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VTU Question Papers

BE-Mechanical Engineering

III to VII Semester

Jan/Feb-2023

2018 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, Jan./Feb. 2023
Transform Calculus, Fourier Series and Numerical Techniques

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the Laplace transform of:
i) $(3t+4)^2 + 5^t$
ii) $e^{-t}\cos^2 3t$
iii) $\dfrac{\cos at - \cos bt}{t}$ **(10 Marks)**

b. Given $f(t) = \begin{cases} E, & 0 < t < a/2 \\ -E, & a/2 < t < a \end{cases}$ where $f(t+a) = f(t)$, show that $L[f(t)] = \dfrac{E}{S}\tanh\ (as/4)$. **(05 Marks)**

c. Employ Laplace transform to solve the equation: $y'' + 5y' + 6y = 5e^{2t}$, taking y(0) = 2, $y'(0) = 1$. **(05 Marks)**

OR

2 a. Find the Inverse Laplace transform of:
i) $\dfrac{(s+2)^2}{s^6}$ ii) $\dfrac{s+1}{s^2+6s+9}$ iii) $\dfrac{3s+2}{s^2-s-2}$ **(10 Marks)**

b. Express $f(t) = \begin{cases} 1, & 0 < t \le 1 \\ t, & 1 < t \le 2 \\ t^2, & t > 2 \end{cases}$ in terms Heaviside's unit step function and hence find its Laplace transform. **(05 Marks)**

c. Find the Laplace transform of $\dfrac{s}{(s^2+a^2)^2}$ using convolution theorem. **(05 Marks)**

Module-2

3 a. Find the Fourier series expansion of f(x) = x – x^2 in -π ≤ x ≤ π. Hence deduce that $\dfrac{x^2}{12} = \dfrac{1}{1^2} - \dfrac{1}{2^2} + \dfrac{1}{3^2} - \dfrac{1}{4^2} + ...$ **(07 Marks)**

b. Find the half-range cosine series of f(x) = 2x-1 in the interval 0 < x < 1. **(06 Marks)**

c. Determine the constant term and the first cosine and sine terms of the Fourier series expansion of y from the following data:

x^o	0	45	90	135	180	225	270	315
y	2	3/2	1	1/2	0	1/2	1	3/2

(07 Marks)

OR

4 a. Obtain the Fourier series of $f(x)=|x|$ in $(-l, l)$. Hence show that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+......=\frac{\pi^2}{8}$. **(07 Marks)**

b. Find the sine half range series of $f(x)=\begin{cases}\frac{1}{4}-x & \text{in} \quad 0<x<\frac{1}{2}\\ x-\frac{3}{4} & \text{in} \quad \frac{1}{2}<x<1\end{cases}$ **(06 Marks)**

c. The following table gives the variations of a periodic current A over a certain period T:

t(sec)	0	T/6	T/3	T/2	2T/3	5T/6	T
A(amp)	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

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

Module-3

5 a. If $f(x)=\begin{cases}1-x^2, & |x|<1\\ 0, & |x|\geq 1\end{cases}$ find the Fourier transform of f(x) and hence find the value of $\int_0^\infty \frac{x\cos x-\sin x}{x^3}dx$. **(07 Marks)**

b. Find the Fourier sine and cosine transform of $f(x) = e^{-\alpha x}$, $\alpha > 0$. **(06 Marks)**

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

OR

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

b. Find the Z-transform of $\cos\left(\frac{n\pi}{2}+\frac{\pi}{4}\right)$.

c. Find the inverse Z-transform of

$\frac{3z^2+2z}{(5z-1)(5z+2)}$. **(06 Marks)**

(07 Marks)

Module-4

7 a. Solve $\frac{dy}{dx}=x-y^2$, y(0) = 1 using Taylor's series method considering upto fourth degree terms and find the value of y(0.1). **(07 Marks)**

b. Using Runge-Kutta method of fourth order, find y(0.2) for the equation $\frac{dy}{dx}=\frac{y-x}{y+x}$, y(0) = 1 taking h = 0.2. **(06 Marks)**

c. Apply Milne's method to compute y(1.4) correct to four decimal places given $\frac{dy}{dx}=x^2+\frac{y}{2}$ and the data: y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514. **(07 Marks)**

OR

8 a. Using modified Euler's method find y(20.2) given that $\frac{dy}{dx} = \log_{10}\left(\frac{x}{y}\right)$ with y(20) = 5 taking h = 0.2. **(07 Marks)**

b. Use Fourth order Runge-Kutta method to compute y(1.1) given that $\frac{dy}{dx} = xy^{1/3}$, y(1) = 1. **(06 Marks)**

c. If $\frac{dy}{dx} = 2e^x - y$, y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040 and y(0.3) = 2.090, find y(0.4) using Adams – Bashforth predictor-corrector method. **(07 Marks)**

Module-5

9 a. Given $\frac{d^2y}{dx^2} - x^2\frac{dy}{dx} - 2xy = 1$, y(0) = 1, y′(0) = 0, evaluate y(0.1) using Runge-Kutta method of 4th order. **(07 Marks)**

b. Find the external of the functional $\int_{x_1}^{x_2}\left(y^{1^2} - y^2 + 2y\sec x\right)dx$. **(06 Marks)**

c. Derive Euler's equation in the standard form:
$\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y^1}\right) = 0$. **(07 Marks)**

OR

10 a. Apply Milne's method to compute y(0.8) given that $\frac{d^2y}{dx^2} = 1 - 2y\frac{dy}{dx}$ and the following table of initial values:

x	0	0.2	0.4	0.6
y	0	0.02	0.0795	0.1762
y′	0	0.1996	0.3937	0.5689

(07 Marks)

b. Find the external of the functional $\int_0^{\pi/2}(y^2 - y^{1^2} - 2y\sin x)\,dx$ under the end conditions y(0) = 0, y(π/2) = 0. **(06 Marks)**

c. Prove that the geodesics on a plane are straight lines. **(07 Marks)**

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18ME32

Third Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanics of Materials

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. Derive an expression for extension of the uniformly tapered rectangular bar subjected to an axial load. **(10 Marks)**

b. A steel circular bar has three segments as shown in Fig.Q1(b). Determine :
(i) The total elongation of the bar
(ii) The length of the middle segment to have zero elongation of the bar.
Take $E = 2.05 \times 10^5$ N/mm^2.

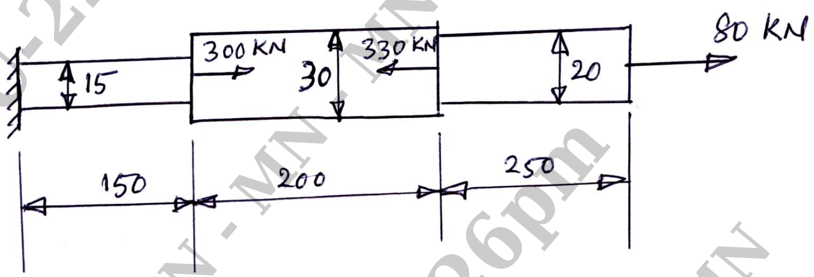

Fig.Q1(b) Dimensions in mm **(10 Marks)**

OR

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

b. A 15 mm diameter steel rod passes centrally through a copper tube 50 mm external diameter and 40 mm internal diameter. The tube is closed at each end by rigid plates of negligible thickness. If the temperature of the assembly is raised by 60°C, calculate the stresses developed in copper and steel. Neglect the effect of tightening the nut. Take E_s = 210 GPa, E_c = 105 GPa, $\alpha_s = 12 \times 10^{-6}$/°C, $\alpha_c = 17.5 \times 10^{-6}$/°C. **(10 Marks)**

Module-2

3 a. For the element subjected to biaxial stress state, derive expressions for normal and tangential stresses acting on a plane inclined at an angle θ with the Y-axis. **(10 Marks)**

b. A thin cylindrical shell 2 m long has 200 mm internal diameter and thickness of the metal 10 mm. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in, find the pressure developed and hoop stress developed. Also find the change in diameter. Take $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio $\frac{1}{m} = 0.3$. **(10 Marks)**

OR

4 a. A point in a machine is subjected to the stresses as shown in Fig.Q4(a). Draw the Mohr's circle and determine:
(i) Stresses on a plane which is at an angle of 60° with respect 80 MPa stress plane.
(ii) Magnitude of principal stresses and their orientations
(iii) Maximum and minimum shear stresses and orientations of their planes.

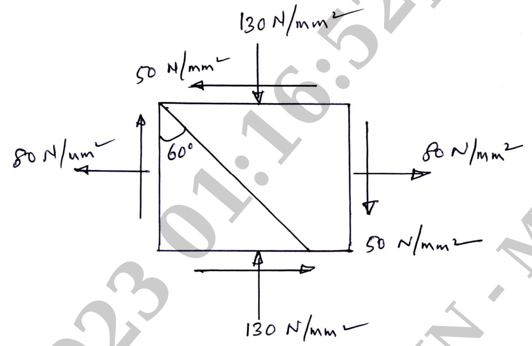

Fig.Q4(a) **(10 Marks)**

b. A thick cylindrical pipe of outside diameter 300 mm and internal diameter of 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 and draw the variation of hoop stress and radial stress across the thickness. **(10 Marks)**

Module-3

5 a. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.Q5(a). Locate the point of contra flexure.

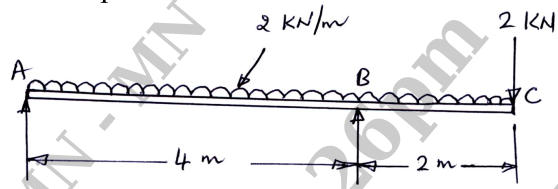

Fig.Q5(a) **(10 Marks)**

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

OR

6 a. Draw the shear force and bending moment diagrams for the cantilever beam shown in Fig.Q6(a).

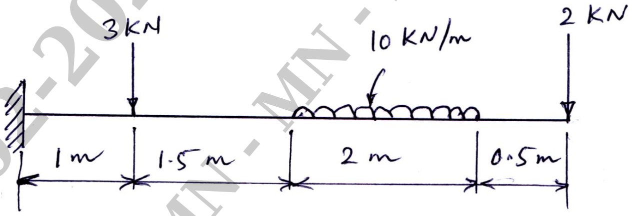

Fig.Q6(a) **(10 Marks)**

b. A beam of an I-section 200 mm × 300 mm has web thickness 10 mm and flange thickness 10 mm. It carries a shearing force of 10 kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

Module-4

7 a. Derive the torsion equation $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notations. State the assumptions made in the derivation. **(10 Marks)**

b. The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of the bolt :
   (i) Maximum principal stress theory
   (ii) Maximum shear stress theory **(10 Marks)**

OR

8 a. Determine the diameter of a solid shaft which transmits 300 kW at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 1° in a shaft length of 2 m. Take modulus of rigidity $G = 1 \times 10^5\ N/mm^2$. **(10 Marks)**

b. A hollow shaft is to transmit 250 KW power at 100 rpm. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 times the external diameter, find the external and internal diameters, assuming that the maximum torque is 1.4 times the mean torque. **(10 Marks)**

Module-5

9 a. Derive Euler's buckling equation for a long column when both ends are hinged. Also state the assumptions made in the derivation. **(10 Marks)**

b. Determine the buckling load for a strut of T-section, the flange width being 100 mm, overall depth 80 mm and both flange and stem 10 mm thick. The strut is 3 m long and is hinged at both ends. Take $E = 200\ GN/m^2$. **(10 Marks)**

OR

10 a. Derive expressions for strain energy due to: (i) axial load (ii) torsion **(10 Marks)**

b. State and prove Castigliano's first theorem. **(10 Marks)**

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18ME33

Third Semester B.E. Degree Examination, Jan./Feb. 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 Thermodynamic handbook is permitt*****ed.**

Module-1

1 a. Distinguish between the following with an example for each
i) Open system and closed system
ii) Macroscopic and microscopic approach
iii) Point function and path function
iv) Diathermic walls and adiabatic walls
v) Intensive and extensive property. **(10 Marks)**

b. The temperature 't' on a Celsius scale is defined in terms of property 'P' by the relation $P = e(t - B)/A$. Where A and B are constants. Experiments gives value of P is 1.86 and 6.81 at the ice and steam point respectively. Obtain relation for 't' and also find temperature 't' for the reading of P = 2.5. **(10 Marks)**

OR

2 a. Explain what do you understand by thermodynamic equilibrium. **(06 Marks)**

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

c. A platinum wire is used as a resistance thermometer. The wire resistance was found to be 10Ω and 16Ω at ice point and steam point respectively and 30Ω at sulphur boiling point of 444.6ºC. Find the resistance of the wire at 750ºC, it the resistance varies with temperature by the relation $R = R_0(1 + \alpha t + \beta t^2)$. **(10 Marks)**

Module-2

3 a. Distinguish between heat and work. **(04 Marks)**

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

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

OR

4 a. Starting from the first law of thermo-dynamics for a closed system undergoing a non cyclic process, derive the steady state, steady flow energy equation for a control volume. **(06 Marks)**

b. State the limitations of first law of thermodynamic. Illustrate with examples. **(04 Marks)**

c. The properties of system during a reversible constant pressure non-flow process at P = 1.6 bar change from $V_1 = 0.3\ m^3/Kg$, $T_1 = 20^oC$ to $V_2 = 0.55\ m^3/Kg$, $T_2 = 260^oC$. The specific heat of the fluid is given by

$$C_p = \left(1.5 + \frac{75}{T + 45}\right) kJ/Kg^oC.$$

Determine: i) Heat added/Kg ii) Work done/Kg iii) $\Delta V = ?$ iv) $\Delta H / Kg = ?$ **(10 Marks)**

Module-3

5 a. State and prove that Kelvin Plank and Clausius statements of second law of Thermodynamic are equivalent. **(10 Marks)**

b. A reversible heat engine operating between two thermal reservoirs at 800ºC and 30ºC respectively. If drives refrigerator operating between -15ºC and 30ºC. The heat input to the heat engine is 1900kJ and the network output from the combined plant is 290KJ. Calculate the heat absorbed by the refrigerant and the total heat transferred to 30ºC reservoir. **(10 Marks)**

OR

6 a. State and prove principle of increase of entropy. **(06 Marks)**

b. A heat engine is supplied with 278kJ/sec of heat at a constant fixed temperature of 283ºC and the heat rejection take place at 5ºC. The following results were reported.

i) 208kJ/sec of heat rejected
ii) 139kJ/Sec of heat rejected
iii) 70 kJ/sec of heat rejected

Classify which of the result report reversible cycle irreversible cycle or impossible cycle. **(06 Marks)**

c. 2Kg of water at 80ºC are mixed adiabatically with 3Kg of water at 30ºC in a constant pressure process at 1 atmosphere. Determine the increase in entropy due to mixing process. Assume for water $C_p = 4.187$ kJ/Kg. **(08 Marks)**

Module-4

7 a. Explain briefly available and unavailable energies referred to a cyclic process. **(10 Marks)**

b. 5 Kg of air at 555K and 4 bar is enclosed in a system.

i) Determine the availability of the system if the surrounding temperature and pressure are 290K and 1 bar respectively.
ii) If the air is cooled at constant pressure to the atmospheric temperature and if $C_p = 1.005$kJ/Kg K and $C_v = 0.718$ kJ/Kg K for air, determine the availability and effectiveness. **(10 Marks)**

OR

8 a. Sketch and explain separating and throttling colorimeter to find out the dryness fraction of pure substance. **(10 Marks)**

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

Module-5

9 a. Define mass fraction and mole fraction. **(04 Marks)**

b. State Gibb's Dalton law of partial pressures and hence device an expression for the gas 'R' of a mixture of gases. **(06 Marks)**

c. A mixture of ideal gases consists of 3Kg of nitrogen and 5Kg of carbon dioxide at a pressure of 300 KPa and a temperature of 20ºC find :

i) Mole fraction of each constituent
ii) The equivalent molecular weight of the mixture
iii) The equivalent gas constant of the mixture
iv) The partial pressure and partial volume
v) The volume and density of the mixture. **(10 Marks)**

OR

10 a. Explain the following :

i) Compressibility factor
ii) Law of corresponding states
iii) Compressibility chart **(10 Marks)**

b. Determine the specific volume of H_2 gas when its pressure is 60 bar and temperature is 100K

i) By using compressibility chart
ii) By using Vander Waal's equation

Take for H_2 $T_c = -239.76$ºC

$P_c = 12.92$ bar

$a = 0.25105 \times 10^5$ $Nm^2/Kg\ mole^4$

$b = 0.0262 m^3/Kg$ mole **(10 Marks)**

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18ME35B/18MEB305

Third Semester B.E. Degree Examination, Jan./Feb. 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. Define Manufacturing Process. Explain the classification of manufacturing process. **(06 Marks)**

b. List out different patterns. Explain any two of them. **(08 Marks)**

c. Explain with a neat sketch, the working principle of Sand Slinger moulding. **(06 Marks)**

OR

2 a. Explain with a neat sketch Shell moulding process. **(08 Marks)**

b. What is meant by a core? List and explain any two types of core. **(06 Marks)**

c. Explain the different types of gating systems with neat sketches. **(06 Marks)**

Module-2

3 a. How are melting furnaces classified? Give the basis. **(06 Marks)**

b. Explain with a neat sketch working of a direct arc electric furnace. **(06 Marks)**

c. Explain the construction and working principle of Cupola furnace with a sketch. **(08 Marks)**

OR

4 a. What is die casting? Draw a neat sketch and explain the hot chamber die casting process. **(08 Marks)**

b. Draw and explain the following :
(i) Squeeze Casting process
(ii) Slush Sasting process. **(12 Marks)**

Module-3

5 a. What is nucleation? Explain types of nucleation with neat sketches. **(06 Marks)**

b. Define solidification. Explain the methods controlling directional solidification. **(08 Marks)**

c. What is fettling? Explain the steps involved in fettling. **(06 Marks)**

OR

6 a. Define grain refinement. Explain the methods of grain refinement. **(06 Marks)**

b. Write a short notes on
(i) Drossing
(ii) Hardness used in Aluminium casting. **(06 Marks)**

c. With a neat sketch, explain the principle of lift out crucible furnace. **(08 Marks)**

Module-4

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

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

c. Explain with a neat figure submerged arc welding process with advantages. **(10 Marks)**

OR

8 a. With a neat sketch describe friction welding and state the advantages. **(10 Marks)**

b. Explain briefly with a neat sketch Electron Beam Welding. State the application. **(10 Marks)**

Module-5

9 a. Explain the various regions of HAZ in low carbon steel, during welding. **(08 Marks)**

b. Explain hoe shrinkage in welds can be minimized. How residual stresses in welds can be removed? **(12 Marks)**

OR

10 a. Explain Soldering and Brazing with examples. Mention their advantages and disadvantages. **(08 Marks)**

b. Explain the following with neat sketches:
i) X-ray radiography
ii) Optical holography **(12 Marks)**

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CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 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. Show that $f(z) = \sin z$ is analytic and hence find $f'(z)$. **(06 Marks)**

b. Derive Cauchy Riemann equation in polar form. **(07 Marks)**

c. If f(z) is analytic, prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$. **(07 Marks)**

OR

2 a. Find the analytic function whose imaginary part is $e^x(x\sin y + y\cos y)$. **(06 Marks)**

b. Show that $u = \sin x \cosh y + 2\cos x \sinh y + x^2 - y^2 + 4xy$ is harmonic. Also determine the analytic function f(z). **(07 Marks)**

c. Derive Cauchy Riemann equation in Cartesian form. **(07 Marks)**

Module-2

3 a. State and prove Cauchy's integral formula. **(06 Marks)**

b. Discuss the transformation $\omega = z^2$ **(07 Marks)**

c. Find the bilinear transformation which maps the points $z = \infty, i, 0$ into $\omega = -1, -i, 1$. Also find the fixed points of the transformation. **(07 Marks)**

OR

4 a. Evaluate $\int_C |z|^2 dz$ where C is the square with vertices (0, 0), (1, 0), (1, 1), (0, 1). **(06 Marks)**

b. Evaluate $\int_C \frac{e^{2z}}{(z+1)(z-2)}$ where C is the circle $|z| = 3$. **(07 Marks)**

c. Find the bilinear transformation which map the points $Z_1 = i$, $Z_2 = 1$, $Z_3 = -1$ onto the points $\omega_1 = 1$, $\omega_2 = 0$, $\omega_3 = \infty$. **(07 Marks)**

Module-3

5 a. The probability distribution of a random variable X is given by the following table:

x	0	1	2	3	4	5	6	7
P(x)	0	K	2K	2K	3K	K^2	$2K^2$	$7K^2+K$

(i) Find K

(ii) Evaluate $P(X < 6)$ and $P(3 < x \le 6)$ **(06 Marks)**

b. The number of telephone lines busy at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are chosen at random, what is the probability that, (i) no line is busy (ii) all lines are busy (iii) at least one line is busy (iv) Atmost 2 lines are busy. **(07 Marks)**

c. In a certain town the duration of a shower is exponentially distributed with mean 5 minutes. What is the probability that a shower will last for :
   (i) 10 minutes or more
   (ii) Less than 10 minutes.
   (iii) Between 10 and 12 minutes **(07 Marks)**

OR

6 a. The probability density function of a random variable is,

$$P(x)=\begin{cases} Kx^2, & -3\le x\le 3 \\ 0, & \text{Otherwise} \end{cases}$$

Find (i) K (ii) $P(1\le x\le 2)$ (iii) $P(x\le 2)$ **(06 Marks)**

b. The probability that a news reader commits no mistake in reading the news is $\frac{1}{e^3}$. Find the probability that on a particular news broadcast he commits (i) Only 2 mistakes (ii) more than 3 mistakes (iii) atmost 3 mistakes, assuming that mistakes follow Poisson distribution. **(07 Marks)**

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be, (i) less than 65, (ii) more than 75 (iii) between 65 and 75. (Given $\phi(1)=0.3413$) **(07 Marks)**

Module-4

7 a. The ranking of 10 students in two subjects, Field theory (A) and Network Analysis (B) are given below:

Roll No. of the students	1	2	3	4	5	6	7	8	9	10
A	3	5	8	4	7	10	2	1	6	9
B	6	4	9	8	1	2	3	10	5	7

Calculate the Rank correlation coefficient. **(06 Marks)**

b. Fit a parabola $y=a+bx+cx^2$ for the data.

x	0	1	2	3	4
y	1	1.8	1.3	2.5	2.3

(07 Marks)

c. In a partially destroyed Laboratory record of an analysis. The lines of regression of y on x and x on y are available as $4x-5y+33=0$ and $20x-9y-107=0$. Calculate $\bar{x}, \bar{y}$ and coefficient of correlation between x and y. **(07 Marks)**

OR

8 a. If θ is the angle between the two regression lines, show that

$$\tan\theta=\frac{1-r^2}{r}\cdot\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}$$ **(06 Marks)**

b. Fit a straight line in the least square sense for the following data:

x	50	70	100	120
y	12	15	21	25

(07 Marks)

c. Find the coefficient of correlation for the data.

x	10	14	18	22	26	30
y	18	12	24	6	30	36

(07 Marks)

Module-5

9 a. Determine (i) Marginal distribution (ii) Covariance between the discrete random variables X and Y along with the joint probability distribution.

X \ Y	1	3	9
2	$1/8$	$1/24$	$1/12$
4	$1/4$	$1/4$	0
6	$1/8$	$1/24$	$1/12$

(06 Marks)

b. In 324 throws of a six faced 'die', an odd number turned up 181 times. Is it possible to think that the 'die' is an unbiased one? **(07 Marks)**

c. A random sample of 10 boys had the following:
I.Q : 70, 120, 110, 101, 88, 83, 95, 98, 107, 100
Does the data support the assumption of a population mean I.Q of 100 at 5% level of significance?
$\left(\text{Note}: t_{0.05} = 2.262 \text{ for g d.f}\right)$ **(07 Marks)**

OR

10 a. Explain the terms : (i) Null hypothesis (ii) Confidence intervals (iii) Type I and II errors **(06 Marks)**

b. The joint probability of the random variable X and Y as follows :

X \ Y	-4	2	7
1	$1/8$	$1/4$	$1/8$
5	$1/4$	$1/8$	$1/8$

Compute :
(i) E(X) and E(Y)
(ii) E(XY)
(iii) σ_X and σ_Y
(iv) COV(X, Y) **(07 Marks)**

c. Fit a Poisson distribution for the data and test the goodness of fit given that $\chi^2_{0.05} = 7.815$ for 3 d.f

x	0	1	2	3	4
f	122	60	15	2	1

(07 Marks)

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CBCS SCHEME

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18ME42

Fourth Semester B.E. Degree Examination, Jan./Feb. 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 handbook is permitted.***

Module-1

1 a. Derive an expression for the efficiency of Otto cycle. **(08 Marks)**

b. A 4 cylinder 2 stroke petrol engine has a bore of 57 mm and stroke of 90 mm. Its rated speed is 2800 rpm and is tested at this speed against a brake, which has a torque arm of 0.356 m. The net brake load is 155 N and the fuel consumption is 6.74 lit/hr. The specific gravity of the petrol is 0.735 and it has a calorific value of 44200 kJ/kg. A Morse test is carried out and the cylinders are cut-off in order 1, 2, 3, 4 with corresponding brake torque loads 111, 106.5, 104.2, 111.3 N respectively. Calculate for this speed:
(i) The engine torque
(ii) BMEP
(iii) Brake thermal efficiency
(iv) BSFC
(v) Mechanical efficiency
(vi) Indicated thermal efficiency **(12 Marks)**

OR

2 a. Explain knocking in SI engine. What are effects of knocking? **(08 Marks)**

b. In an air standard diesel cycle, the compression ratio is 16 and at the beginning of isentropic compression the temperature is 25°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of constant pressure process is 1500°C. Calculate:
(i) The cut-off ratio
(ii) The heat supplied per kg of air
(iii) The cycle efficiency
(iv) The mean effective pressure **(12 Marks)**

Module-2

3 a. Derive an expression for the efficiency of Brayton cycle. **(08 Marks)**

b. In a gas turbine installation, the air is taken in at 1 bar and 15°C and compressed to 4 bar. The isentropic efficiency of the turbine and the compressor are 82% and 85% respectively. Determine: (i) Compression work (ii) Turbine work (iii) Thermal efficiency.

What would be the improvement in the thermal efficiency if a regenerator with 75% effectiveness is incorporated in the cycle? Assume maximum cycle temperature to be 825°K. **(12 Marks)**

OR

4 a. Explain how the regeneration will improve the efficiency of the Brayton cycle. **(06 Marks)**

b. With a neat sketch, explain the working of turbojet engine. **(04 Marks)**

c. In an open cycle gas turbine plant, air enters the compressor at 1 bar and 27°C. The pressure after compression is 4 bar. The isentropic efficiencies of the turbine and compressor are 85% and 80% respectively. Air-fuel ratio is 80:1. Calorific value of the fuel used is 42000 kJ/kg. Mass flow rate of air is 2.5 kg/s. Determine the power output from the plant and the cycle efficiency. Assume that C_p and γ values are same for both air and products of combustion. **(10 Marks)**

Module-3

5 a. With a schematic and T-S diagram, explain the working of reheat vapour power cycle and deduce an expression for cycle efficiency. **(10 Marks)**

b. Steam enters the turbine of a steam power plant, operating on Rankine cycle, at 10 bar, 300°C. The condenser pressure is 0.1 bar. Steam leaving the turbine is 90% dry. Calculate the adiabatic efficiency of the turbine and also the cycle efficiency, neglecting the pump work. **(10 Marks)**

OR

6 a. With the help of schematic diagram, T-S diagram explain regenerative vapour power cycle with one open feed water heater and derive an expression for its thermal efficiency. **(10 Marks)**

b. An ideal reheat cycle utilizes steam as the working fluid. Steam at 100 bar, 400°C is expanded in the HP turbine to 15 bar. After this it is reheated to 350°C at 15 bar and is then expanded in the LP turbine to the condenser pressure of 0.5 bar. Determine the thermal efficiency and steam rate. **(10 Marks)**

Module-4

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(10 Marks)**

b. It is required to design an air conditioning plant for an office room with the following conditions:
Outdoor conditions: 14°C DBT and 10°C WBT
Required conditions: 20°C DBT and 60% RH
Amount of air circulated 0.3 m^3/min/person
Seating capacity of the office = 60
The required condition is achieved first by heating and then by adiabatic humidifying. Determine the following:
(i) Heating capacity of the coil in KW and the surface temperature required if the bypass factor of the coil is 0.4.
(ii) Capacity of the humidifier. **(10 Marks)**

OR

8 a. With the help of schematic diagram and appropriate psychrometric diagram, explain summer air conditioning system for hot and dry outdoor conditions. **(10 Marks)**

b. A Freon-12 refrigerator producing a cooling effect of 20 kJ/s operator on a simple cycle with pressure limits of 1.509 bar and 9.607 bar. The vapour leaves the evaporator dry saturated and there is no under cooling. Determine the power required by the machine.
If the compressor operates at 300 rpm and has a clearance volume of 3% of stroke volume, determine the piston displacement of the compressor. For compressor assume that the expansion following the law $PV^{1.3}$ = constant. Given:

Temperature °C	P in bar	V_g in m^3/kg	Enthalpy kJ/kg		Entropy kJ/kg/K		Specific heat kJ/kg/K
			h_f	h_g	s_f	s_g	
–20	1.509	0.1088	17.8	176.61	0.073	0.7082	-
40	9.607	-	74.53	203.05	0.2716	0.682	0.747

(10 Marks)

Module-5

9 a. Derive the condition for minimum work in a 2 stage reciprocating air compressor. Using this condition obtain the expression for minimum work in a two stage compression. **(10 Marks)**

b. A single cylinder, single acting reciprocating air compressor is belt driven from an electric motor at 300 rpm. The cylinder diameter is 20 cm and the stroke is 24 cm. The air is compressed from one atmosphere to 8 atmosphere and the law of compression is $PV^{1.25}$ = constant. Find the power of the electric motor if the transmission efficiency is 96% and the mechanical efficiency of the compressor is 85%. Neglect clearance effect. **(10 Marks)**

OR

10 a. Explain different types of steam nozzles. **(06 Marks)**

b. Starting from steady flow energy equation, derive an expression for velocity of steam coming out of nozzle. **(06 Marks)**

c. An adiabatic steam nozzle is to be designed for a discharge rate of 10 kg/s of steam from 10 bar and 400°C to a back pressure of 1 bar. The nozzle efficiency is 0.92 and the frictional loss is assumed to take place in the divergent portion of the nozzle only. Calculate:

(i) Velocity of steam at throat and exit of the nozzle

(ii) Throat and exit area

Assume index of expansion = 1.3. **(08 Marks)**

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CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Any missing data assumed suitably.***

Module-1

1 a. Define the following terms with SI units:
(i) Mass density (ii) Kinematic viscosity
(iii) Capillarity (iv) Compressibility **(10 Marks)**

b. An oil film thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m × 0.9 m slides down as a inclined plane having an inclination of 20° with horizontal. The weight of the squire plate is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Find the kinematic viscosity of oil. Specific gravity of oil is 0.7. **(10 Marks)**

OR

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

b. Derive an expression for total pressure torque and depth of centre of pressure for an inclined plane surface submerged in liquid. **(06 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of manometer is open to atmosphere. Find the vacuum pressure in a pipe, if the difference of mercury level in two limbs is 40 cms and height of the fluid in the left from the centre of pipe is 15 cm below. **(08 Marks)**

Module-2

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

b. Explain different types of fluid flow. **(04 Marks)**

c. Derive continuity equations in Cartesian coordinated for a fluid flow 3 dimensional steady incompressible flow. **(08 Marks)**

OR

4 a. Write an expression for acceleration of fluid in x, y and z directions. Differentiate between local and convective acceleration. **(06 Marks)**

b. The velocity potential function (ϕ) is given by the expression $\phi = -2\ell n (x^2 + y^2)$. Show that it represents a possible case of fluid flow. **(06 Marks)**

c. A solid cylinder of diameter 4 m has a height of 3m. Find the meta centre height when it is floating with its axis vertical. The specific gravity of cylinder is 0.6. **(08 Marks)**

Module-3

5 a. With a suitable assumption, derive a Bernoulli's equation. **(07 Marks)**

b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of pipe charges from 200 mm at section A to 500 mm at section 'B' which is 4 m higher than A. If the pressure at 'A' and 'B' is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/s. Determine:
(i) Loss of head (ii) Flow direction. **(06 Marks)**

c. Obtain the Euler's equation of motion along a stream line. State the assumptions made. **(07 Marks)**

OR

6 a. Derive Hagen Poiseuille equation for laminar flow through a circular pipe. **(06 Marks)**

b. Three pipes of length 800 m, 500 m and 400 m of diameters 500 mm, 400 mm and 300 mm respectively are connected in series, these pipes are replaced by a single pipe of 1700 m. Find the diameter of the single pipe. **(10 Marks)**

c. Write a note on venture-meter. **(04 Marks)**

Module-4

7 a. Explain boundary layer separation and discuss methods of controlling boundary layer separation. **(10 Marks)**

b. What is a similitude's? Explain the following:
(i) Geometric similarity
(ii) Dynamic similarity **(10 Marks)**

OR

8 a. The frictional torque of a disc of diameter 'D' depends on speed 'N' in a fluid dynamic viscosity μ and density of fluid ρ in a turbulent fluid flow by Buckingham's PI method develop a frictional torque T. **(10 Marks)**

b. The resisting force 'F' of a plane during flight can be considered as dependent upon length of aircraft 'ℓ' velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variable and the resisting force using dimensional analysis. Explain the physical meaning of these groups. **(10 Marks)**

Module-5

9 a. Define stagnation properties. Obtain an expression for stagnation pressure of a compressible fluid interms of Mach number and pressure. **(08 Marks)**

b. A projectile travels in air of pressure 15 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. **(08 Marks)**

c. What is normal shock and oblique shocks? **(04 Marks)**

OR

10 a. Define the following terms:
(i) Mach number
(ii) Zone of action
(iii) Subsonic flow
(iv) Supersonic flow
(v) Transonic flow **(10 Marks)**

b. Explain CFD and mention its applications. **(06 Marks)**

c. Explain one dimensional flow. **(04 Marks)**

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CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 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 chain (iii) Degree of freedom (iv) Inversion **(06 Marks)**

b. Explain Grubler's criterion for plane mechanism. **(06 Marks)**

c. What are quick return motion mechanisms? When are they used? Sketch and explain the functioning of Whitworth mechanism. **(08 Marks)**

OR

2 a. Derive an expression for necessary condition of correct steering and explain Ackerman steering gear with neat sketch. **(10 Marks)**

b. Sketch and explain following mechanisms:
(i) Drug link mechanism (ii) Geneva wheel. **(10 Marks)**

Module-2

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

b. In a reciprocating engine the length of crank is 250mm and length of connecting rod is 1000mm. The crank rotates at an uniform speed of 300 rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The centre of gravity of connecting rod is 400mm from the crank end. By Klein's construction determine
(i) Velocity and acceleration of piston.
(ii) Angular velocity and acceleration of connecting rod.
(iii) Velocity and acceleration at the centre of gravity of connecting rod. **(14 Marks)**

OR

4 In a four bar mechanism ABCD, AD is fixed link of 120 mm long. The crank AB is 30mm and rotates at 100 rpm clockwise while CD = 60mm oscillates about D. BC and AD are of same length. Find the angular velocity of link CD when angle BAD = 60° by (i) relative velocity method (ii) Instantaneous centre method. **(20 Marks)**

Module-3

5 Using complex algebra derive expressions for velocity and acceleration of the piston angular acceleration of connecting rod of a slider crank mechanism. **(20 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(10 Marks)**

b. Design a four link mechanism to coordinate three positions of the input and the output as follows:

$\theta_1 = 20°$ $\phi_1 = 35°$
$\theta_2 = 35°$ $\phi_2 = 45°$
$\theta_3 = 50°$ $\phi_3 = 60°$ **(10 Marks)**

Module-4

7 A cam rotates at a uniform speed of 300 rpm clockwise and gives an oscillating follower 75mm long, an angular displacement of 30° in each stroke. The follower if fitted with a roller of 20mm diameter which makes contact with the cam. The outward and inward displacements of the follower each occupying 120° cam rotation and there is no dwell in the lifted position. The follower moves throughout with SHM. The axis of fulcrum is 80mm from the axis of cam and least distance of roller axis from cam axis is 40mm. **(20 Marks)**

OR

8 A vertical spindle supplied with a plane horizontal face at its lower end is actuated by a cam keyed to a uniformly rotating shaft. The spindle is raised through a distance of 30mm in one forth remains at rest in one fourth, is lowered in one third and remains at rest for the remainder of a complete revolution. Draw the profile assuming the least radius of cam profile as 25mm and that the spindle moves with uniform acceleration and retardation on both ascent and descent, however during descent deceleration period is half the acceleration period. The axis of the spindle passes through cam axis. The cam rotates in anticlockwise direction. **(20 Marks)**

Module-5

9 a. Derive an expression for minimum number of teeth necessary for gear to avoid interference. **(10 Marks)**

b. The standard full depth 14½° gear have module of 5mm. The pinion has 15 teeth and the gear has 60 teeth. Addendum = 1 module.
(i) Show that the gear will interfere with pinion
(ii) Should the pressure angle be increased to eliminate the interference? **(10 Marks)**

OR

10 a. Explain the term train valve and velocity ratio used in gear train. **(04 Marks)**

b. In an epicyclic gear train the internal wheels A, B and the compound wheel C and D rotate independently about the axis 'O'. The wheels E and F rotate on a pin fixed to the arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18; C = 28, D = 26.
(i) Sketch the arrangement
(ii) Find the number of teeth on A and B
(iii) If the arm G makes 150 rpm CW and A is fixed find the speed of B.
(iv) If the arm G makes 150 rpm CW and wheel A makes 15 rpm CCW find the speed of B. **(16 Marks)**

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CBCS SCHEME

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18ME45A/18MEA405

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Metal Cutting and Forming

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Differentiate between orthogonal and oblique cutting with a neat sketch. **(10 Marks)**

b. Explain the following types of chip formation with a neat sketch:
(i) Continuous chips
(ii) Discontinues chips
(iii) Continuous with built up edges **(10 Marks)**

OR

2 a. With a neat sketch, explain following lathe operations:
(i) Facing operation
(ii) Step turning operation **(10 Marks)**

b. Draw simple lathe diagram and explain following main parts of lathe:
(i) Head stock
(ii) Tail stock
(iii) Carriage assembly **(10 Marks)**

Module-2

3 a. Describe up-milling and down-milling with a neat sketch. **(10 Marks)**

b. Define indexing and need for indexing in milling machine and explain simple indexing with a neat sketch **(10 Marks)**

OR

4 a. Explain constructional features of radial arm drilling machine with a neat sketch. **(10 Marks)**

b. With a neat sketch, explain external centreless grinding. **(10 Marks)**

Module-3

5 a. Define cutting fluids and explain different types of cutting fluids used in machining operations. **(05 Marks)**

b. Discuss the functions of cutting fluids in machining operations. **(05 Marks)**

c. Explain the major machining parameters affecting the surface finish. **(10 Marks)**

OR

6 a. Explain different tool wear mechanisms in machining. **(10 Marks)**

b. Describe the factors or parameters affecting cutting tool life. **(10 Marks)**

Module-4

7 a. Define metal forming processes and give detailed classification of it. **(04 Marks)**

b. List and discuss different forging defects. **(06 Marks)**

c. List and discuss different defects in rolled products. **(10 Marks)**

OR

8 a. Define rolling process and list different types of rolling mill. With neat sketch, explain four high mill rolling. **(10 Marks)**

b. Differentiate between drawing and extrusion with a neat sketch. **(10 Marks)**

Module-5

9 a. Explain embossing and coining sheet metal operation with a neat sketch. **(10 Marks)**

b. Describe any five variables in deep drawing process. **(10 Marks)**

OR

10 a. With a neat sketch, explain compound dies and progressive dies. **(10 Marks)**

b. Explain drawing force and draw ratio in sheet metal operations. **(10 Marks)**

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CBCS SCHEME

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18ME46B/18MEB406

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define metrology. State the objectives of metrology. **(06 Marks)**

b. Distinguish between line standard and end standard. **(06 Marks)**

c. Four length of bars A, B, C, D of approximately 250 mm each are to be calibrated with standard calibrated metre bar which is actually 0.0008 mm less than a metre. It is also found that, bar B is 0.0002 mm longer than bar A, bar C is 0.0004 mm longer than bar A and bar D is 0.0001 mm shorter than bar A. The length of all four bars put together is 0.0003 mm longer than the calibrated standard metre. Determine the actual dimension of each bar. **(08 Marks)**

OR

2 a. Explain the wringing phenomena of slip gauge. **(05 Marks)**

b. Explain the working of autocollimator with the help of a neat sketch. **(07 Marks)**

c. Select size of the angle gauges required to build the following angles. Also sketch the arrangement: (i) 33°16′42″ (ii) 102°8′42″ **(08 Marks)**

Module-2

3 a. With a general sketch, explain the limits, tolerance, fits, allowances and deviations. **(10 Marks)**

b. What is meant by interchangeability? State its advantages. **(06 Marks)**

c. Enumerate the classification of plain gauges. **(04 Marks)**

OR

4 a. Define comparator. What is the need of comparator? **(04 Marks)**

b. With a neat sketch, explain the working of sigma comparator. **(08 Marks)**

c. Sketch and explain the working of LVDT. **(08 Marks)**

Module-3

5 a. Derive the expression for the effective diameter of screw thread using two wire method. **(10 Marks)**

b. With a neat sketch, explain the construction and working of tool makers microscope. What are its applications? **(10 Marks)**

OR

6 a. Explain how gear tooth Vernier caliper is used to measure gear tooth thickness. **(10 Marks)**

b. With a schematic diagram, explain the working principle of CMM. **(10 Marks)**

Module-4

7 a. Explain the generalized measurement system with the aid of block diagram. **(10 Marks)**

b. Explain the following terms:
(i) Sensitivity (ii) Repeatability (iii) Linearity
(iv) Threshold (v) Least count **(10 Marks)**

OR

8 a. What is transducer? Sketch and explain working principle of piezo-electric transducers. **(10 Marks)**

b. With a neat sketch, explain the working of CRT. **(10 Marks)**

Module-5

9 a. With a neat sketch, explain the working of Rope brake dynamometer. **(10 Marks)**

b. With a neat sketch explain the working of McLeod gauge. **(10 Marks)**

OR

10 a. What is thermocouple? State the laws of thermocouple. **(08 Marks)**

b. Describe the working and construction of optical pyrometer. **(08 Marks)**

c. Write short note on gauge factor. **(04 Marks)**

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18ME51

Fifth Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023
Management and Economics

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Interest Factor table is permitted.***

Module-1

1 a. Define Management and discuss its nature and characteristics. **(06 Marks)**
b. Discuss Fayol's principles of Administrative Management. **(14 Marks)**

OR

2 a. What is Planning? Explain different steps in Planning. **(10 Marks)**
b. What do you understand by term Planning Premises? Explain different types of Planning premises. **(10 Marks)**

Module-2

3 a. Briefly explain principles of Organisation. **(10 Marks)**
b. What is Recruitment? Explain sources of Recruitment. **(10 Marks)**

OR

4 a. List various Motivation theories. Explain Maslow need Hierarchy theory in brief. **(10 Marks)**
b. Explain requirements of a good control system. **(10 Marks)**

Module-3

5 a. Explain Laws of Supply and Demand using suitable sketch. **(08 Marks)**
b. With a neat sketch, explain Cash flow diagram. **(04 Marks)**
c. Determine the effective interest rate for nominal annual rate of 8% compounded.
i) Daily (Assume 365 days/yr) ii) Monthly iii) Quarterly iv) Semi – annually. **(08 Marks)**

OR

6 a. What is Law of Diminishing return? Write its limitations. **(03 Marks)**
b. Discuss terms : i) Price elasticity of demand ii) Income elasticity of demand. **(08 Marks)**
c. A person is planning for his retired life. He has 10 more years of service. He would like to deposit 20% of his salary, which is Rs 4000 in first year and thereafter he wishes to deposit amount with annual increase of Rs 500 for next nine years with an interest rate of 15%. What will be the maturity amount? **(09 Marks)**

Module-4

7 a. Following table gives initial outlay and annual revenue of a production firm using three various alternatives. Find the best alternative based on present worth if the rate of interest is 20% compounded annually. **(09 Marks)**

	Initial Outlay	Annual Revenue	Life (Years)
Alternative 1	13,00,000	4,00,000	10
Alternative 2	21,00,000	6,50,000	10
Alternative 3	23,00,000	8,60,000	10

b. Find the most economical alternatives from following on the basis of equivalent future worth at interest rate of 9.5% per year.
Alternative 1 : Initial purchase cost = Rs 15,00,000 , Annual operating cost = Rs 35,000 starting from end of second year till end of life , Annual revenue generated = Rs 340000 for first 4 yrs then Rs 320000 afterwards till end of useful life. Expected salvage value is Rs 430000 and useful life = 8 yrs.
Alternative II : Initial purchase cost = Rs 1800000 , Annual operating cost = Rs 2500 , Annual revenue generated = Rs 365000 , Salvage value = Rs 550000 , Useful life = 8 yrs. **(11 Marks)**

OR

8 a. Explain IRR , ERR and MARR. Enlist the misconcepts of IRR. **(08 Marks)**

b. A firm has identified three mutually exclusive investment proposals whose details are given below. The life of three investments is estimated to be five years with negligible salvage value. The minimum rate of return for the firm is 12%. Find the best alternative based on rate of return method of comparison. **(12 Marks)**

	Alternative		
	A_1	A_2	A_3
Investment	1,50,000	2,10,000	2,55,000
Annual net income	45,570	58,260	69,000

Module-5

9 a. With a block diagram, explain how a selling price of a product is determined? **(08 Marks)**

b. The expenditure incurred in manufacturing machine is as follows :
1) Material consumed = Rs 55,00,000
2) Indirect factory wages = Rs 8,00,000
3) Directors fees = Rs 3,00,000
4) Cost of advertisement = Rs 1,00,000
5) Net profit = Rs 1,20,000
6) Depreciation on sales dept car = Rs 11,000
7) Printing and stationery cost = Rs 2500
8) Depreciation of plant = Rs 45,000
9) Direct wages = Rs 6,50,000
10) Factory rent = Rs 60,000
11) Telephone and postage charges = Rs 15,000
12) Gas and electricity = Rs 50,000
13) Office salaries = Rs 2,10,000
14) Office rent = Rs 50,000
15) Show room rent = Rs 1,50,000
16) Sales man commission = Rs 26,500
17) Sales dept car expensed = Rs 15,000

Determine i) Direct cost ii) Factory cost iii) Total cost of production iv) Cost of sales v) Selling price. **(12 Marks)**

OR

10 a. What do you mean by Depreciation? Discuss various causes of depreciation. **(10 Marks)**

b. A Company has purchased on equipment whose first cost is Rs 2,00,000 with an estimated life of eight years. Estimated salvage value is 40,000 at the end of its life. Determine the depreciation charges and book value at the end of second year by sum of year's digit method of depreciation. **(10 Marks)**

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18ME52

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

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Discuss the factors influencing the selection of suitable material for machine element. **(08 Marks)**

b. Determine the safe load that can be carried by a bar of rectangular cross section shown in Fig.Q1(b). Limiting the maximum stress to 130 MPa taking stress concentration into account and assume thickness of bar as 10 mm.

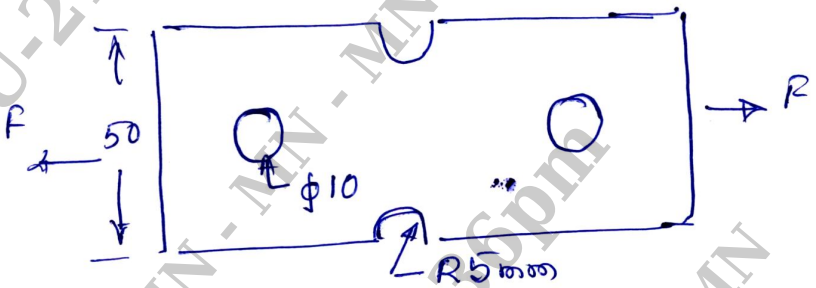

Fig.Q1(b) **(12 Marks)**

OR

2 a. Explain the following theories of failure :
(i) Maximum normal stress theory
(ii) Maximum shear stress theory
(iii) Distortion energy theory **(10 Marks)**

b. A machine element made of C45 steel is subjected to a system of loads, following stresses are induced at critical point:
σ_x = 150 MPa, σ_y = 100 MPa and τ_{xy} = 50 MPa
Find the factor of safety according to:
(i) Maximum normal stress theory
(ii) Maximum shear stress theory
(iii) Distortion energy theory **(10 Marks)**

Module-2

3 a. Derive Soderberg's equation. **(06 Marks)**

b. A hot rolled steel rod is subjected to torsional load that varies from +330 N-m clockwise to 110 N-m counter clockwise and an applied bending moment varies from +440 N-m to –220 N-m. The rod is of uniform cross section. Determine the required diameter rod. The material has an ultimate tensile strength of 550 MPa and yield strength of 410 MPa. Assume a factor of safety 1.5. Take the endurance limit as half of the ultimate strength. **(14 Marks)**

OR

4 a. List and explain the various factors effecting the endurance limit of the material. **(08 Marks)**

b. An unknown weight falls through 20 mm as to a collar rigidly attached to the lower end of a vertical bar 2 meter long and 500 mm^2 section. If the maximum instantaneous extension is 2 mm. What is the corresponding stress and the value of unknown weight? Take E = 200 GPa. **(06 Marks)**

c. A cantilever beam of span 800 mm has a rectangular cross section of depth 200 mm. The free end of beam is subjected to a transverse load of 1 kN that drops on to it from a height of 40 mm. Selecting C40 steel as material and a factor of safety 2. Determine the width of rectangular cross section. Assume E = 200 GPa. **(06 Marks)**

Module-3

5 A commercial shaft 1 metre long supported between bearings has a pulley of 600 mm diameter weighing 1 kN, driven by a horizontal belt drive keyed to the shaft at a distance of 400 mm to the left of the right bearing and receives 25 KW at 1000 rpm. Power from the shaft is transmitted from the 20° spur pinion of a pitch circle diameter 200 mm which is mounted at 200 mm to the right of the left bearing to a gear such that tangential force on gear acts vertically upwards. Take the ratio of the belt tension is 3. Determine the standard size of the shaft based on maximum shear stress theory. Assume $C_m = 1.75$, $C_t = 1.25$. **(20 Marks)**

OR

6 a. Compare weight, strength and stiffness of hollow shaft of same external diameter of that solid shaft. The inside diameter being half the external diameter. Both the shafts have same material and length. **(06 Marks)**

b. Design a cast iron flanged coupling for a steel shaft transmitting 100 KW at 250 rpm. Take the allowable shear stress for the shaft as 40 N/mm^2. The angle of twist is not to exceed 1° in a length of 20 diameters. Allowable shear stress for the bolts is 13 MPa. The allowable shear stress in the flange is 14 MPa for the key is 40 MPa. Allowable compressive stress in key is 80 MPa. **(14 Marks)**

Module-4

7 a. Explain in detail various possible modes of failure of riveted joint. **(06 Marks)**

b. Design a double riveted butt joint with two equal cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume an efficiency of 75% allowable tensile stress in the plate of 90 N/mm^2, allowable crushing stress of 140 N/mm^2 and an allowable shear stress in the rivet of 50 N/mm^2. **(14 Marks)**

OR

8 a. A bracket having a load of 15 kN is to be welded as shown in Fig.Q8(a). Find the size of weld required, if allowable shear stress is not to exceed 80 N/mm^2.

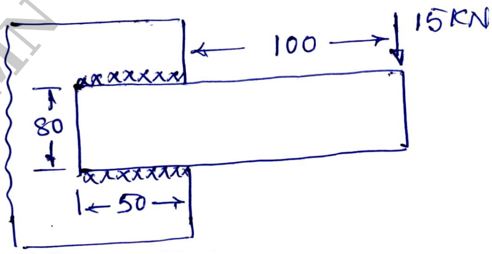

Fig.Q8(a) **(10 Marks)**

b. Determine the size of rivets required for the bracket shown in Fig.Q8(b). Take allowable shear stress of rivet material as 100 N/mm^2.

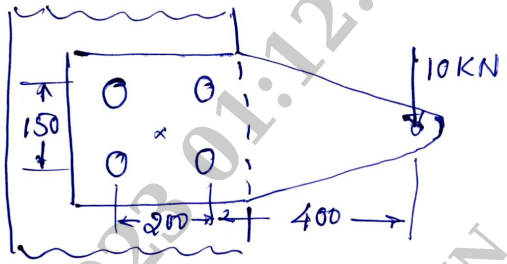

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Obtain an expression for torque required to lift the load on a square threaded screw. **(08 Marks)**

b. 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 σ_t = 100 N/mm^2, σ_c = 150 N/mm^2 and τ = 60 N/mm^2. **(12 Marks)**

OR

10 a. Explain self locking and overhauling of power screw. **(06 Marks)**

b. The cotter of a broaching machine is pulled by square threaded screw of 55 mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N. On a flat surface of 60 mm and 90 mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces, determine the power required to rotate the nut when the cutting speed is 6 m/min. Also find the efficiency of the screw. **(14 Marks)**

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CBCS SCHEME

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18ME53

Fifth Semester B.E. Degree Examination, Jan./Feb. 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 four bar mechanism with the following dimensions is acted upon by a force 80N , 150° on the link DC. Determine the input torque on the link AB for the static equilibrium of the mechanism for the given configuration Fig. Q1. AB = 400mm , BC = 1000mm , CD = 750mm and DE = 350mm , AD = 500mm. **(20 Marks)**

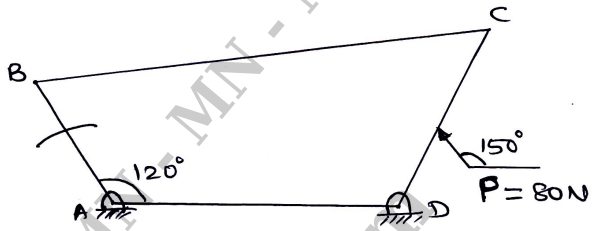

Fig. Q1

OR

2 a. State the condition of equilibrium of a body subjected to a system of
i) Two force ii) Three force iii) Two force and a torque. **(06 Marks)**

b. In a vertical engine, the length of connecting rod is 4.5 times the crank. The mass of reciprocating parts is 120kg and the crank length is 220mm. The engine runs at 250 rpm. The load on the piston due to steam pressure is 25 kN, when the crank has turned through an angle of 120° from the top dead centre. Determine i) Net effective driving force on the piston ii) Thrust on connecting rod iii) Thrust on the bearings iv) Turning moment on the crank shaft. **(14 Marks)**

Module-2

3 a. Explain Static and Dynamic balancing of rotating masses. **(04 Marks)**

b. Four masses A, B, C and D carried on a shaft at radii 100mm , 125mm , 200mm and 150mm respectively. The planes at which masses are rotating are placed 600mm apart. The mass B, C and D are 10kg , 5kg and 4kg respectively. Find the mass of A and relative angular position of the four masses so that the shaft will be in equilibrium. **(16 Marks)**

OR

4 The firing order in a six cylinder four stroke in line engine is 1 – 4 – 2 – 6 – 3 – 5. The piston stroke is 100mm and length of each connecting rod is 200mm. The pitch of the cylinder centre lines are 100mm , 100mm , 150mm , 100mm and 100mm respectively. The reciprocating mass per cylinder is 1kg and the engine runs at 3000 rpm. Determine the unbalanced primary and secondary forces and couples, if any. Take central plane of the engine as reference plane. **(20 Marks)**

Module-3

5 a. Derive the expression for speed of a Porter Governor with usual notations, taking friction into account. **(08 Marks)**

b. The upper arms of a Porter Governor has lengths 350mm and are pivoted on the axis of rotation. The lower arms have lengths 300mm and are attached to the sleeve at a distance of 40mm from the axis. Each ball has a mass of 4 kg and mass on the sleeve is 45kg. Determine the equilibrium speed for a radius of rotation of 200mm and find the effort and power of governor for 1% speed change. **(12 Marks)**

OR

6 a. Explain the effect of gyroscopic couple on an Aeroplane. **(06 Marks)**

b. The turbine rotor of a ship has a mass of 3500kg. It has a radius of gyration of 0.45m and a speed of 3000 rpm clockwise when looking from stress. Determine the gyroscopic couple and its effect upon the ship.

i) When the ship is steering to the left on a curve of 100m radius at a speed of 36km/hour.

ii) When the ship is pitching with SHM the bow falling with its maximum velocity. The period of pitching is 40 sec and the total angular displacement between the two extreme position of pitching is 12°. **(14 Marks)**

Module-4

7 a. Define the following with respect to vibration : i) Degrees of freedom ii) Amplitude iii) Resonance iv) Natural frequency v) Damping factor. **(10 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q7(b) by Newton's and Energy method. **(10 Marks)**

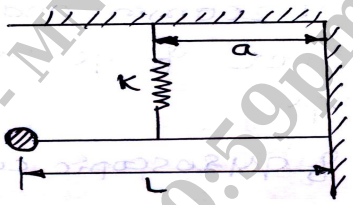

Fig. Q7(b)

OR

8 a. Set up the differential equation for a spring mass damper system and obtain complete solution for the critically damped condition. **(10 Marks)**

b. A vibrating system having a mass of 3kg, spring stiffness of 100 N/mm and damping coefficient of 3 N-S/m. Determine damping ratio, damped natural frequency , logarithmic decrement, ratio of two consecutive amplitudes and number of cycles after which the original amplitude is reduced to 20%. **(10 Marks)**

Module-5

9 a. Define "Transmissibility". Derive an expression for force transmissibility. **(10 Marks)**

b. A 35kg block is connected to a support through a spring of stiffness 1.4×10^6 N/m in parallel with dashpot of damping coefficient 1.8×10^3 N-S/m. The support is given a harmonic displacement of amplitude 10mm at a frequency of 35Hz. Compute the steady state amplitude of the absolute displacement of the block. **(10 Marks)**

OR

10 a. Derive an equation for steady state amplitude for forced vibration with rotating unbalance. **(10 Marks)**

b. A rotor has a mass of 12kg and is mounted midway on a 24mm diameter horizontal shaft supported simply at the ends by two bearings. The bearings are 1m apart. The shaft rotates at 2400 rpm. If the centre of mass of the rotor is 0.11mm away from the geometric centre of the rotor due to manufacturing defect, find i) the amplitude of the steady state vibration ii) the dynamic force transmitted to the bearing. Take E = 200 GPa. **(10 Marks)**

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CBCS SCHEME

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18ME54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Turbomachines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define specific speed of a turbine. Derive an expression for specific speed of a turbine. **(08 Marks)**

b. A model of a centrifugal pump absorbs 5kW at a speed of 1500rpm. Pumping water against a head of 6m. The large prototype pump is required to pump water to a head of 30m. The scale ratio of diameter is 4. Assuming some efficiency and similarities, find the speed, power of prototype and ratio of discharge of prototype and model. **(08 Marks)**

c. For power generating turbomachines, define
i) Total – to – total efficiency
ii) Total – to – static efficiency. **(04 Marks)**

OR

2 a. With usual notations, derive an expression for infinitesimal stage efficiency during compression process with an aid of T-S plot. **(08 Marks)**

b. An air compressor has eight stages of equal pressure ratio 1.3. The flow rate through the compressor and its overall efficiency are 45Kg/s and 80% respectively. If the conditions of air at entry are 1 bar and 35ºC, determine,
i) State of air at compressor exit
ii) Polytropic efficiency **(06 Marks)**

c. Compare the turbomachine with positive displacement machines. **(06 Marks)**

Module-2

3 a. Derive alternate form of Euler's turbine equation and explain the significance of each energy component. **(10 Marks)**

b. At a stage of an axial flow impulse turbine, the mean blade diameter is 80cm and the speed is 3000 rpm. The absolute velocity of the fluid at inlet is 300m/sec and is inclined at 20º to the plane of the wheel. If the utilization factor is 0.85 and the relative velocity at rotor exit is equal to that at inlet, determine
i) Inlet and exit blade angles
ii) Power output for a mass flow rate of 1Kg/sec. **(10 Marks)**

OR

4 a. Define degree of reaction for an axial flow machine. Prove that degree of reaction for an axial flow device assuming constant velocity of flow is given by

$$R = \frac{Va}{2u}[Cot\beta_1 + Cot\beta_2]$$ **(10 Marks)**

b. In a turbine stage with 50% reaction the tangential blade speed is 98.5 m/sec. The steam velocity at the nozzle exit is 155 m/sec and the nozzle angle is 18º. Assuming symmetric inlet and outlet velocity triangles. Compute the inlet blade angle for the rotor and power developed by the stage assuming a steam flow rate of 10Kg/sec. Also find the utilization factor. **(10 Marks)**

Module-3

5 a. Draw the inlet and exit velocity triangle for a single stage impulse steam turbine and prove that maximum blade efficiency is given by

$\eta_{b\max} = \cos^2 \alpha_1$

Assume $v_{r_1} = v_{r_2}$ and $\beta_1 = \beta_2$ **(10 Marks)**

b. The following particular refer to a stage of a Parson's steam turbine. The mean diameter of the blade ring is 70cm, the steam velocity at the inlet of moving blades is 160m/sec, the outer blade angle of moving blade β_2 is 20º. The steam flow through the blades is 7Kg/sec, Speed 1500rpm and η_{st} is 0.8. Draw the velocity diagrams and find the following :

i) Blade inlet angle
ii) Power developed in the stage
iii) Available isentropic enthalpy drop. **(10 Marks)**

OR

6 a. Define and explain nozzle efficiency and stage efficiency. **(04 Marks)**

b. With a neat sketch, explain the velocity compounding. **(06 Marks)**

c. In a stage of an impulse turbine provided with single row wheel, the mean diameters of the blade ring is 80cm and the speed of rotation is 3000rpm. The steam issues from the nozzle with a velocity of 300m/sec and the nozzle angle is 20º. The rotor blades are equiangular and blade velocity coefficient is 0.85. What is the power developed in the blades when the axial thrust on the blade is 140N? **(10 Marks)**

Module-4

7 a. Derive an expression for force, power and efficiency of a Pelton turbine assuming no frictional losses with the help of velocity triangles. **(10 Marks)**

b. The following data is given for a Francis turbine net head = 70m, Speed = 600rpm, Shaft power = 368kW, η_0 = 86%, η_h = 95%, flow ratio = 0.25, breadth ratio = 0.12, outer diameter of runner = 2 times inner diameter of runner, velocity of flow is constant at inlet and outlet, the thickness of vanes occupies 10% of the circumferential area of the runner and discharge is radial at outlet. Determine :

i) Guide blade angle
ii) Runner vane angles at inlet and outlet
iii) Diameters of runner at inlet and outlet
iv) Width of the wheel at inlet **(10 Marks)**

OR

8 a. Draw the cross sectional views of a Kaplan turbine and explain its working with a neat sketches of velocity triangles at inlet and outlet of Kaplan turbine runner. **(10 Marks)**

b. A three – jet Pelton wheel is required to generate 10,000kW under a head of 400m. The blade angle at outlet is 15º and reduction in relative velocity over the bucket is 5%. If the overall efficiency is 80%, C_v = 0.98 and speed ratio = 0.46. Find

i) Diameter of jet
ii) Total flow in m^3/sec
iii) Force exerted by a jet on the buckets **(10 Marks)**

Module-5

9 a. Applying Bernoulli's equation between the inlet and exit of the impeller of a centrifugal pump. Show that the static pressure rise is given by,

$(P_2 - P_1) = \rho/2\ [vf_1^2 + u_2^2 - vf_2^2 \text{Co sec}^2 \beta_2]$

Where, vf_1 = Velocity of flow at inlet

vf_2 = Velocity of flow at exit

β_2 = Blade angle at exit

u_2 = Blade speed at exit

ρ = density of fluid **(08 Marks)**

P_1 and P_2 = Static pressure at inlet and exit

b. The outer diameter of the impeller of a centrifugal pump is 40cm and width of the impeller at outlet is 5cm. The pump is running at 800rpm and is working against a total head of 15m. the vane angle at outlet is 40º and manometric efficiency is 75%. Determine :

i) Velocity of flow at outlet
ii) Velocity of water leaving the vane
iii) Angle made by the absolute velocity at outlet with the direction of motion at outlet
iv) Discharge **(08 Marks)**

c. Explain the phenomenon of surging in compressor. **(04 Marks)**

OR

10 a. Define the following for a centrifugal compressor

i) Slip and slip coefficient
ii) Energy transfer
iii) Power input factor
iv) Overall pressure ratio
v) Loading coefficient **(10 Marks)**

b. A 4 –stage centrifugal pump has impellers each of 38cms diameter and 1.9cms wide at outlet. The outlet vane angle is 49º and vanes occupy 8% of the outlet area. The manometric efficiency is 84% and overall efficiency is 75%. Determine the head generated by the pump when running at 900rpm discharging 59 litres/second. Also determine the power required. **(10 Marks)**

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18ME55

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Fluid Power Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. With a block diagram, explain hydraulic system. **(07 Marks)**
b. Give the differences between hydraulic system and pneumatic system. **(07 Marks)**
c. Explain Pascal's law. **(06 Marks)**

OR

2 a. With the help of sketch explain filter position in a hydraulic system. **(07 Marks)**
b. With a neat sketch, explain water cooled heat exchanger. **(07 Marks)**
c. Write a note on Seals. **(06 Marks)**

Module-2

3 a. With a neat sketch, explain internal gear pump. **(07 Marks)**
b. A pump having a displacement volume of $90cm^3$ delivers $0.082m^3$/min at 1000rpm and 6.9MPa. If the input torque is 102Nm. Find
i) Overall efficiency of the pump
ii) Theoretical torque required to operate the pump **(07 Marks)**
c. With a neat sketch, explain diaphragm type gas loaded accumulator. **(06 Marks)**

OR

4 a. With a neat sketch, explain hydraulic cylinder cushioning. **(07 Marks)**
b. A hydraulic motor has a $100cm^3$ volumetric displacement. If it has a pressure rating of 140 bars receives oil from a $0.001m^3$/s theoretical flow rate pump, find motor
i) Speed
ii) Theoretical torque
iii) Theoretical power **(08 Marks)**
c. With a neat sketch, explain rotary actuator. **(05 Marks)**

Module-3

5 a. With a sketch, explain 3 position 4 way direction control valve. **(08 Marks)**
b. Explain working of unloading valve **(07 Marks)**
c. Explain working of shuttle valve. **(05 Marks)**

OR

6 a. With the help of circuit diagram, explain sequencing of cylinder. **(08 Marks)**
b. Explain metering in and metering out circuits. **(12 Marks)**

Module-4

7 a. List the advantages, disadvantages and applications of Pneumatic system. **(08 Marks)**
b. With a neat sketch, explain F.R.L unit in a pneumatic system. **(12 Marks)**

OR

8 a. With a neat labelled sketch explain parts of pneumatic double acting cylinder. **(07 Marks)**
b. With a neat sketch, explain quick exhaust valve. **(07 Marks)**
c. Explain working of reciprocating air compressor. **(06 Marks)**

Module-5

9 a. With circuit diagram, explain indirect control of single acting cylinders. **(08 Marks)**
b. Explain 'OR' and 'AND' logic gates. **(08 Marks)**
c. Write a note on pneumatic throttle valve. **(04 Marks)**

OR

10 a. Explain with circuit coordinated cylinder movements. **(10 Marks)**
b. With a neat sketch, explain solenoid controlled direction control valve. Mention advantages. **(10 Marks)**

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CBCS SCHEME

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18ME56

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Operations Management

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Operation Management. Explain in brief the functions of operations managements. **(10 Marks)**

b. Define Productivity. Explain the factors affecting productivity. **(10 Marks)**

OR

2 a. A glass firm developing a substantial back log of orders is considering three courses of action

i) Arrange for sub contracting
ii) Begin overtime production construct new facilities

The correct choice depends largely on future demand, which may be low, medium (or) high. By consensus, management ranks the respective probabilities as 0.10, 0.50 and 0.40. A cost analysis reveals the effect on profits as shown below :

	Profit (in thousand R) if the demand is		
Course of action	Low (P = 0.1)	Medium (P = 0.5)	High (P = 0.4)
A. Arrange for sub-constructing	10	50	50
B-Begin over time	-20	60	100
C-construct new facilities	-150	20	200

(12 Marks)

b. Explain break-even analysis with necessary equations, graph and assumptions. **(08 Marks)**

Module-2

3 a. A company adopts method of least squares to develop a linear trend equation for the data as shown in the table below :

Year (X)	1	2	3	4	5	6	7	8	9	10	11
Shipment in tons (Y)	2	3	5	10	8	7	12	14	14	18	19

Calculate the trend forecast for the year 12 and 20. **(12 Marks)**

b. Explain the following forecasting methods :

i) Exponential smoothing
ii) Linear Regression **(08 Marks)**

OR

4 a. What is forecasting? List the steps involved in forecasting process. **(10 Marks)**

b. A firm use simple exponential smoothing with $\alpha = 0.1$ to forecast demand. The forecast for the week of February 1 was 500 units, where as actual demand turned out to be 450 units.

i) Forecast the demand for the week of February 8
ii) Assume that the actual demand during the week of the February 8 turned out to be 505units. Forecast the demand for the week of February 15. Continue on forecasting through March 15, assuming the sub sequent demands were actually 516, 488, 467, 554 and 510 units. **(10 Marks)**

Module-3

5 a. Explain the various factors that influence the location of plants. **(10 Marks)**

b. Define the following :
   i) Design capacity
   ii) System capacity
   iii) Capacity planning
   iv) Facility layout **(10 Marks)**

OR

6 a. Sketch and explain any two types of layouts. **(10 Marks)**

b. What is facility layout? What factors determines the types of layout used in an organization. **(10 Marks)**

Module-4

7 a. Define aggregate planning and master scheduling. Explain the pure strategies used for aggregate planning in brief. **(10 Marks)**

b. List the common strategies used in aggregate planning. Explain any two. **(10 Marks)**

OR

8 a. What are the objectives and importance of aggregate planning? **(10 Marks)**

b. Briefly explain the following with the help of a flow chart.
   i) Aggregate planning
   ii) Master scheduling **(10 Marks)**

Module-5

9 a. What are the benefits and limitation of MRP? **(10 Marks)**

b. State the importance of purchasing and supply management. **(10 Marks)**

OR

10 a. Briefly explain the following :
   i) Vendor Development
   ii) E-procurement
   iii) Concept of tenders
   iv) The procurement process **(10 Marks)**

b. Write a note on make or buy decision. **(10 Marks)**

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CBCS SCHEME

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18ME61

Sixth Semester B.E. Degree Examination, Jan./Feb. 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. Explain the steps involved in finite element method to solve engineering problems. **(08 Marks)**

b. A simply supported beam subjected to uniformly distributed load over the entire span. Derive the expression for maximum deflection using Rayleigh-Ritz method. Assume $y = C_1 \sin\left(\frac{\pi x}{L}\right) + C_2 \sin\left(\frac{3\pi x}{L}\right)$ as an admissible displacement function. **(08 Marks)**

c. What are confirming and non-confirming elements? **(04 Marks)**

OR

2 a. Explain the importance of node numbering scheme with suitable example. **(06 Marks)**

b. Explain Simplex, Complex and multiplex elements with examples. **(06 Marks)**

c. Derive strain-displacement relations for a two – dimensional elastic body. **(08 Marks)**

Module-2

3 a. Derive a shape function for one-dimensional quadratic element in natural co-ordinate system. **(06 Marks)**

b. Derive strain-displacement matrix [B] for a 3-noded triangular element. **(06 Marks)**

c. For the truss configuration shown in Fig Q3(c), determine the stiffness values K_{11}, K_{12}, K_{22} and K_{66} of the global stiffness matrix. Assume E = 210GPa, A = 6 × 10^{-4}m^2 for both the truss member.

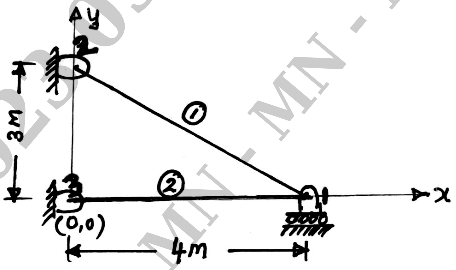

Fig Q3(c) **(08 Marks)**

OR

4 a. Evaluate the integral by 3-point gauss quadrate formula

$$I = \int_{-1}^{+1} (x^3 - 2x^2 + 5x - 7)dx$$ **(04 Marks)**

b. Derive stiffness matrix for a plane truss element. **(08 Marks)**

c. An axial bar subjected to force as shown in Fig Q4(c). Determine nodal displacement, stress in each material and reaction forces.

Assume : E_{steel} = 200GPa $E_{Aluminum}$ = 70GPa

A_{steel} = 2400mm^2 $A_{Aluminum}$ = 1200mm^2

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.

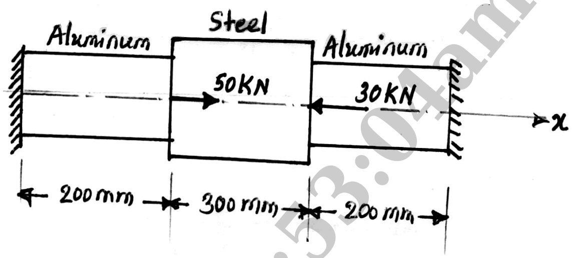

Fig Q4(c) **(08 Marks)**

Module-3

5 a. Derive the Hermite shape function for beam element and plot them. **(10 Marks)**

b. For the beam and loading as shown in Fig Q5(b) find the deflection at the centre of the beam. Assume E = 200GPa, $I = 4 \times 10^6 mm^4$

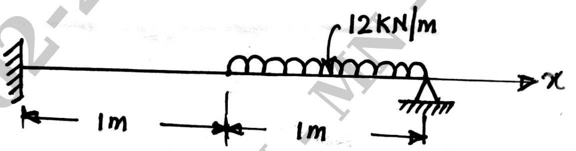

Fig Q5(b) **(10 Marks)**

OR

6 a. Derive stiffness matrix for a circular shaft subjected to pure torsion. **(10 Marks)**

b. A circular shaft subjected to torque at section "B" and "C" as shown in Fig Q6(b). Determine the maximum angle of twist and shear stress by taking modulus of rigidity for the shaft material as 70GPa.

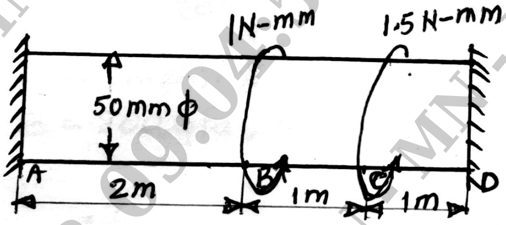

Fig Q6(b) **(10 Marks)**

Module-4

7 a. Explain different types of boundary conditions used in heat transfer problems. **(08 Marks)**

b. Heat is generated in a large plat at the rate of $4000 W/m^3$. The plate is 25mm thick. The outside surfaces of the plate are exposed to ambient air at 30ºC with a convective heat transfer co-efficient of $20 W/m^2 ºC$. Determine the temperature distribution in the wall. Assume the thermal conductivity for the plate material as 0.8W/mºC. Model the plate with 2 bar elements. **(12 Marks)**

OR

8 a. Derive differential equation in one – dimensional for fluid flow through porous medium. **(10 Marks)**

b. For the Smooth pipe with stepped cross-section as shown in Fig Q8(b), determine the potentials at the junctions. The potentials at the left end is 10m and that at the right end is 2m. Assume the permeability coefficient is 1m/sec.
$A_1 = 3m^2$, $A_2 = 2m^2$, $A_3 = 1m^2$

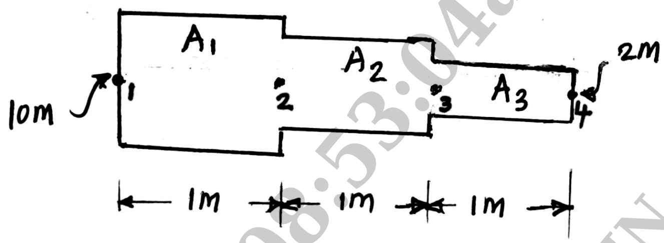

Fig Q8(b) **(10 Marks)**

Module-5

9 a. Derive the strain displacement matrix for axisymmetric constant strain triangle element. **(12 Marks)**

b. For the axisymmetric element shown in Fig Q9(b), determine the strain displacement matrix [B]. Take E = 200GPa, and $\upsilon = 0.3$

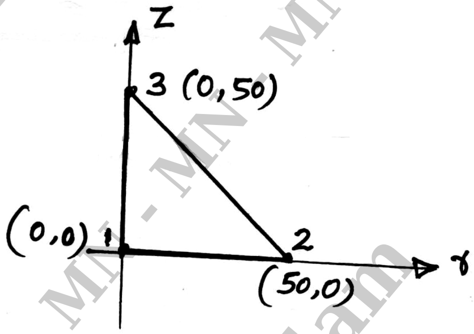

Fig Q9(b) **(08 Marks)**

OR

10 a. Derive the consistent mass matrix for two-noded bar element. **(06 Marks)**

b. Determine the eigenvalues and eigenvectors for the stepped bar as shown in Fig Q10(b). Take E = 200GPa, $\rho = 7830$ Kg/m^3

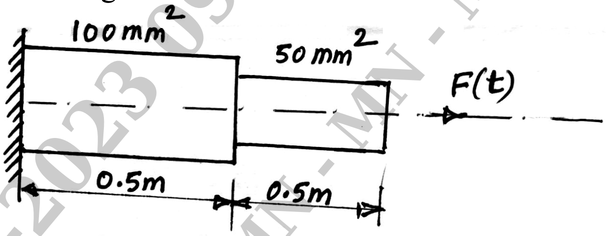

Fig Q10(b) **(14 Marks)**

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CBCS SCHEME

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18ME62

Sixth Semester B.E. Degree Examination, Jan./Feb. 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. Use of design data hand book is permitted.
3. Missing data if any, may suitably be assumed.

Module-1

1 a. A railway Wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the Wagon is 15,000 kg. The springs are compressed by 150 mm in bringing the Wagon to rest. The spring index can be taken as 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity of 81,370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. The springs should have square and ground ends. Design the spring. **(10 Marks)**

b. Discuss the significance of nipping of leaf springs with appropriate sketch. **(04 Marks)**

c. A semi-elliptic leaf spring used for automobile suspension consists of three extra-full length leaves and 15 graduated length leaves including the master leaf. The centre-to-centre distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 kN. For each leaf, the ratio of width to thickness is 9 : 1. The modulus of elasticity of the leaf material is 207 GPa. The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm^2. Determine (i) the width and thickness of leave ; (ii) the initial nip (iii) the initial pre-load required to close the gap 'C'. **(06 Marks)**

OR

2 a. Describe the phenomenon of creep and slip in the belt drive. **(04 Marks)**

b. It is required to select a V-belt drive from a normal torque motor of 5 kW capacity, which runs at 1440 rpm to a light duty compressor running at 970 rpm. The compressor runs for 24 hours per day. Space is available for a centre distance of about 500 mm. Assume that the pitch diameter of the driving pulley is 150 mm. Design the V-belt. **(08 Marks)**

c. It is required to select a 6×19 wire rope with 1569 as tensile designation for a hoist on the basis of long life. The weight of the hoist along with the material is 5 KN. It is to be raised from a depth of 100 m. The maximum speed of 5 m/s is attained in 5 seconds. Determine the size of wire rope and the sleave diameter for long life on the basis of the fatigue as failure criterion. Take 0.5 kg/m as mass per unit length of the wire rope. 70 KN as the breaking strength of the wire rope. What is the factor of safety of this wire rope under static conditions? Take the dimensionless quantity $\frac{P}{S_{ut}} = 0.0015$ for long fatigue life. **(08 Marks)**

Module-2

3 a. Describe gear tooth failure modes. **(04 Marks)**

b. It is required to design a pair of spur gears with 20° full-depth involute teeth based on the Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 KW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. The pinion as well as the gear is made of plain carbon steel with an allowable static stress of 200 N/mm^2. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears. Take a f.o.s 1.5 for beam strength. The minimum number of teeth on pinion is 18. Endurance limit for checking the beam strength of the teeth is 259 N/mm^2. Take face width to module ratio as 10. Assume carefully cut gears (class II). **(16 Marks)**

OR

4 a. Obtain Lewis equation for the beam strength of a spur gear tooth. **(04 Marks)**

b. A pair of helical gears with a 23° helix angle is to transmit 2.5 kW at 10,000 rpm of pinion. The velocity ratio is 4 to 1. Both pinion and gear are to be made of hardened steel with an allowable stress $\sigma_d = 100$ MPa. The gears are 20° stub and the pinion to have 24 teeth. Determine minimum diameter of the gear that may be used and the required BHN. Take wear and lubrication factor as 1.15. Ratio of face width to normal module as 10. **(16 Marks)**

Module-3

5 a. Describe formative number of teeth for a bevel gear. **(02 Marks)**

b. A pair of right angle bevel gears is to be used to transmit 9 kW. The number of teeth an pinion is 21 and on the gear is 60. The material of the pinion is steel with allowable static stress of 85 MPa and that of the gear is C.I with 55 MPa. The pinion rotates at 1200 rpm and the gear at 420 rpm. The tooth profile is $14\frac{1}{2}^{\circ}$ (14.5 degree) composite. The teeth are to be generated. Take $C_S = 1.5$, b = 10 m. The gears are expected to be precission cut. Determine the required module and diameters of the gears. Design for strength using the Lewis equation and check for wear, considering the effect of overhanging. Suggest suitable surface hardness for the gear pair. **(18 Marks)**

OR

6 a. List any four applications of worm gears. **(02 Marks)**

b. A pair of worm and worm wheel is designated as, 1/30/10/10. The input speed of the worm is 1200 rpm, The worm wheel is made of centrifugally cast, phosphor bronze and the worm is made of case-hardened carbon steel. Determine the power transmitting capacity based on,
(i) the beam strength (ii) wear strength
Bending stress factor for worm = 28.2
and worm wheel = 7
Speed factor for strength of worm = 0.25 and
For worm wheel = 0.48
Speed factor for wear of worm = 0.112
and for worm wheel = 0.26
Surface stress factor for worm = 4.93
and for worm wheel = 1.55
zone factor = 1.143 **(18 Marks)**

Module-4

7 a. Explain any six desirable properties of a good friction material used in clutches. **(06 Marks)**

b. A multi-disk clutch consists of five steel plates and four bronze plates. The inner and outer diameters of the friction disks are 75 and 150 mm respectively. The coefficient of friction is 0.1 and the intensity of pressure on friction lining is limited to 0.3 N/mm^2. Assuming uniform wear theory, calculate (i) the required force to engage the clutch, and (ii) Power transmitting capacity at 750 rpm. **(06 Marks)**

c. A cone clutch with asbestor friction lining transmits 30 kW power at 500 rpm. The coefficient of friction is 0.2 and the permissible intensity of pressure is 0.35 N/mm^2. The semi cone angle is 12.5°. The outer diameter is fixed as 300 mm from space limitations. Assuming uniform wear theory, calculate ;
(i) The inner diameter.
(ii) The face width of the friction lining
(iii) The force required to engage the clutch. **(08 Marks)**

OR

8 a. A single block brake with a torque capacity of 250 Nm is shown in Fig.Q8 (a). The brake drum rotates at 100 rpm and the co-efficient of friction is 0.35. Calculate

(i) The actuating force and hinge-pin reaction for clockwise rotation of the drum.
(ii) The actuating force and hinge-pin reaction for anticlockwise rotation of the drum.
(iii) The dimensions of the block, if the intensity of pressure between the block and brake drum is 1 N/mm^2. The length of the block is twice its width.

State whether the brake is self locking

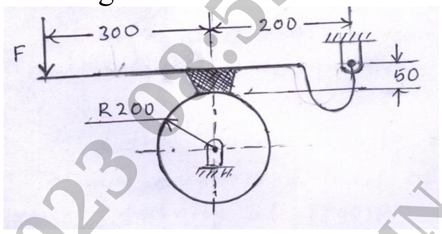

Fig. Q8 (a) **(12 Marks)**

b. A differential band brake is shown in Fig. Q8 (b). The width and thickness of the steel band are 100 mm and 3 mm respectively and the maximum tensile stress in the band is 50 N/mm^2. The coefficient of friction between the friction lining and the brake drum is 0.25. Calculate (i) the tensions in the band (ii) the actuating force (iii) the torque capacity of the brake. Find out whether the brake is self-locking

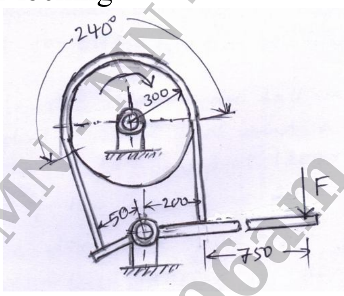

Fig. Q8 (b) **(08 Marks)**

Module-5

9 a. Obtain Petroff's equation for co-efficient of friction. Mention two assumptions. **(06 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a load of 12 kN on a journal turning at 1800 rpm. Assuming a r/c ratio of 1000, and an oil of viscosity 0.01 kg/ms at the operating temperature. Determine the coefficient of friction by using (i) the McKee equation, (ii) the Raimondi and Boyd curve (iii) also determine the amount of heat generated using the coefficient of friction as calculated by the McKee equation, and (iv) determine the probable surface temperature of the bearing, using the following equation and assuming that the heat generated in all dissipated in still air at 20˚C.

$$H_d = \frac{(\Delta T + 18)^2}{0.484} LD \times 10^{-6}$$ **(14 Marks)**

OR

10 a. Describe (i) Static load carrying capacity and (ii) Dynamic load carrying capacity with respect to anti-friction bearings. **(04 Marks)**

b. A single-row deep groove ball bearing is subjected to a radial force of 8 KN and a thrust force of 3 KN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 20,000h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application. **(10 Marks)**

c. A single row deep groove ball bearing is subjected to an axial thrust of 1000 N and a radial load of 2200 N. Find the expected life that 50% of the bearings will complete under this condition. Take C_O = 2500 N and C = 5590 N. **(06 Marks)**

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CBCS SCHEME

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18ME63

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. Heat transfer data hand book permitted.

Module-1

1 a. Derive the general three dimensional heat conduction equation in Cartesian co-ordinate system. **(10 Marks)**

b. A wall of a furnace is made up of inside layer of silica brick 120mm thick (1.7w/m°k) covered with a layer of magnetite brick 240mm thick (5.8w/m°k). Temperature at the inside surface of silica and outside surface of magnetite brick wall are 725°C and 110°C respectively. The thermal contact resistance between two walls is 0.0035°k/w per unit area. Calculate : i) Heat flux ii) Temperature drop at interface. **(10 Marks)**

OR

2 a. What do you mean by boundary condition of 1st, 2nd and 3rd kind? **(06 Marks)**

b. Derive critical thickness and insulation of cylinder. **(06 Marks)**

c. A composite wall consists of 10cm layer of building brick (0.7 w/m°C) and 3 cm plaster (0.5 w/m°k). An insulating material of K = 0.08 w/m°C is to be added to reduce the heat transfer through the wall by 70%. Determine the thickness of insulating layer. **(08 Marks)**

Module-2

3 a. Derive an expression for the temperature distribution for a long fin of uniform cross section with insulated trip. **(10 Marks)**

b. A rod (K = 200w/m°k) 10mm in diameter and 5cm long has its one end maintained at 100°C. The surface of the rod is exposed to ambient air at 30°C with convective HTC of 100w/m^2K. Assuming other end insulated, determine :

i) Temperature of rod at 25mm distance from the end at 100°C
ii) Heat dissipation rate
iii) Effectiveness. **(10 Marks)**

OR

4 a. Obtain an expression for temperature distribution of solid in lumped heat transfer analysis in dimensional numbers. **(10 Marks)**

b. A 15 mm diameter mild steel sphere K = 42 w/m°C is exposed to cooling air flow at 20°C with h = 120 w/m^2°C. Determine the following :

i) Time required to cool from 550°C to 90°C
ii) Instantaneous heat transfer rate 2 minutes after start of cooling. **(10 Marks)**

Module-3

5 a. Explain the energy balance procedure to obtain the finite difference formulation of one – dimensional conduction problem in Cartesian coordinates. **(08 Marks)**

b. One face of a slab of thickness 1 cm (K = 20w/mk) is maintained at 40°C and the other surface is subjected to a convection heat transfer with fluid at 100°C and h = 4000w/m^2°k. There is uniform internal heat generation of 8×10^7w/m^3. Dividing slab into 5 equally spaced subregions.

i) Find temperature at different nodes. Assume one dimensional steady state conduction.
ii) If the left surface is insulated. What is the temperatures at surface in steady state. **(12 Marks)**

OR

6 a. State and explain :
i) Kirchoff's law
ii) Plank's law
iii) Wein's Displacement law
iv) Stefan – Boltzamann law. **(08 Marks)**

b. Explain the concept of Black body. **(04 Marks)**

c. Calculate the net radiant heat exchange per unit area for two large parallel plates at temperature of 427°C and 27°C respectively. E_{hot} = 0.9, E_{cold} = 0.6. If a polished aluminium shield is placed between them. Find the percentage reduction in heat transfer $\in_{shield}$ = 0.4. **(08 Marks)**

Module-4

7 a. With reference to fluid flow over a flat plate, discuss the concepts of velocity boundary layer and thermal boundary layer, with necessary sketches. **(08 Marks)**

b. Air at 0°C and 20 m/sec flows over a flat plate of length 1.5m, that is maintained at 50°C. Calculate the average heat transfer coefficient over the region where flow is laminar. Find the average heat transfer coefficient and the heat loss for the entire plates per unit width. **(12 Marks)**

OR

8 a. Explain the significance of :
i) Nusselt number
ii) Reynolds's number
iii) Prandtl number
iv) Groshoff number. **(08 Marks)**

b. Consider a square plate size of 0.6m in a room with stagnant air at 20°C. One side of plate is maintained at 100°C, while the other side is adiabatic. Determine the heat loss if the plate is:
i) Vertical ii) Horizontal with hot surface facing NP. **(12 Marks)**

Module-5

9 a. Derive an expression for LMTD for a parallel flow heat exchanges. **(10 Marks)**

b. Oil at 100°C (C_p = 3.6kJ/kg°K) flows at rate of 30,000kg/hr and enters a parallel flow heat exchanges. Cooling water (C_P = 4.2kJ/kg°K) enters heat exchanges at 10°C at the rate of 50,000kg/hr. The heat transfer area is 10m^2 and u = 1000w/m^2k calculate outlet temperature of oil and water. Also find maximum possible temperature of oil and water at exit. **(10 Marks)**

OR

10 a. Clearly explain the regions of pool boiling with neat sketch. **(08 Marks)**

b. A vertical tube of 60mm outside diameter and 1.2m long is exposed at atmospheric pressure. The outer surface of the tube is maintained at a temperature of 30°C. Calculate the following:
i) Rate of heat transfer
ii) Rate of steam condensation per second. **(12 Marks)**

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CBCS SCHEME

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18ME651

Sixth Semester B.E. Degree Examination, Jan./Feb. 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. Elaborate on India's Production and reserves of commercial energy sources. **(10 Marks)**
b. Briefly describe energy alternatives (i) Photovoltaic (ii) Tar Sand and oil shale **(10 Marks)**

OR

2 a. Write a note on spectral distribution of extra terrestrial radiation. **(10 Marks)**
b. With neat sketch explain (i) Sunshine recorder (ii) Pyrometer. **(10 Marks)**

Module-2

3 a. Define the following :
i) Declination angle ii) Hour angle iii) Latitude iv) Zenith angle. **(12 Marks)**
b. Determine the local solar time and declination at a location latitude 23° 15′ N, longitude 77° 33′ E at 12.30 IST on June 19.
Equation of time correction is = -(1′01″) **(08 Marks)**

OR

4 a. With neat sketch explain any two types of concentrating collectors. **(12 Marks)**
b. Explain sensible heat and latent heat thermal energy storage. **(08 Marks)**

Module-3

5 a. Write a short note on collector efficiency factor and collector heat removal factor. **(08 Marks)**
b. Explain heat transfer process in LFPC with neat sketch and also write energy balance equation explaining each term in it. **(12 Marks)**

OR

6 a. Explain working principle, characteristics and application photovoltaic conversion. **(12 Marks)**
b. Explain any four parameters that affect the performance of the collector. **(08 Marks)**

Module-4

7 a. What are the constraints in wind energy utilization? **(06 Marks)**
b. Write a classification of wind mills. **(04 Marks)**
c. With sketch explain horizontal axis wind mill. **(10 Marks)**

OR

8 a. A 10 m/s wind is at 1 standard atmospheric pressure at 15°C temperature, calculate:
(i) Total power density in the wind stream
(ii) Maximum obtainable power density
(iii) A reasonable obtainable power density in W/m^2
(iv) Total power in (kW) if turbine diameter is 120 m
Assume conversion efficiency = 40%. **(12 Marks)**
b. Explain principle of generation of tides. **(08 Marks)**

Module-5

9 a. List various sources of geothermal energy. What are the problems associated with geothermal energy conversion? **(08 Marks)**

b. Write a note on:
(i) Energy Plantation (ii) Anaerobic fermentation. **(12 Marks)**

OR

10 a. What are the problems involved in production of biogas. **(05 Marks)**

b. List any five sources of Hydrogen. **(03 Marks)**

c. Explain the process of electrolytic production of hydrogen with a neat sketch. **(12 Marks)**

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CBCS SCHEME

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18ME71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Control Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. With a block diagram, explain automobile speed closed control system. **(10 Marks)**
b. List and explain requirements of an ideal control system. **(10 Marks)**

OR

2 a. Explain: (i) Proportional controller (ii) Derivative controller **(10 Marks)**
b. Obtain transfer function for armature controlled D-C motor. **(10 Marks)**

Module-2

3 a. Explain typical test signals in control system. **(10 Marks)**
b. Determine order and type for open and closed loop control system as shown in Fig.Q3(b).

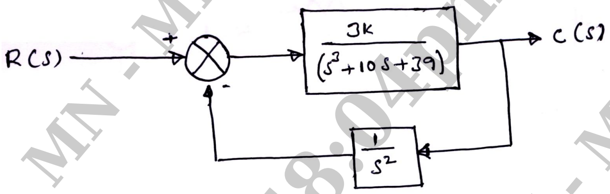

Fig.Q3(b) **(10 Marks)**

OR

4 a. Define:
(i) Delay time (ii) Rise time (iii) Peak time
(iv) Maximum overshoot (v) Setting time **(10 Marks)**
b. A unity feedback system is characterized by open loop transfer function $G(s) = \frac{16}{s^2 + 2s + 16}$.
Determine the following when the system subjected to unit step input :
(i) Undamped not usual frequency (ii) Damping ratio (iii) Peak overshoot
(iv) Peak time (iv) Settling time **(10 Marks)**

Module-3

5 a. Reduce the block diagram as shown in Fig.Q5(a) to simple form and find transfer function:

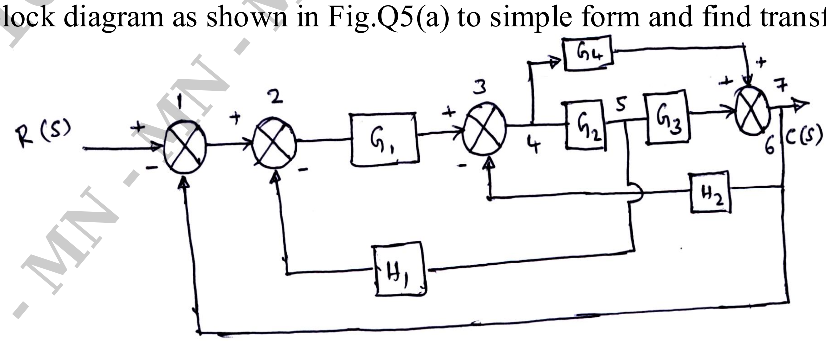

Fig.Q5(a) **(10 Marks)**

b. Obtain transfer function of block diagram shown in Fig.Q5(b) by reduction technique.

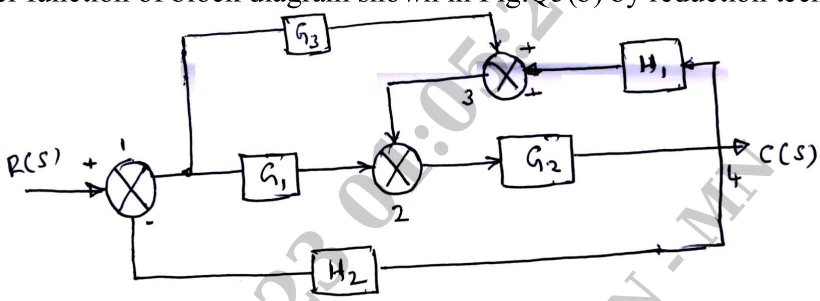

Fig.Q5(b) **(10 Marks)**

OR

6 a. For the system shown in Fig.Q6(a), determine $\frac{C(s)}{R(s)}$ using Mason's gain formula.

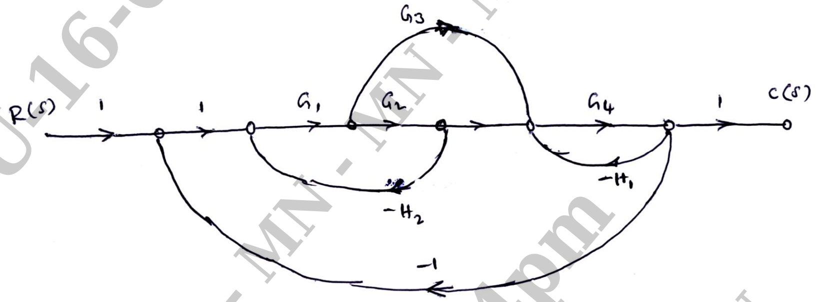

Fig.Q6(a) **(10 Marks)**

b. Using SFG and Mason's gain formula, obtain the overall transfer function of system shown in Fig.Q6(b).

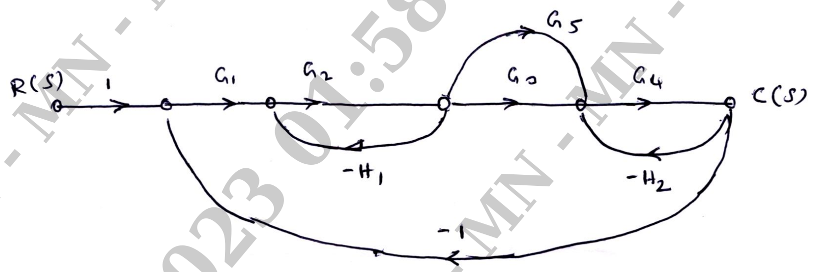

Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Applying Routh criterion, discuss the stability of closed loop system as function for open loop transfer function:

$$G(s)H(s) = \frac{K(s+1)}{s(s-1)(s^2+4s+16)}$$ **(10 Marks)**

b. Investigate the stability of system using Routh Hurwitz criterion having characteristic equation $s^5 + 4s^4 + 12s^3 + 20s^2 + 30s + 100 = 0$ **(10 Marks)**

OR

8 Sketch the root locus for negative feedback system whose open loop transfer function is given by $G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+4.5)}$ **(20 Marks)**

Module-5

9 a. Sketch polar plot for transfer function $G(s) = \frac{10}{s(s+1)(s+2)}$. **(10 Marks)**

b. Open loop function control system $G(s)H(s) = \frac{1}{s^2(s+2)}$, sketch Nyquist plot and ascertain stability. **(10 Marks)**

OR

10 A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot if phase cross over occur at $\omega = 6.35$ rad/sec, find the corresponding gain margin. **(20 Marks)**

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CBCS SCHEME

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18ME72

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Computer Aided Design and Manufacturing

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 Automation? List different types of automation and discuss with an example. **(10 Marks)**

b. Define : (i) Production rate
(ii) Production capacity
(iii) Utilization and availability
(iv) MLT and WIP **(10 Marks)**

OR

2 a. Sketch and explain any two types of Automated flow lines. **(10 Marks)**

b. The ideal cycle time of an 16 station transfer line is 1.4 min. The average down time per line will be 6 min and the probability of break downs per cycle is equal for all cycles and is equal to 0.004. Determine production rate and line efficiency by considering both upper bound and lower bound approaches. **(10 Marks)**

Module-2

3 a. Briefly explain design process and the application of computer in design process. **(10 Marks)**

b. Explain the following in detail:
Translation , Rotation , Concatenation and benefits of CAD. **(10 Marks)**

OR

4 a. What do you understand by CAPP? With a block diagram explain Generative System. **(10 Marks)**

b. Write a note on MRP Inputs and Outputs, Benefits of MRP. **(10 Marks)**

Module-3

5 a. Define Group Technology. List various types of FMS and benefits of FMS. **(10 Marks)**

b. What do you mean by As/Rs? Explain briefly about Part Identification System. **(10 Marks)**

OR

6 a. A manual assembly line has to accomplish 10 work elements to complete the assembly. The element times and precedence requirements are listed in the table. The production rate of the line is 60 units per hour. The efficiency of the line is 95% and the repositioning time is 3 sec. Use Kilbridge and Westers method to balance the line and compute balance delay and balance efficiency.

Element	1	2	3	4	5	6	7	8	9	10
T_e (min)	0.3	0.4	0.3	0.2	0.4	0.1	0.5	0.6	0.4	0.6
Preceeded by	-	-	1	1, 2	2	3, 4	4	5	6, 7	8, 9

(10 Marks)

b. From above data compute balance delay and balance efficiency using RPW method. **(10 Marks)**

Module-4

7 a. Define CNC. Enlist various advantages / disadvantages and application of CNC. **(10 Marks)**

b. List few G and M codes you came across and write a program to cut the profile shown in Fig.Q7(b).

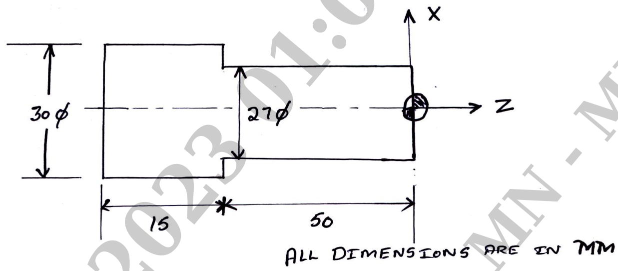

Fig.Q7(b) **(10 Marks)**

OR

8 a. With a neat sketches show robot components and joints. **(10 Marks)**

b. List various configuration of a Industrial robot, sketch and draw in detail. **(10 Marks)**

Module-5

9 a. Discuss the basic principles of additive manufacturing and list various advantages / limitations of AM technique. **(10 Marks)**

b. Explain the process in brief photopolymerization, material jetting. **(10 Marks)**

OR

10 a. Describe Slicing in AM. **(10 Marks)**

b. Explain the following :
(i) Direct Energy deposition (ii) Sheet lamination. **(10 Marks)**

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CBCS SCHEME

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18ME734

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Total Quality Management

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Quality. Explain quality in daily life in middle age during Industrial revolution. **(10 Marks)**
b. What are the factors affecting Quality? **(10 Marks)**

OR

2 a. Explain the list of dimension of Quality. **(10 Marks)**
b. Explain the contribution of Gurus Quality. **(10 Marks)**

Module-2

3 a. Explain the Modern method of Leadership. **(10 Marks)**
b. What are the duties of Quality Control? **(10 Marks)**

OR

4 a. Mention the Deming's Philosophy of 14 points. **(10 Marks)**
b. What are the future requirements for the short and long term factors affects in the Organisation? **(10 Marks)**

Module-3

5 a. Explain with neat sketch, the Kano model. **(10 Marks)**
b. What are the elements present in structure of Quality circle? **(10 Marks)**

OR

6 a. Mention the Tangible and Intangible benefits through TQM. **(10 Marks)**
b. Who was Malcolm Baldrige? What is the Malcolm Baldrige National Quality Award? What was the award established? **(10 Marks)**

Module-4

7 a. What is Six Sigma? Define Six Sigma and phases of Six Sigma. **(10 Marks)**
b. With neat analysis of graph, explain Pareto Analysis. **(10 Marks)**

OR

8 a. Define Process of Operation of Quality circle and steps. **(10 Marks)**
b. What are the benefits of Forming Quality circles? **(10 Marks)**

Module-5

9 a. What is meant by Total Productive Maintenance, with an example? **(10 Marks)**
b. Define Quality by Design in TQM and What are elements of Quality by design? **(10 Marks)**

OR

10 a. Define the Environmental Management Systems and what is the importance. **(10 Marks)**
b. Explain EMS under ISO 14001. What is the cost and benefits? **(10 Marks)**

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CBCS SCHEME

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18ME741

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Additive Manufacturing

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Additive Manufacturing process. List out advantages and disadvantages of Additive Manufacturing process in detail. **(06 Marks)**

b. Explain Additive Manufacturing process chain with block diagram. **(08 Marks)**

c. Differentiate between Additive Manufacturing and CNC. **(06 Marks)**

OR

2 a. Explain the classification of Additive Manufacturing process. **(10 Marks)**

b. Write a note on :
i) Reverse Engineering Technology ii) Computer Aided Design Technology. **(10 Marks)**

Module-2

3 a. With a neat sketch, briefly explain principle operation of Steriolithography. State its applications. **(10 Marks)**

b. Explain the principle operation of selective laser sintering with neat sketch. List the advantages of SLS. **(10 Marks)**

OR

4 a. List the advantages and disadvantages of Powder bed fusion process. **(06 Marks)**

b. Sketch and explain Fused Deposition Modelling [FDM] process. Also add a note on FDM materials. **(10 Marks)**

c. List the various materials which may be used for electro beam melting process. **(04 Marks)**

Module-3

5 a. Describe three dimensional printing process, with a neat sketch. **(10 Marks)**

b. Explain Principle of Operation and application of LOM. **(10 Marks)**

OR

6 a. With a neat sketch, explain Beam Deposition process and list its advantages and disadvantages. **(10 Marks)**

b. List the various Direct write technologies and explain Ink based direct write process. **(10 Marks)**

Module-4

7 a. Discuss guidelines for process selection in AM. **(08 Marks)**

b. Write a short note on STL file. **(06 Marks)**

c. Discuss problems occured with STL file. **(06 Marks)**

OR

8 a. Explain Post processing of Additive Manufacturing parts. **(10 Marks)**

b. Explain steps involved in property enhancement using thermal technique and non thermal technique. **(10 Marks)**

Module-5

9 a. Explain Multi Material Manufacturing process and state its applications. **(10 Marks)**

b. Explain the applications of Additive Manufacturing process in various fields. **(10 Marks)**

OR

10 a. Explain use of Pattern prepared by AM process for investment casting. **(10 Marks)**

b. Write a note on :

i) Align technology ii) DDM drives. **(10 Marks)**

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