer cranks. Each crank is 400 mm long.

Determine the firing order of the cylinders for the best balance of reciprocating masses and also the magnitude of the unbalanced primary couple for that arrangement. **(15 Marks)**

Module-3

5 a. Derive the expression for equilibrium speed of porter governor. **(08 Marks)**

b. Each arm of a porter governor is 250 mm long. The upper arms are pivoted to links of 40 mm from the axis of rotation. The lower arms are pivoted to links of 50 mm from the axis of rotation. Each ball has a mass of 5 kg and the central mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm respectively. **(12 Marks)**

OR

6 a. Explain gyroscopic couple effect on steering, pitching and rolling with respect to naval ship. **(06 Marks)**

b. What is angle of heel? Explain its importance. **(02 Marks)**

c. An aeroplane flying at 300 kmph turns towards the left and completes a quarter circle of 60 m radius. The mass of rotary engine and propeller of the plane is 450 kg with a radius of gyration of 320 mm. The engine speed is 2000 rpm clockwise when viewed from the rear. Determine the gyroscopic couple on the aircraft and state its effect.

In what way is the effect changed when the (i) aeroplane turns towards right (ii) engine rotates clockwise when viewed from the front (nose end) and aeroplane turns left. **(12 Marks)**

Module-4

7 a. Explain energy method to find natural frequency of spring-mass-system. **(06 Marks)**

b. What is the effect of spring mass? Derive the expression for natural frequency of the system. **(06 Marks)**

c. Determine the frequency of vibration of the system shown in Fig.Q7(c). Use the following data m = 10 kg, K_1 = 200 N/m, K_2 = 400 N/m.

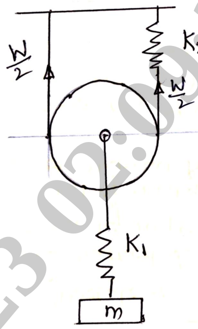

Fig.Q7(c) **(08 Marks)**

OR

8 a. Setup the differential equation for a spring mass damper system and obtain complete solution for the under-damped condition. **(10 Marks)**

b. Determine :
(i) Critical damping coefficient
(ii) Damping factor
(iii) Natural frequency of damped vibrations
(iv) Logarithmic decrement
(v) Ratio of two consecutive amplitude of vibrating system which consists of mass of 30 kg, a spring of stiffness 1800 N/m and a damper. The damping provided is only 15% of the critical value. **(10 Marks)**

Module-5

9 a. Derive the expression for the maximum displacement for forced vibration of undamped single degree freedom system. **(08 Marks)**

b. Explain vibration isolation. **(02 Marks)**

c. A machine of total mass 18 kg is mounted on springs having stiffness K = 12000 N/cm. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and speed 6000 rpm. Assuming the motion to be SHM. Determine:
(i) Amplitude of vibration
(ii) Transmissibility
(iii) Force transmitted to the ground to foundation.
Take ξ = damping ratio = 0.2. **(10 Marks)**

OR

10 a. Define critical speed and explain its types. **(05 Marks)**

b. A shaft supported freely at the ends has a mass of 120 kg placed 250 mm from one end. The shaft diameter is 40 mm. Determine the natural frequency of the transverse vibrations if the length of the shaft is 700 mm. Take E = 200 GN/m^2. **(05 Marks)**

c. The following data relate to a horizontal shaft held in long bearings.
Length of the shaft = 1.2 m
Diameter of the shaft = 14 mm
Mass of rotor at mid point = 16 kg
Eccentricity of center of mass of rotor from center of rotor = 0.4 mm
E = 200 GN/m^2
Permissible stress in the shaft material = 70×10^6 N/m^2
Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft. Neglect mass of the shaft. **(10 Marks)**

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CBCS SCHEME

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18ME54

Fifth Semester B.E. Degree Examination, June/July 2023
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of steam tables is permitted.***

Module-1

1 a. Explain the significance and use of :
(i) Flow coefficient (ii) Head coefficient
(iii) Power coefficient (iv) Specific speed of turbomachine **(08 Marks)**

b. A low pressure air compressor develops a pressure of 1.147 bar and temperature of 320 K if the initial pressure and temperature are 1.01 bar and 305 K respectively. Determine compressor and polytropic efficiency. **(06 Marks)**

c. Distinguish static and stagnation properties. Why are stagnation properties preferred to static properties for use in the analysis of turbomachine processes? **(06 Marks)**

OR

2 a. What is a reheat factor? Prove that the overall isentropic expansion efficiency is more than the individual stage isentropic expansion efficiency. **(08 Marks)**

b. Define with the help of temperature entropy diagram for expansion:
(i) Mechanical efficiency (ii) Adiabatic efficiency
(iii) Overall efficiency (iv) Total-Total efficiency **(08 Marks)**

c. A centrifugal pump operating at the best efficiency point produces a head of 26 m and delivers 1 m^3/sec of water when rotating at 1500 rpm. Its impeller diameter is 0.5 m. If a geometrically similar pump of impeller diameter 0.8 m is operating at 1200 rpm, calculate the discharge and head. **(04 Marks)**

Module-2

3 a. Derive an Euler's turbine equation for turbomachine. State the assumptions made in the derivation. **(10 Marks)**

b. A centrifugal pump of 1.5 m diameter runs at 210 rpm and pumps 1.8 m^3/sec of water. The vanes are set back with an angle 25° at exit. Assuming radial entry and velocity of flow throughout is 2.5 m/sec. Determine the power required to drive the pump. If the manometric efficiency of the pump is 65%. Find the average lift of the pump. **(10 Marks)**

OR

4 a. Discuss the effect of discharge blade angle on degree of reaction and energy transfer in the radial flow turbo machine. Assume the radial fluid entry at the inlet. **(10 Marks)**

b. Air enters a rotor in an axial flow turbine with a tangential component of the absolute velocity equal to 600 m/sec in the direction of rotation. At the rotor exit the tangential component of absolute velocity is 100 m/sec in the direction opposite to that of the rotational speed. The tangential blade velocity is 250 m/sec. Evaluate total enthalpy change across the rotor, the change in total temperature across the rotor and the power developed if the mass flow rate is 10 kg/sec. Take the value of C_p = 1.005 kJ/kgK for air. **(10 Marks)**

Module-3

5 a. What are the methods used in reducing the speed of turbine rotor? Explain any one method of reducing speed with necessary sketches. **(10 Marks)**

b. In a reaction turbine, the blade tips are inclined at 35° and 20° in the direction of rotor. The blades are the same shape as the moving blades but reverted in the direction at certain place in the turbine. The drum is 1 m diameter and the blades are 10 cm high of this place the steam has a density of 1.042 kg/m^3. If the speed of the turbine is 250 rpm and the steam passes through the blade without shock find the mass flow rate of the steam and power developed, taking absolute velocity of the steam as 32 m/sec. **(10 Marks)**

OR

6 a. Explain the working of a single stage reaction type steam turbine, with relevant diagrams. **(10 Marks)**

b. Derive an expression for maximum blade efficiency of a single stage impulse turbine with the help of velocity triangles. **(10 Marks)**

Module-4

7 a. Explain with a neat sketch the set up of Kaplan Turbine. Where it is suited? **(10 Marks)**

b. Determine the power given by the jet of water to the runner of a pelton wheel which is having tangential velocity as 20 m/sec. The net head on the turbine is 50 m and discharge through the jet is 0.03 m^3/sec. the side clearance angle is 15° and take $C_V = 0.975$. **(10 Marks)**

OR

8 a. What is a draft tube? Why it is used in reaction turbine? Describe with sketch any two types of draft tube. **(10 Marks)**

b. A Kaplan turbine working under a head of 20 m develops 11772 KW shaft power. The outer and hub diameter of runner is 3.5 m and 1.75 m respectively. The hydraulic and overall efficiency of the turbine are 0.88 and 0.84 respectively. If the velocity of whirl is zero at outlet. Determine: (i) Runner vane angles at inlet and outlet (ii) Speed of the turbine. **(10 Marks)**

Module-5

9 a. With a neat diagram show different heads and efficiencies that are used in the study of centrifugal pumps. **(10 Marks)**

b. The diameter ratio of the impeller of a centrifugal compressor is 2 and the pressure ratio is 4. At a speed of 12000 rpm the flow rate is 10 m^3/sec of free air. The isentropic efficiency of the compressor is 94%. The blades are radial at the outlet and the entry is radial at the inlet. The velocity of flow remains constant at 60 m/sec through the impeller. Calculate:

(i) Power input to the machine

(ii) The impeller diameter at inlet and outlet the suction is from the atmosphere at 100 kPa and 300 K.

Take for air $C_p = 1.004$ kJ/kgK and $\gamma = 1.4$ **(10 Marks)**

OR

10 a. What is slip factor? Explain how does it affect the performance of the centrifugal compressor. **(06 Marks)**

b. Explain what net positive suction head of a centrifugal pump. **(04 Marks)**

c. The blade angles at inlet and outlet of the impeller of a centrifugal pump are 55° and 75° and the corresponding diameters are 3 cm and 6 cm respectively. The blade width at outlet is 0.75 cm. The speed is 1500 rpm. The entry of water is radial without any whirl component. The velocity of flow remains constant in the impeller. Draw the velocity triangles and calculate : (i) Specific work (ii) Flow rate (iii) Power of the machine (iv) The manometric head. The hydraulic efficiency may be taken as 0.85. **(10 Marks)**

CBCS SCHEME

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18ME61

Sixth Semester B.E. Degree Examination, June/July 2023
Finite Element Methods

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define FEM. List the advantages and disadvantages of FEM. **(10 Marks)**

b. List and explain steps in FEM. **(10 Marks)**

OR

2 a. Explain simplex, complex and multiplex elements. **(06 Marks)**

b. A cantilever beam of span 'L' is subjected to a point load at its free end as shown in Fig.Q2(b). Derive an equation for the deflection at free end by using RR method. Assume polynomial displacement function.

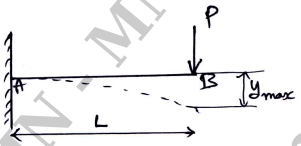

Fig.Q2(b) **(14 Marks)**

Module-2

3 a. Derive the element stiffness matrix of 1D bar element. **(08 Marks)**

b. Using penalty method of handling boundary condition, determine the nodal displacement, stress in each element and support reaction in the bar shown due to applied load in Fig.Q3(b). P = 100 kN.

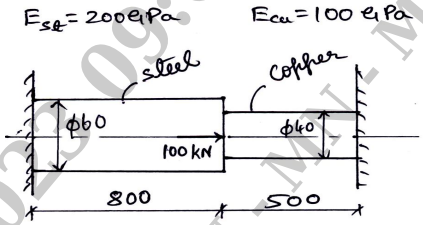

Fig.Q3(b) **(12 Marks)**

OR

4 a. List the assumptions made in Truss. **(04 Marks)**

b. A 4 bar truss element is shown in Fig.Q4(b). Determine the following:
i) Nodal displacement ii) Stress in each element iii) Reaction at supports.
Area of each truss element = 100 mm^2 ; E = 2×10^5 N/mm^2.

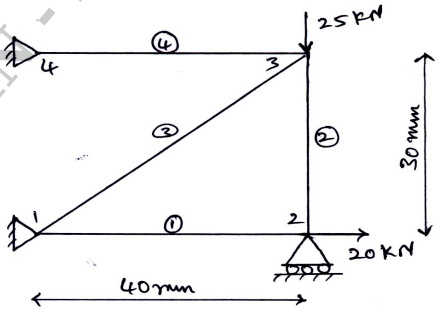

Fig.Q4(b) **(16 Marks)**

Module-3

5 a. Derive the Hermite shape function of a Beam element. **(08 Marks)**

b. For the beam shown in Fig.Q5(b), determine the displacement at node 2 and internal loads. Take E = 210 GPa, b = 0.2 m ; h = 0.4 m.

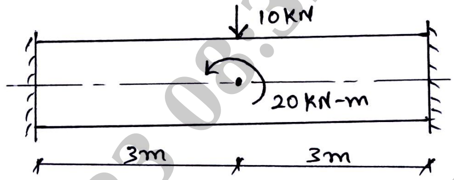

Fig.Q5(b) **(12 Marks)**

OR

6 a. Derive the stiffness matrix for the torsion of shafts. **(08 Marks)**

b. A solid stepped bar of circular cross section shown in Fig.Q6(b) is subjected to a torque of 1 kN-m at its free end and a torque of 3 kN-m at its change in c/s. Determine the angle of twist and shear stresses in the bar. Take E = 2×10^5 N/mm^2 and G = 7×10^4 N/mm^2.

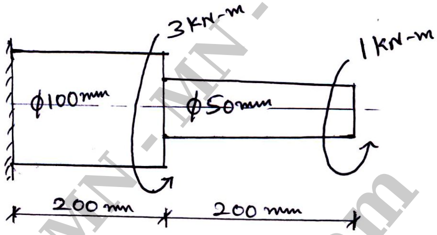

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Derive the governing differential equation for 1-D heat conduction. **(06 Marks)**

b. Determine the temperature distribution in the composite wall using 1D heat elements, use penalty approach of handling BC's. Refer Fig.Q7(b).

Given :

k_1 = 20 W/m °C
k_2 = 30 W/m °C
k_3 = 55 W/m °C
h = 30 W/m^2 C
T_∞ = 900°C
A = Unit area

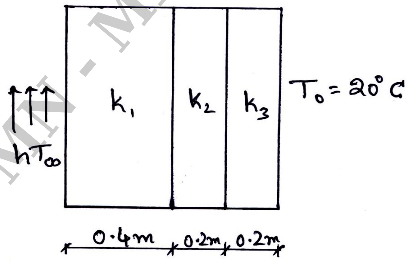

Fig.Q7(b) **(14 Marks)**

OR

8 a. Derive the element stiffness matrix of 1-D fluid flow element. **(06 Marks)**

b. For the smooth pipe of variable cross-section shown in Fig.Q8(b), determine the potential at the junction, the velocities in each section of pipe and the volumetric flow rate. The potential at left end is P_1 = 10 m^2/s and at right end is P_4 = 1 m^2/s. For the fluid flow through a smooth pipe k_x = 1.

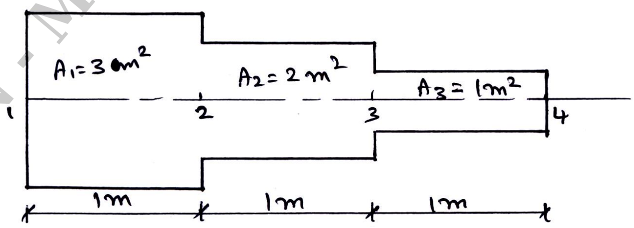

Fig.Q8(b) **(14 Marks)**

Module-5

9 a. Derive the element stiffness matrix of a triangular axisymmetric element using potential energy approach. **(06 Marks)**

b. For the element of an axisymmetric body rotating with constant angular velocity w = 1000 rev/min as shown in Fig.Q9(b). Determine the body force vector. Include the weight of the material, where specific density is 7850 kg/m^3.

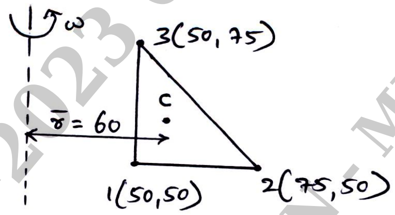

Fig.Q9(b) **(14 Marks)**

OR

10 a. Derive an expression of element mass matrices of
(i) 1-D bar element
(ii) Truss element **(10 Marks)**

b. Evaluate eigen value and eigen vector of longitudinal vibration of the constrained uniform circular bar shown in Fig.Q10(b). Take minimum two elements. Take E = 210 GPa and ρ = 7860 kg/m^3.

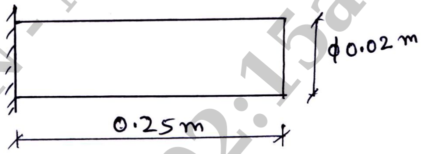

Fig.Q10(b) **(10 Marks)**

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CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, June/July 2023
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

Note:1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Using design data hand book is permitted.
3. Assume missing data suitably.

Module-1

1 a. Discuss about the following terms :
(i) Active coils
(ii) Deflection
(iii) Solid length
(iv) Free length
(v) Resilience **(05 Marks)**

b. Derive an expression for energy stored in a spring. **(05 Marks)**

c. Design a helical compression spring to carry a load of 500 N with a deflection of 20 mm. The allowable shear stress in the spring material is 350 MN/m^2 and the modulus of rigidity is 82.7×10^3 MN/m^2. The spring index is 6. **(10 Marks)**

OR

2 a. A leather belt 125 mm wide and 6 mm thickness transmits power from a pulley 750 mm diameter which runs at 500 rpm. The angle of lap is 150° and the coefficients of friction between the belt and the pulley is 0.3. If the belt density is 1000 kg/m^3 and the stress in the belt is not to exceed 2.75 N/mm^2, find the power that can be transmitted by the belt. Also find the initial tension in the belt. **(10 Marks)**

b. An oil well has to be drilled to a depth of 900 mm using 100 drill pipe. Assume 200 N for every 15 m length of pipe. The rope sheaves are of 80 mm diameter and acceleration is 2.5 m/s^2. Determine the size of 6×37 wire rope for lifting the string of pipes using a FOS as 3 and ultimate stress as 1800 MPa. **(10 Marks)**

Module-2

3 Design a pair of spur gear to transmit 27 kW for an oil pump with the gear ratio of 3 : 1, the rpm of the pinion is 1200, the centre distance is 400 mm, and the gears are to be forged steel untreated with $14\frac{1}{2}^\circ$ FDI. Check the design for dynamic and wear condition. **(20 Marks)**

OR

4 A pair of helical gears are used to transmit 15 kW. The teeth are 20° full depth in normal plane and have a helix angle of 30°. The pinion has 24 teeth and operates at 1000 rpm. The velocity ratio is 5 to 1. The pinion is made of cast steel $[\sigma_d = 50\,MPa]$ and the gear is of bronze $[\sigma_d = 40\,MPa]$. The pinion material is hardened to 200 BHN. Design the gear pair. **(20 Marks)**

Module-3

5 A pair of straight tooth bevel gear at right angle is to transmit 5 kW at 1200 rpm of the pinion. The diameter of the pinion is 80 mm and the velocity ratio is 3.5 to 1. The tooth form is $14\frac{1}{2}^{\circ}$ composite type. Both pinion and gear are made of CI $\left[\sigma_d = 55 \text{ N/mm}^2\right]$. Determine the face width and the required module from the stand point of strength using Lewis equation and check for design from the stand point of dynamic load and wear load. **(20 Marks)**

OR

6 Design a worm gear to transmit 2 kW at 1000 rpm, speed ratio is 20 and centre distance is 200 mm. **(20 Marks)**

Module-4

7 a. A cone clutch with a face angle of 14° has to transmit 286 N-m of torque at a speed of 600 rev/min. The larger diameter of the clutch is 250 mm, face width is 60 mm and co-efficient of friction is 0.18. Determine (i) Axial force to transmit the torque (ii) Average normal pressure (iii) Maximum normal pressure. Assume uniform wear condition. **(10 Marks)**

b. A single plate friction clutch of both sides effective has 0.3 m outer diameter and 0.16 m inner diameter. The coefficient of friction is 0.2 and it runs at 1000 rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases if the allowable maximum pressure is 0.08 MPa. **(10 Marks)**

OR

8 a. Fig. Q8 (a) shows a CI brake shoe. The coefficient of friction is 0.30. The breaking torsional moment is to be 346 N. Determine

(i) The force P, for anti-clock wise rotation.
(ii) The force P, for clockwise direction.
(iii) Where must the pivot be placed to make the brake self energizing with the counter clockwise direction.

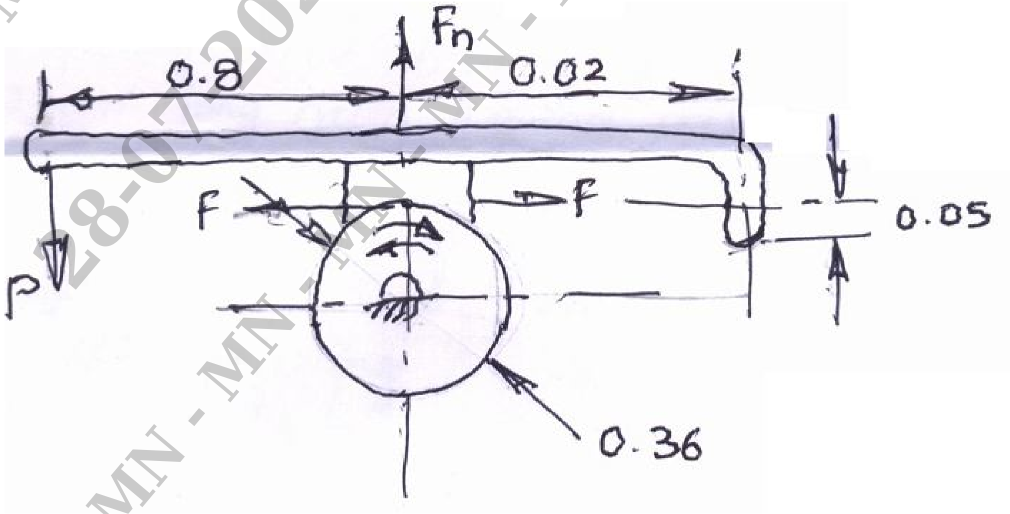

Fig. Q8 (a) **(10 Marks)**

b. In a simple band break, the length of the lever is 440 mm, the tight end of the hand is attached to the fulcrum of the lever and the slack end to a pin 50 mm from the fulcrum. The diameter of the break drum is 1 mm and arc of contact is 300°, the co-efficient of friction between the band and the drum is 0.35. the break drum is attached to a hoisting drum of diameters 0.65 m that sustains a load of 20 kN (Fig. Q8(b)),
   (i) Force required at the end of lever to support the load.
   (ii) Width of steel band if the tensile stress is limited to 50 N/mm^2.

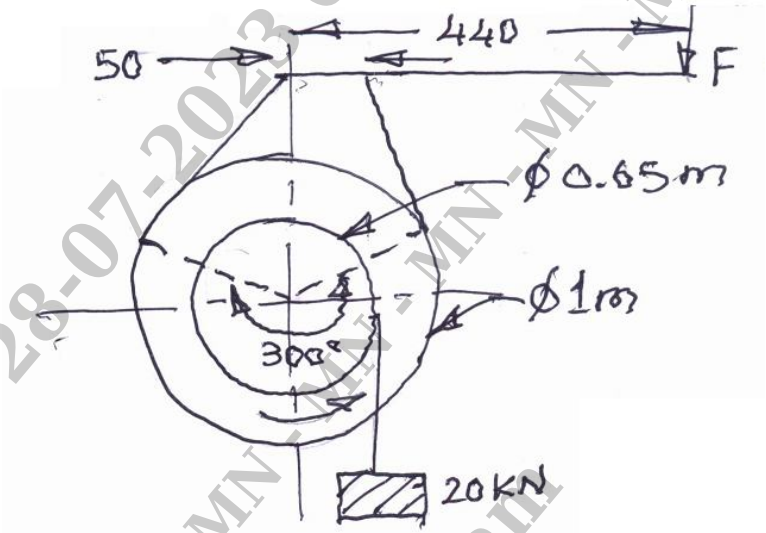

Fig. Q8 (b) **(10 Marks)**

Module-5

9 a. Derive Petroff's equation for lightly loaded bearing. **(12 Marks)**

b. For a full journal bearing has the following specification : Shaft diameter 45 mm, bearing length 66 mm, Clearance ratio 0.0015, Speed 2800 rpm, Load 800 N and absolute viscosity 8.27×10^{-3} Pa-S. Determine (a) frictional torque (b) Co-efficient of friction (c) Power loss. **(08 Marks)**

OR

10 a. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of journal is 900 rpm and the ratio of journal diameter to the diametrical clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m. The room temperature is 35°C. Determine :
   (i) The amount of artificial cooling required.
   (ii) The mass of lubricating oil required, if the difference between outlet and inlet temperature of the oil is 10°C.

   Take specific heat of 1850 J/kg°K. **(10 Marks)**

b. A bearing for an axial flow compressor is to carry a radial load of 4905 N and thrust load of 2452 N. The service imposes light shock and the bearing is used for 40 hours/week for 5 years. The speed of the shaft is 300 rpm and diameter of the shaft is 60 mm. Select a suitable bearing. **(10 Marks)**

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CBCS SCHEME

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18ME63

Sixth Semester B.E. Degree Examination, June/July 2023
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Thermodynamic and Heat Transfer data hand book is permitted.***
3. ***Any missing data can be suitably assumed.***

Module-1

1 a. With usual notations, starting from 3-dimesional conduction equation, derive one dimensional equation in rectangular coordinates. **(10 Marks)**

b. Explain the different boundary conditions as applicable to heat transfer analysis. **(10 Marks)**

OR

2 a. What is critical thickness of insulation? Derive an expression for critical radius of insulation interms of thermal conductivity and HTC 'h'. **(10 Marks)**

b. A furnace wall is made up of inside silica brick (K = 1.856 W/m-K) and outside magnesia brick (K = 5.568 W/m-K) each 10 mm thick. If inner and outer surface temperature of wall are 820°C and 120°C. Find the heat flow rate through the plane Wall/m^2. Take the contact resistance of 1.722×10^{-3} m^2-K/W. Also find the interface temperature. **(10 Marks)**

Module-2

3 a. With usual notations, derive an expression for temperature distribution for infinite Fin. State the assumptions made. **(10 Marks)**

b. Find the amount of heat transfer through iron fin of thickness 5 mm, height 50 mm and width 100 cm. Take atmospheric temperature as 28°C and K = 50 W/m-K. The HTC = 10 W/m^2-K the temperature difference at the base of the fin = 80°C. Estimate the efficiency of the fin. **(10 Marks)**

OR

4 a. With usual notations derive an expression for temperature distribution through a body for lumped parameter analysis in terms of Biot number and Fourier number. **(10 Marks)**

b. Mild Steel Sphere of 15 mm dia initially at 625°C is exposed to current of air at 25°C with HTC h = 120 W/m^2-K. Calculate:
(i) Time required to cool the sphere to 100°C
(ii) Initial rate of cooling in °C/sec.
(iii) Total energy removed for one minute. The thermophysical properties for MS are K = 43 W/m-K, C = 474 W/m-K, ρ = 7850 kg/m^3 and α = 0.045 m^2/sec. **(10 Marks)**

Module-3

5 a. Write a note on spectral and total emissive power of a body. **(08 Marks)**

b. Write a short note on the concept of black body and grey body. **(04 Marks)**

c. The average solar radiation flux on the earth's atmosphere is 1353 W/m^2. Calculate the temperature of sun (a black body) having diameter 1.392×10^6 km and has a mean distance of 1.496×10^8 km from the earth's atmosphere. State any assumption made. **(08 Marks)**

OR

6 a. Explain Wein's displacement law, Kirchoff's law and Max Plank's law. **(10 Marks)**

b. Two large parallel planes with emissivity of 0.6 are at 900 K and 300 K. A radiation shield with one side polished and having emissivity of 0.05, while the emissivity of other side is 0.4 is proposed to used. Which side of the shield to face the hotter plane, if the temperature of shield is to kept minimum? Comment on your answer. **(10 Marks)**

Module-4

7 a. Explain the concept of development of boundary layer over a flat plate with different zones. **(10 Marks)**

b. Atmospheric air at 2°C and free stream velocity of 20 m/s flows over 1.5 m long flat plate maintained at uniform temperature of 88°C. Calculate:

(i) The average HTC 'h' over the region of laminar boundary layer.

(ii) Average H.T.C. (Heat Transfer Coefficient) for entire length of plate 1.5 m.

(iii) Total Heat Transfer Rate. Take critical Reynolds number $Re_c = 2 \times 10^5$. **(10 Marks)**

OR

8 a. Explain the significance of Reynolds number, Prandtl Number, Nusselt number and Grasshof number with equations. **(10 Marks)**

b. Calculate the total heat loss from a human body, assuming as vertical cylinder, 30 cm in dia and 175 cm in height stand in still air at 13°C. Take the skin temperature as 37°C and emissivity as 0.4. **(10 Marks)**

Module-5

9 a. Define heat exchanger and classify them. **(04 Marks)**

b. Derive an expression for Lag Mean Temperature Difference (LMTD) for counter flow heat exchanger. State the assumptions made. **(08 Marks)**

c. A heat exchanger is required to cool 55000 kg/hr of alcohol from 66°C to 40°C using 44,000 kg/hr of water entering at 5°C. Calculate:

(i) Exit temperature of water

(ii) Heat transfer

(iii) Surface area required for parallel flow and counter flow type heat exchanger design and comment on the results overall HTC U = 580 W/m^2-K, $C_{p(alcohol)}$ = 3760 J/kg-K, $C_{p(water)}$ = 4180 J/kg-K. **(08 Marks)**

OR

10 a. Define film wise and drop wise condensation process. **(04 Marks)**

b. With a neat sketch, explain the modes of pool boiling. **(08 Marks)**

c. Steam at 0.065 bar condenser on a vertical plate 0.6 m square. If the surface temperature of the plate is maintained at 15°C, estimate the rate of condensate. The properties of condensate at mean temperature 26.4°C are, $\rho = 1000$ kg/m^3, $\mu = 864 \times 10^{-6}$ N-S/m^2, K = 0.913 W/m-K., $h_{fg(latent\ heat)} = 2412 \times 10^3$ J/kg-K. **(08 Marks)**

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18ME641

Sixth Semester B.E. Degree Examination, June/July 2023
Non - Traditional Machining

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Non-traditional Machining. What are the need of NTM? Explain briefly. **(08 Marks)**
b. What are difference between Conventional and Non – conventional Machining? **(06 Marks)**
c. List and explain the various factors to be considered for selection of NTM process. **(06 Marks)**

OR

2 a. Give classification of NTM process. **(08 Marks)**
b. List applications of NTM. **(06 Marks)**
c. List any 3 advantages and limitations of NTM. **(06 Marks)**

Module-2

3 a. With neat sketch, explain USM process. **(10 Marks)**
b. Explain with neat diagram, process parameters in USM. **(10 Marks)**

OR

4 a. Explain with neat sketch, working principle of Abrasive Jet Machining and also give advantages of AJM. **(10 Marks)**
b. With the neat sketch, explain Water Jet Machining process and also give advantages and limitations of WJM. **(10 Marks)**

Module-3

5 a. With neat sketch, explain the working of ECM process. **(10 Marks)**
b. With neat sketch, explain ECG. Also give the advantages and limitations of ECG. **(10 Marks)**

OR

6 a. Explain the following in Chemical Machining Process :
i) Maskants ii) Etchants. **(08 Marks)**
b. List out advantages and applications of Chemical Machining. **(06 Marks)**
c. Write a short note on Chemical Blanking. **(06 Marks)**

Module-4

7 a. Explain with neat sketch the mechanism of metal removal in Electric discharge machining and also give applications. **(10 Marks)**
b. Explain Die Electric Medium, its functions and desirable properties in EDM process. **(10 Marks)**

OR

8 a. With a neat sketch, explain Plasma Arc Machining Process. **(10 Marks)**
b. Discus some of the important considerations in the design of Plasma torch in PAM. **(10 Marks)**

Module-5

9 a. With a neat sketch, explain working principle of Laser Beam Machining. **(08 Marks)**

b. What are the advantages and disadvantages of LBM process? **(06 Marks)**

c. List the limitations and applications of LBM proces. **(06 Marks)**

OR

10 a. Explain with the help of neat diagram Principle of Electron Beam Machining (EBM). **(10 Marks)**

b. What are the advantages , disadvantages and applications of EBM process? **(10 Marks)**

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18ME651

Sixth Semester B.E. Degree Examination, June/July 2023
Non-Conventional Energy Sources

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Enlist and explain the merits and demerits of any three non-conventional Energy Sources. **(10 Marks)**

b. Explain Tar Sands and Oil shale as energy sources and mention their limitations. **(10 Marks)**

OR

2 a. With schematic representation, explain mechanism of absorption, scattering beam and diffuse radiation received at earth's surface. **(10 Marks)**

b. Explain with a neat sketch, explain the working of pyrenometer. **(05 Marks)**

c. Explain briefly the need for alternate energy sources. **(05 Marks)**

Module-2

3 a. Define the following term with respect to solar radiation:
i) Hour angle ii) Declination angle iii) Zenith angle iv) Latitude angle
v) Solar Azimath angle. **(10 Marks)**

b. Calculate the day length of location (latitude 22° 00′ W, 73° 10′ E) during the month of March 1. **(05 Marks)**

c. With the usual expression for flux explain beam and diffuse radiation on a tilted surface. **(05 Marks)**

OR

4 a. With a neat sketch explain working of liquid flat-plate collector. **(08 Marks)**

b. Describe solar pond for solar energy collection and storage. **(07 Marks)**

c. Explain how solar energy can be used for drying with a neat sketch. **(05 Marks)**

Module-3

5 a. List and discuss the various parameters that affect the performance of collector. **(10 Marks)**

b. Explain the heat transfer process in LFPc with neat sketch and write the energy balance equation, explaining each terminal. **(10 Marks)**

OR

6 a. Explain the working principle and I-V characteristics of a solar PV cell. **(10 Marks)**

b. Define : i) Collector efficiency factor ii) Collector heat removal factor of LPFc write the expression for the above. **(05 Marks)**

c. What are the applications of solar PV cell? **(05 Marks)**

Module-4

7 a. Describe the main consideration in selecting the site for wind generators. **(10 Marks)**

b. Wind blows with a velocity of 15 m/s at 15°C and 1 std. atm. pressure. The turbine diameter is 120m with operating speed of 40 rpm at maximum efficiency. Propeller type wind turbine is considered. Calculate the following :
i) Total power density in the wind stream
ii) Maximum obtainable power density
iii) Obtainable power density
iv) Total power
v) Torque at max η
vi) Maximum axial thrust
Assume R = 0.287 kJ/kgK , η = 35%. **(10 Marks)**

OR

8 a. Explain with a sketch, the closed Rankine cycle OTEC system. **(10 Marks)**
b. Explain briefly the harnessing of Tidal energy. **(05 Marks)**
c. Explain the advantages and disadvantages of Tidal energy. **(05 Marks)**

Module-5

9 a. State the environmental problem associated with geothermal energy conversion. **(05 Marks)**
b. List the factors affecting biogas generation. **(05 Marks)**
c. Sketch and explain the working of a fixed dome type biogas plant used in India. **(10 Marks)**

OR

10 a. What are the different methods of hydrogen production? Describe electrolytic method of hydrogen production. **(10 Marks)**
b. Briefly explain the safe utilization of hydrogen energy. **(05 Marks)**
c. Describe various methods of storage of hydrogen. **(05 Marks)**

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18ME81

Eighth Semester B.E. Degree Examination, June/July 2023
Energy Engineering

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 pulvarised coal? What are the advantages and limitations of pulvarised coal? **(10 Marks)**

b. Briefly explain the various steps involved in coal handling. **(10 Marks)**

OR

2 a. Explain the working principle of Benson boiler, with a neat sketch. **(10 Marks)**

b. Explain common methods used for controlling super heat temperature of the steam. **(10 Marks)**

Module-2

3 a. Explain the working principle of pyranometer and pyrheliometer with a neat sketch. **(10 Marks)**

b. With the help of a neat sketch, explain the extraction of solar energy from solar ponds. **(10 Marks)**

OR

4 a. Explain the working of floating drum biogas plant with a neat sketch. **(10 Marks)**

b. Explain the working of updraft gasifier with a neat sketch. **(10 Marks)**

Module-3

5 a. With a neat sketch, explain the working of vapor dominated geothermal power plant. **(10 Marks)**

b. With a neat sketch explain the harnessing tidal energy by the arrangement of double basin tidal power plant. **(10 Marks)**

OR

6 a. What are the properties of wind and explain the problems associated with the wind power. **(10 Marks)**

b. With a neat sketch, explain Darrieus type wind machines and list the advantages and disadvantages. **(10 Marks)**

Module-4

7 a. With a neat sketch, explain medium and low head power plant (hydroelectric). **(10 Marks)**

b. The mean monthly discharge for 12 months at a particular site of river is tabulated below:

Month	Discharge in millions of Cubic meter/month	Month	Discharge in millions of Cubic meter/month
May	500	October	2000
June	200	November	1500
March	1500	December	1500
July	2500	January	1000
August	3000	February	800
September	2400	March	600

(i) Draw hydrograph and flow duration curve for the above and find average monthly flow.

(ii) Determine the power available at mean flow of water if available head is 80 m at the site and overall efficiency of generation is 80%. Take 30 days in a month. **(10 Marks)**

OR

8 a. With a diagram, explain Open cycle or Claude cycle OTEC system. **(10 Marks)**

b. With a diagram, explain Closed or Anderson OTEC system. **(10 Marks)**

Module-5

9 a. Explain the principle of radioactive decay, half life, fusion and fission in nuclear energy. **(10 Marks)**

b. Explain with neat sketch of components of nuclear reactor. **(10 Marks)**

OR

10 a. Explain the working principle of pressurized water reactor with a neat sketch. **(10 Marks)**

b. Explain the working principle of homogeneous graphite reactor and gas cooled reactor (indirect circuit gas cooled reactor) with a neat sketch. **(10 Marks)**

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18ME823

Eighth Semester B.E. Degree Examination, June/July. 2023
Non-Destructive Testing and Evaluation

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 non-destructive testing? What are the merits, demerits and benefits of NDT? **(10 Marks)**
b. What are the classification of NDT and explain overview of the NDT. **(05 Marks)**
c. What are the difference between destructive testing and non-destructive testing? **(05 Marks)**

OR

2 a. Define visual inspection. Explain different types of visual inspection. **(10 Marks)**
b. What are the advantages, disadvantages and applications of visual inspection? **(10 Marks)**

Module-2

3 a. What is liquid penetrant testing? Explain different steps involved in testing procedure of liquid penetrant testing with neat sketches. **(10 Marks)**
b. What are the advantages, disadvantages and application of L.P.T. **(06 Marks)**
c. What are the properties of L.P.T? Explain briefly. **(04 Marks)**

OR

4 a. Define magnetic particle inspection and explain the general procedure for magnetic particle inspection with neat diagram. **(10 Marks)**
b. Write a short notes on :
i) Methods of demagnetization
ii) Residual magnetism **(04 Marks)**
c. What are the advantages, disadvantages and applications of M.P.I. **(06 Marks)**

Module-3

5 a. What is thermography testing? What are the classifications of thermography testing? Explain with neat sketch any two of them. **(12 Marks)**
b. Explain Infrared radiation and infrared detectors with neat sketches. **(08 Marks)**

OR

6 a. Explain the different types of operations variables affecting performance in Eddy current inspection. **(10 Marks)**
b. Write a short notes on :
i) Properties of eddy currents
ii) Eddy current sensing elements. **(05 Marks)**
c. What are the advantages and disadvantages of E.C.T. **(05 Marks)**

Module-4

7 a. Explain with a neat sketch working principle of ultrasonic Testing. **(10 Marks)**

b. Explain with sketches the following :

i) A – Scan system
ii) B – Scan system
iii) C – Scan system. **(10 Marks)**

OR

8 a. Explain with sketches the following :

i) Angle beam units
ii) Dual elements units
iii) Immersion type units
iv) Straight beam units. **(10 Marks)**

b. Explain with neat diagram, working principle of Acoustic emission technique, and write a application of A.E.T. **(10 Marks)**

Module-5

9 a. Explain the basic principle of radio graphic inspection with neat sketch and also discuss its merits and demerits. **(10 Marks)**

b. Write short notes with respect to radiography.

i) Types and use of filter and screens
ii) Geometric factors
iii) Characteristics of films. **(10 Marks)**

OR

10 a. Explain the a neat sketch, construction and principle of Fluoroscopy Testing. **(10 Marks)**

b. Explain with neat sketches :

i) Xero – Radiography
ii) Computes radiography
iii) Computed Tomography. **(10 Marks)**

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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.***

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. 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 :

$$f(x)=1-\left(\frac{x}{\pi}\right) \text{in } \ 0\le x\le \pi.$$ **(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

$$\int_0^\infty \frac{x\sin mx}{1+x^2}dx,\ m>0\cdot$$ **(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 $\text{Cos}\, n\,\theta$ and $\text{Sin}\, n\,\theta$ **(07 Marks)**

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

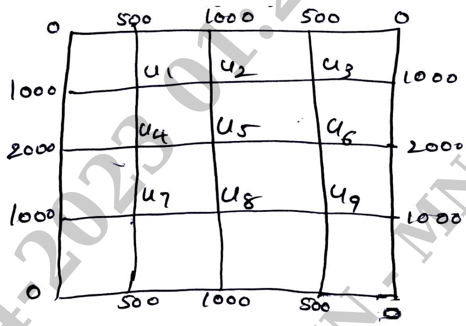

Fig.Q8(a) **(10 Marks)**

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 $\int_0^1 \left[[y']^2 + 12xy\right]dx$ 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, June/July 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. List the different types of pattern. Explain match plate pattern with a neat sketch. **(07 Marks)**
b. Briefly discuss the importance of binders and additives in sand moulding. **(07 Marks)**
c. With a neat sketch explain Jolt type of Molding machine. **(06 Marks)**

OR

2 a. With a neat sketch explain shell moulding process. **(10 Marks)**
b. What is core? Explain the need of core. **(04 Marks)**
c. Draw a neat sketch of gating system showing all the elements. **(06 Marks)**

Module-2

3 a. With a neat sketch explain the different zones present in CUPOLA furnace. **(12 Marks)**
b. With a neat sketch explain Direct electric arc furnace. **(08 Marks)**

OR

4 a. What is die casting? With a neat sketch explain gravity die casting process. **(10 Marks)**
b. With a neat sketch explain continuous casting process. **(10 Marks)**

Module-3

5 a. Differentiate between hot working and cold working process. **(04 Marks)**
b. With a sketch explain Gravity (or) board drop hammer. **(06 Marks)**
c. Explain with a sketches any four type of rolling mills. **(10 Marks)**

OR

6 a. With respect to sheet metal forming explain :
(i) Blanking process
(ii) Bending process. **(04 Marks)**
b. With a sketches explain progressive die and compound die. **(08 Marks)**
c. With a sketch explain explosive high energy rate forming process. **(08 Marks)**

Module-4

7 a. With a neat sketch explain Gas Welding process. Also explain types of flames used in gas welding. **(12 Marks)**
b. With a neat sketch explain manual metal arc welding. **(08 Marks)**

OR

8 a. With a sketch explain Gas tungsten arc welding process. **(10 Marks)**
b. With a sketch explain Submerged arc welding. **(10 Marks)**

Module-5

9 a. Define Weldability. With respect to the thermal aspects explain the following :
(i) Distortion (i) Shrinkage (iii) Residual stresses. **(12 Marks)**

b. Briefly explain welding defects and their remedies. **(08 Marks)**

OR

10 a. Explain the following Joining Processes.
i) Soldering
ii) Brazing
iii) Adhesive bonding **(12 Marks)**

b. Explain with a sketch Resistance arc welding process. Also mention their advantages and limitations. **(08 Marks)**

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21ME33

Third Semester B.E. Degree Examination, June/July 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. Explain them with examples.	**(08 Marks)**
	b.	Differentiate between crystalline and non-crystalline solids.	**(07 Marks)**
	c.	Explain the various geometrical crystal rotation geometry operations.	**(05 Marks)**

OR

2	a.	Define unit cell and crystal lattice. Explain the cubic, tetragonal, orthorhombic and rhobhohedral unit cells with examples.	**(10 Marks)**
	b.	Define atomic packing factor. Calculate APF of FCC unit cell.	**(05 Marks)**
	c.	Define crystal imperfections in solids. Explain point imperfections.	**(05 Marks)**

Module-2

3	a.	Classify and explain solid solutions. What are intermediate phases?	**(10 Marks)**
	b.	Explain Hume – Rothery rules.	**(04 Marks)**
	c.	Explain (i) Gibb's phase rule (ii) Level rule.	**(06 Marks)**

OR

4	a.	Explain the eutectic system binary phase diagram for two metals completely soluble in liquid state but completely insoluble in solid state.	**(10 Marks)**
	b.	Explain the two Fick's laws of diffusion.	**(04 Marks)**
	c.	Explain the role of imperfections in diffusions.	**(06 Marks)**

Module-3

5	a.	Explain the homogeneous and heterogeneous nucleation process with a suitable sketch or graph or equations.	**(10 Marks)**
	b.	Explain the plastic deformation by : (i) Slip (ii) Twinning.	**(06 Marks)**
	c.	Define and classify strengthening mechanisms. Explain anyone method.	**(04 Marks)**

OR

6	a.	Differentiate between Annealing and Normalising.	**(05 Marks)**
	b.	With sketch, explain the flame hardening process.	**(05 Marks)**
	c.	Explain the TTT diagram for 0.8% C eutectoid steel.	**(10 Marks)**

Module-4

7	a.	Classify surface coating methods. Explain the electrochemical coating method.	**(08 Marks)**
	b.	Explain the various surface coating materials.	**(06 Marks)**
	c.	What are the advantages and disadvantages of powder metallurgy?	**(06 Marks)**

OR

8 a. Explain the characteristics of metal powders with regard to particle size and shape distribution. **(06 Marks)**

b. Explain : (i) Powder compacting process (ii) Powder sintering process. **(08 Marks)**

c. What are the applications of powder metallurgy? **(06 Marks)**

Module-5

9 a. Explain the evolution of engineering materials. **(06 Marks)**

b. Explain the design process with a suitable flow chart. **(08 Marks)**

c. With sketch, explain the design tools and materials data. **(06 Marks)**

OR

10 a. Classify engineering materials. Explain them with examples. **(10 Marks)**

b. Classify material property charts. Sketch and explain the Young's modulus – density chart. **(10 Marks)**

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21ME34

Third Semester B.E. Degree Examination, June/July 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. Explain different types of temperature scales. **(04 Marks)**

b. Derive an expression for PdV work for an isentropic process. **(08 Marks)**

A thermo couple with test junction at $1^{\circ}C$ on a gas thermo meter scale and reference junction at ice point gives the emf as $e = \left(0.3t - 4\times10^{-4}t\right)mV$. The millimeter is calibrated at ice and steam points. What will be the reading on this thermometer when gas thermometer reads $80^{\circ}C$? **(08 Marks)**

OR

2 a. Obtain the expression for displacement work,
(i) Isothermal process
(ii) Polytropic process.
(iii) Isobaric process
(iv) Isochronic process. **(10 Marks)**

b. A piston-cylinder arrangement contains a fluid system which passes through a complete cycle of four process. During a cycle, the sum of all heat transfer is $-170kJ$. The system completes 100 cycles per minute. Complete the following table and compute the net rate of work in K.

Process	Q KJ/min	W KJ/min	ΔE KJ/min
AB	0	2170	-
BC	21000	0	-
CD	2100	-	36600
DA	-	-	-

(10 Marks)

Module-2

3 a. Give Kelvin Plank and Clausius statements of second law of thermodynamics. **(04 Marks)**

b. Show that entropy is a property of system. **(06 Marks)**

c. A heat engine working on a Carnot cycle absorbs heat from three thermal reservoirs at 1000 K, 800 K and 600 K respectively. The engine does 10 kW of net work and rejects 400 kJ/min of heat to the sink at 300 K if the heat supplies by the reservoir at 1000 K is 60% of heat supplied by the reservoir at 600 K. Find the quantities of heat supplies by each reservoirs. **(10 Marks)**

OR

4 a. State and prove Clausius inequality. **(08 Marks)**

b. State and Carnot's theorem. **(02 Marks)**

c. Heat is transferred by conduction from a reservoir at 500 °K to a reservoir at 300 °K at the rate of 100 kJ/min. Evaluate $\oint \frac{\delta Q}{T}$. What will be $\oint \frac{\delta Q}{T}$ if reversible heat engine operates between these two reservoirs? How much work would be have been done by the engine. **(10 Marks)**

Module-3

5 a. Write Maxwell equations and explain the terms involved. **(06 Marks)**

b. Define : (i) Sub cooled liquid (ii) Tripple point (iii) Critical point. **(06 Marks)**

c. Super heated steam from initial condition of 5 bar and 300 °C is expanded isentropically to a pressure of 0.5 bar. Calculate (i) Final condition of steam after expansion (ii) Change in enthalpy / kg of steam (iii) Change in internal energy / kg of steam. **(08 Marks)**

OR

6 a. With a neat sketch, explain working of a combined separating and throttling calorimeter. **(10 Marks)**

b. Steam at 10 bar and dry state is cooled under constant pressure until it becomes 0.85 dry. Using steam tables find the work done, change in enthalpy, heat transfer and change in entropy. **(10 Marks)**

Module-4

7 a. Define :

(i) Mole fraction.
(ii) Mass fraction.
(iii) Dalton's law.
(iv) Amagat's law of additives **(10 Marks)**

b. A mixture of gases contain 1 kg of CO_2 and 1.5 kg of N. The pressures and temperature of the mixture are 3.5 bar and 27 °C. Calculate

(i) Mole fraction of each constituent.
(ii) Partial pressure.
(iii) Partial value.
(iv) Volume of mixture.
(v) Density of mixture **(10 Marks)**

OR

8 a. Derive an expression of air standard efficiency of diesel cycle with neat PV and TS diagrams. **(10 Marks)**

b. An engine with 200 mm cylinder and 300 mm stoke length works on diesel cycle. The initial pressure and temperature of air are 0.1 MPa and 27 °C. The cut off is 8% of stoke volume and compression ratio is 15. Calculate

(i) Pressure and temperature of salient points.
(ii) Air standard efficiency. **(10 Marks)**

Module-5

9 a. Draw a neat PV and TS diagram of air standard dual cycle and derive an expression for air standard efficiency interms of compression ratio, explosion ratio and cut off ratio under what conditions the dual cycle becomes otto cycle and diesel cycle. **(10 Marks)**

b. An air standard diesel cycle has compression ratio 16. The temperature before compressor is 27°C and the temperature after expansion is 627°C. Compute

(i) Cut off ratio.
(ii) The net work output per unit mass of air.
(iii) Thermal efficiency.
(iv) Mean effective pressure in bar. **(10 Marks)**

OR

10 a. Explain any two methods of improving the efficiency of an open cycle gas turbine plant. **(10 Marks)**

b. In an open cycle gas turbine plant air enters the compressor at 1 bar and 27°C. The pressure of after compression is 4 bar. The isentropic efficiency of the turbine and compressor are 85%, 80% and air fuel ratio is 80%. The calorific value of fuel used is 42000 kJ/kg and mass flow rate is 2.5 kg/s. Calculate the power output from the plant and the cycle efficiency. Assume that C_P and γ to be same for both air and products of combustion. **(10 Marks)**

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CBCS SCHEME

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21ME42

Fourth Semester B.E. Degree Examination, June/July 2023
Machining Science and Jigs & Fixtures

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the working principle of lathe. How can you specify a lathe? **(06 Marks)**

b. Explain with neat sketch, the working of Radial drilling machine. **(08 Marks)**

c. Explain briefly with sketches at any three drilling operation. **(06 Marks)**

OR

2 a. Draw the engine lathe and cable the parts and discuss the function of lathe parts. **(10 Marks)**

b. Difference between upmilling and down milling process. **(05 Marks)**

c. With a neat sketch, explain construction and working of common grinding machine. **(05 Marks)**

Module-2

3 a. Distinguish between orthogonal and oblique cutting with a neat sketch. **(06 Marks)**

b. List and explain different types of chips formed in metal cutting process. **(08 Marks)**

c. Sketch and explain single point turning tool geometry. **(06 Marks)**

OR

4 a. List and explain different types of cutting tool materials and state their specific applications. **(06 Marks)**

b. Draw a merchant's circle diagram, using usual notations and state the assumptions. **(08 Marks)**

c. List the various types of cutting fluids used in metal cutting briefly. Explain. **(06 Marks)**

Module-3

5 a. What is machinability? Define machinability index. **(04 Marks)**

b. What are the factors affecting on tool life? **(06 Marks)**

c. Explain the process of Electroplating. **(10 Marks)**

OR

6 a. Describe the importance of surface finish process. **(04 Marks)**

b. With a neat sketch, explain the Honing process. **(06 Marks)**

c. Briefly explain powder coating and Galvanizing process. **(10 Marks)**

Module-4

7 a. Explain with neat sketch the process of Abrasive Jet Machining. **(10 Marks)**

b. Explain with neat sketch the process of ultrasonic machining process. **(10 Marks)**

OR

8	a.	Explain with neat sketch of Electro Discharge machining.	**(10 Marks)**
	b.	Explain with neat sketch of Laser beam machining.	**(10 Marks)**

Module-5

9	a.	What are the importances of Jigs and Fixtures in industries?	**(06 Marks)**
	b.	List the types of Jigs and Fixtures.	**(06 Marks)**
	c.	What are the materials used to manufacture Jigs and Fixtures?	**(08 Marks)**

OR

10	a.	What are the factors to be considered to design Jigs and Fixtures?	**(06 Marks)**
	b.	Briefly explain on Template, Plate, Channel in Jigs.	**(06 Marks)**
	c.	Briefly explain the importance of fixtures in milling and turning.	**(08 Marks)**

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CBCS SCHEME

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21ME43

Fourth Semester B.E. Degree Examination, June/July 2023
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the following terms:
(i) Total pressure (ii) Centre of pressure
(iii) Gauge pressure (iv) Buoyancy **(08 Marks)**

b. Derive expression for total pressure force and centre of pressure act on a vertical surface immersed in static fluid. **(08 Marks)**

c. Discuss on fluid pressure measuring devices. **(04 Marks)**

OR

2 a. Explain the Eulerian and Langragian method of fluid flow analysis with suitable example. **(08 Marks)**

b. Derive the 3-dimensional flow continuity equation in cartesian coordinates. **(08 Marks)**

c. Calculate the velocity of fluid flow at a point (2, 3) if its 2-D flow stream function is given by $\psi = 2xy$. **(04 Marks)**

Module-2

3 a. Derive the Euler's equation of fluid motion and hence deduce Bernoulli's equation. **(10 Marks)**

b. Derive an expression for discharge through venturimeter. **(10 Marks)**

OR

4 a. Derive expression for discharge through a triangular notch. **(10 Marks)**

b. A horizontal venturimeter of 20 cm inlet diameter and 10 cm throat diameter is used to measure an oil flow. The discharge of oil through venturimeter is 60 lit/s. Calculate the reading of oil-mercury differential manometer. Take $C_d = 0.98$ and specific gravity = 0.8. **(10 Marks)**

Module-3

5 a. Derive Hagen Poiseulle equation for laminar flow through a circular pipe. **(10 Marks)**

b. A crude oil flowing through a horizontal circular pipe of 10 cm diameter and 100 cm length. Assume laminar flow and calculate pressure drop if 100 kg oil collected in a tank in 30 seconds. Take viscosity = 0.97 N-S/m^2 and specific gravity = 0.9. **(10 Marks)**

OR

6 a. Discuss the energy losses that occur in pipe flow. **(10 Marks)**

b. Derive Darcy-Weisbach equation for determining loss of head due to friction. **(10 Marks)**

Module-4

7 a. Explain the following terms:
(i) Boundary layer thickness (ii) Streamline body (iii) Bluff body
(iv) Lift (v) Drag **(10 Marks)**

b. Deduce an expression for pressure drop (dp) in a pipe flow using Buckingham's π - theorem if fluid has velocity (V), viscosity (μ) and density (ρ). Consider pipe diameter (D) and length (L). **(10 Marks)**

OR

8 a. Explain the following terms:
(i) Reynold's number (ii) Froude's number (iii) Euler's number
(iv) Weber's number (v) Mach number **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. The coefficients of drag and lift are 0.15 and 0.75 respectively. Compute:
(i) Lift force
(ii) Drag force
(iii) Resultant force
(iv) Power required to keep the plate in motion. **(10 Marks)**

Module-5

9 a. Show that velocity of elastic wave propagation in an adiabatic medium is given by $C = \sqrt{\gamma RT}$. **(10 Marks)**

b. A projectile travels in air of pressure 100 kPa at 10°C with a speed of 1500 km/hr. Compute the Mach number and Mach angle. Take $\gamma = 1.4$ and R = 287 J/kg-K. **(10 Marks)**

OR

10 a. Explain the necessity, applications and limitations of CFD. **(10 Marks)**

b. A projectile travels with a speed of 1500 km/hr at 20°C temperature and 0.1 MPa air pressure. Calculate the Mach number and Mach angle. Take $\gamma = 1.4$ and R = 287 J/kg-K. **(10 Marks)**

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CBCS SCHEME

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21ME44

Fourth Semester B.E. Degree Examination, June/July 2023

Mechanics and Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terms :
i) Elasticity ii) Stress iii) Strain iv) Young's modulus v) Poison's ratio. **(05 Marks)**

b. Derive an expression for extension of the uniformly tapered circular bar subjected to an axial load. **(05 Marks)**

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

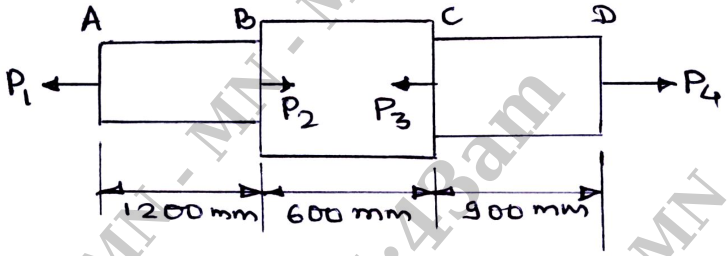

Fig.Q1(c) **(10 Marks)**

OR

2 a. Derive relationship between modulus of elasticity and modulus of rigidity. **(10 Marks)**

b. A compound bar is made up of a central steel plate 50mm wide and 10mm thick to which copper plate 50mm wide and 5mm thick are connected rigidly on each side. The length of the compound bar at room temperature is 1000mm. If the temperature is raised by 100°C, determine the stress in each material and change in length of the compound bar. Assume E_{st} = 200GPa, E_{CO} = 100GPa. **(10 Marks)**

Module-2

3 a. Derive an expression for the normal stress and shear stress on a plane inclined at 'θ' to the vertical axis in a biaxial stress system. **(10 Marks)**

b. An element with the stresses acting on it as shown in Fig.Q3(b). Determine :
i) Principal stresses and its locations
ii) Maximum shear stresses and its locations.

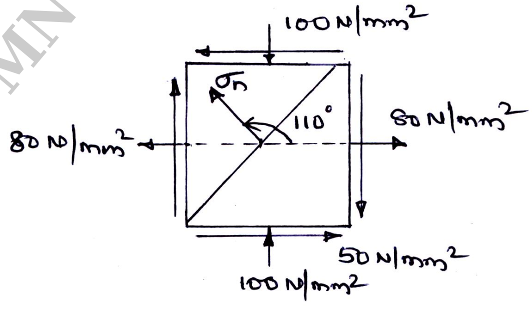

Fig.Q3(b) **(10 Marks)**

OR

4 The state of stress at a point in a strained material is shown in Fig.Q4. Determine :

a. Stresses on a plane whose normal is at an angle of 45° with reference to 80N/mm^2 stress direction

b. Magnitude of principal stresses and their location

c. Maximum and minimum shear stress and their location

d. Draw Mohr's circle and verify the results obtained analytically.

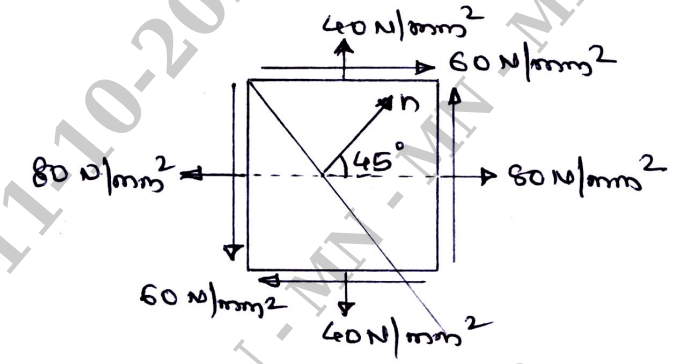

Fig.Q4 **(20 Marks)**

Module-3

5 a. Obtain expressions relating load, shear force and bending moment. **(05 Marks)**

b. Draw the shear force and bending moment diagram for the beam shown in Fig.Q5(b).

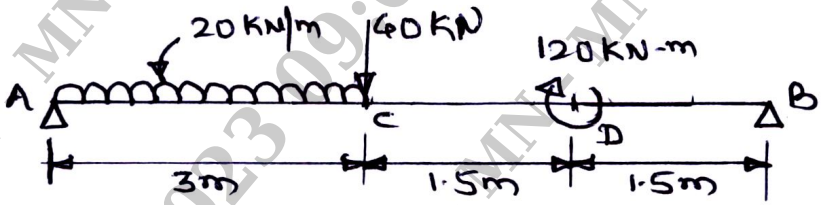

Fig.Q5(b) **(15 Marks)**

OR

6 a. Derive the equation $\frac{M}{I} = \frac{\sigma_b}{Y} = \frac{E}{R}$ with usual notations. State the assumptions in the derivation. **(10 Marks)**

b. A beam having T-section with its flanges of 180mm × 10mm and web of 220mm × 10mm is subjected to sagging bending moment 15kN-m. Determine the maximum tensile stress and maximum compressive stress, and their location in the section. **(10 Marks)**

Module-4

7 a. Derive differential equation for deflection of beam. **(10 Marks)**

b. Determine slope and deflection for a cantilever beam of length L and subjected to UDL W/unit length. **(10 Marks)**

OR

8 a. State assumptions and derive the torsional equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$. **(10 Marks)**

b. A hollow shaft of diameter ratio 3/8 is required to transmit 588kW at 110rpm, the maximum torque being 120% of the mean. Shear stress is not exceed 63N/mm^2 and twist in a length of 3m not to exceed 1.4° calculate external diameter of shaft which would satisfy these conditions. Take modulus of rigidity as 84GPa. **(10 Marks)**

Module-5

9 a. Derive an expression for circumferential stress and longitudinal stress for a thin cylinder. **(10 Marks)**

b. Derive an expression for strain energy for a member subjected to axial load. **(05 Marks)**

c. A steel bar 15mm diameter is pulled axially by a force of 10kN. If the bar is 250mm long, calculate the strain energy stored per unit volume of the bar and total strain energy stored by the bar. Take $E = 2 \times 10^5$ N/mm^2. **(05 Marks)**

OR

10 a. Obtain the expression for Euler's critical load for a long column with both ends hinged. Also state assumptions made. **(10 Marks)**

b. A thick cylinder with internal diameter 80mm and external diameter 120mm is subjected to an external pressure of 40N/mm^2 when the internal pressure is 120N/mm^2. Plot the variation of circumferential stress and radial pressure on the thickness of the cylinder. **(10 Marks)**

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