B.L.D.E.A's V.P. Dr. P.G. Halakatti College of Enginering and Technology
Vijayapur-586103

Department of Mechanical Engineering

Question Papers Dec.2024/Jan.2025

CBCS SCHEME

USN

First/Second Semester B.E. Degree Examination, June/July 2024
Elements of Mechanical Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain with the help of neat sketch, working principle of Hydroelectric power plant. **(08 Marks)**

b. Explain the steam formation process with T-h diagram. **(08 Marks)**

c. Write a short note on Global warming. **(04 Marks)**

OR

2 a. Define Thermodynamic system. Differentiate between open system, closed system and Isolated system. **(10 Marks)**

b. 5 kg of wet steam of dryness 0.8, passes from a boiler to a superheater at a constant pressure of 1 MPa absolute. In the superheater its temperature increases to 350 °C. Determine the amount of heat supplied in the super heater. The specific heat of super heated steam, $CP_S = 2.25$ KJ/kg.K **(10 Marks)**

Module-2

3 a. Sketch and label all the parts of a Bobcook and Wilcox boiler. Indicate the path of the flue gases and the water circulation. **(10 Marks)**

b. List the important boiler mountings and accessories and mention their functions. **(10 Marks)**

OR

4 a. Sketch and explain working of a Pelton wheel. **(10 Marks)**

b. Describe the working principle of centrifugal pump. **(10 Marks)**

Module-3

5 a. With the help of a P-V diagram, explain the working of a four stroke diesel engine. **(10 Marks)**

b. A single cylinder four stroke engine runs at 1000 rpm and has a bore of 115 mm and has a stroke of 140 mm. The brake load is 6 kg, at 600 mm radius and mechanical efficiency is 80%. Calculate Brake power and mean effective pressure. **(10 Marks)**

OR

6 a. Explain with a neat sketch, the working of a vapour compression refrigeration system. **(10 Marks)**

b. Explain briefly the following :
   (i) Refrigerants
   (ii) Ton of refrigeration
   (iii) COP
   (iv) Ice making capacity
   (v) Relative COP **(10 Marks)**

Module-4

7	a.	With a neat sketch, explain MIG welding process.	**(08 Marks)**
	b.	Define composites and give their applications.	**(06 Marks)**
	c.	Classify and explain various types of ferry metals.	**(06 Marks)**

OR

8	a.	Derive an expression for length of open belt drive.	**(10 Marks)**
	b.	Classify and explain the importance of Gear drives.	**(10 Marks)**

Module-5

9	a.	Sketch and explain taper turning by swivelling the compound rest.	**(10 Marks)**
	b.	With a neat sketch, explain principle parts of vertical milling machine.	**(10 Marks)**

OR

10	a.	Explain the advantages and applications of Robots in industries.	**(10 Marks)**
	b.	With a neat block diagram, explain elements of CNC system.	**(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | |

First/Second Semester B.E. Degree Examination, Dec.2024/Jan.2025
Elements of Mechanical 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 neat sketch, explain briefly hydro-electric power plant. **(10 Marks)**
b. Discuss briefly global warming and ozone depletion. **(10 Marks)**

OR

2 a. Define : i) open system ii) closed system. **(05 Marks)**
b. State and explain Zeroth law of thermodynamics. **(05 Marks)**
c. Explain briefly formation of steam at constant pressure with temperature enthalpy diagram. **(10 Marks)**

Module-2

3 a. Explain briefly the working of Babcock and Wilcox boiler. **(10 Marks)**
b. Define turbine. Explain with a neat sketch working of pelton wheel turbine. **(10 Marks)**

OR

4 a. Briefly explain the construction and working of Francis turbine. **(10 Marks)**
b. Write short notes on : i) Cavitation ii) Priming. **(10 Marks)**

Module-3

5 a. With a neat sketch, explain constructional details of 2 stroke petrol engine. **(10 Marks)**
b. The following datas were obtained for 4-stroke diesel engine.

Cylinder diameter	=	25 cm
Stroke	=	40 cm
Speed	=	250 rpm
Brake load	=	70 Kg
Brake drum diameter	=	2 m
Mean effective pressure	=	6 bar
Diesel oil consumption	=	0.1 m^3/min
Specific gravity of diesel	=	0.78
Calorific value of fuel diesel	=	43,900 kJ/Kg

Find i) Brake power ii) Indicated power iii) Friction power iv) Mechanical Efficiency v) Brake Thermal Efficiency. **(10 Marks)**

OR

6 a. Define : i) Ton of refrigeration ii) COP iii) Refrigeration effect iv) Ice making capacity v) Refrigeration. **(10 Marks)**
b. Explain briefly with a neat sketch working of vapour compression Refrigeration. **(10 Marks)**

Module-4

7 a. Write a note on Ferrous Alloys (Any two). **(10 Marks)**
b. Explain briefly the types and applications of Non-Ferrous Alloys (Any three). **(10 Marks)**

OR

8 a. What is Welding? With neat sketch explain arc welding. **(10 Marks)**

b. With a neat sketch, explain briefly soldering method. **(10 Marks)**

Module-5

9 a. Explain briefly with neat sketches the following lathe operations :
i) Turning ii) Facing iii) Knurling iv) Drilling. **(10 Marks)**

b. Explain with a neat sketch taper turning by swivelling compound rest method. **(10 Marks)**

OR

10 a. Sketch and explain polar and Cartesian coordinate Robot configuration. **(10 Marks)**

b. Explain briefly working of horizontal milling machine with a neat sketch. **(10 Marks)**

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CBCS SCHEME

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BMATM101

First Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mathematics–I for ME Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Prove with usual notations, $\tan\phi = r \cdot \frac{d\theta}{dr}$	**06**	**L2**	**CO1**
	b.	Find the angle between the curves, $r = a(1 + \cos\theta)$ and $r = b(1 - \cos\theta)$	**07**	**L2**	**CO1**
	c.	Find the pedal equation to the curves $r^n = a^n \cos n\theta$	**07**	**L2**	**CO1**
		OR			
Q.2	**a.**	Prove that for the radius of curvature in Cartesian form $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	**07**	**L2**	**CO1**
	b.	Find the radius of curvature for the curve $x^3 + y^3 = 3axy$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$ on it.	**08**	**L2**	**CO1**
	c.	Using modern mathematical tools write the code to find the radius of curvature $r = 4(1 + \cos t)$ at $t = \pi/2$	**05**	**L3**	**CO5**
		Module – 2			
Q.3	**a.**	Expand $e^{\sin x}$ by Maclaurin's series upto the terms containing x^4.	**06**	**L2**	**CO2**
	b.	Evaluate : $\lim_{x \to 0} \left(\frac{a^x + b^x + c^x + d^x}{4}\right)^{1/x}$	**07**	**L2**	**CO2**
	c.	If $u = \log(x^3 + y^3 + z^3 - 3xyz)$ then prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$	**07**	**L2**	**CO2**
		OR			
Q.4	**a.**	If $u = f(x - y, y - z, z - x)$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	**07**	**L2**	**CO2**
	b.	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	**08**	**L2**	**CO2**
	c.	Using modern mathematical tools, write the code to solve : $y'' - 5y' + 6y = \cos 4x$	**05**	**L3**	**CO5**
		Module – 3			
Q.5	**a.**	Solve : $xy(1 + xy^2)\frac{dy}{dx} = 1$	**06**	**L2**	**CO3**
	b.	Solve : $(x^2 + y^2 + x)dx + xy\,dy = 0$	**07**	**L2**	**CO3**
	c.	Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{b^2 + \lambda} = 1$ where λ is the parameter.	**07**	**L2**	**CO3**

		OR			
Q.6	**a.**	Solve : $\frac{dy}{dx}-\frac{dx}{dy}=\frac{x}{y}-\frac{y}{x}$	**06**	**L2**	**CO3**
	b.	Solve the equation $(px-y)(py+x)=2$ by reducing in to Clairaut's form, taking the substitution. $X=x^2$, $Y=y^2$.	**07**	**L2**	**CO3**
	c.	If the temperature of the air is 30°C and a metal ball cools from 100°C to 70°C in 15 minutes, find how long will it take for the metal ball to reach a temperature of 40°C.	**07**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Solve : $(4D^4-4D^3-23D^2+12D+36)y=0$	**06**	**L2**	**CO3**
	b.	Solve : $\frac{d^2y}{dx^2}-4y=\cosh(2x-1)+3^x$	**07**	**L2**	**CO3**
	c.	Solve : $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=4\cos^2 x$	**07**	**L2**	**CO3**
		OR			
Q.8	**a.**	Solve : $\frac{d^2y}{dx^2}+y=\tan x$ by the method of variation of parameters.	**06**	**L2**	**CO3**
	b.	Solve : $x^2\frac{d^2y}{dx^2}-3x\frac{dy}{dx}+4y=(1+x)^2$, using Cauchy's equation.	**07**	**L3**	**CO3**
	c.	Solve the Legendre's linear equation $(1+x)^2\frac{d^2y}{dx^2}+(1+x)\frac{dy}{dx}+y=2\sin\log(1+x)$	**07**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of a matrix by elementary row transformation $A=\begin{bmatrix}4&0&2&1\\2&1&3&4\\2&3&4&7\\2&3&1&4\end{bmatrix}$	**06**	**L2**	**CO4**
	b.	Investigate the values of λ and μ such that the system of equations: $x+y+z=6$; $x+2y+3z=10$; $x+2y+\lambda z=\mu$	**07**	**L2**	**CO4**
	c.	Solve the following system of equations by Gauss-Jordan method. $x+y+z=9$; $x-2y+3z=8$; $2x+y-z=3$	**07**	**L2**	**CO4**
		OR			
Q.10	**a.**	Using Rayleigh's power method, find numerically the largest eigen value and the corresponding eigen vectors of the matrix $A=\begin{bmatrix}6&-2&2\\-2&3&-1\\2&-1&3\end{bmatrix}$	**07**	**L2**	**CO4**
	b.	Solve the following system of equations by Gauss-Seidel method. $10x+y+z=12$; $x+10y+z=12$; $x+y+10z=12$	**08**	**L2**	**CO4**
	c.	Using modern mathematical tools, write the code to check whether the following system of homogeneous linear equation has non-trivial solution: $x_1+2x_2-x_3=0$; $2x_1+x_2+4x_3=0$; $3x_1+3x_2+4x_3=0$	**05**	**L3**	**CO5**

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CBCS SCHEME

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BMATM201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Mathematics – II for Mechanical Engineering Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Evaluate $\int_{-1}^{1}\int_{0}^{2}\int_{x-2}^{x+2}(x+y+z)\,dy\,dx\,dz$.	7	L3	CO1
	b.	Evaluate $\int_{0}^{1}\int_{\sqrt{y}}^{1}dx\,dy$ by changing the order of integration.	7	L3	CO1
	c.	With usual notation show that $\beta(m,n)=\dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.	6	L2	CO1
		OR			
Q.2	a.	Evaluate $\int_{0}^{1}\int_{0}^{\sqrt{1-y^2}}x^3y\,dx\,dy$.	7	L3	CO1
	b.	Evaluate $\iint xy(x+y)\,dy\,dx$ taken over the area between $y=x^2$ and $y=x$.	7	L2	CO1
	c.	Write a modern mathematical program to evaluate the integral $\int_{0}^{3}\int_{0}^{3-x}\int_{0}^{3-x-y}(xyz)\,dz\,dy\,dx$.	6	L3	CO5
		Module – 2			
Q.3	a.	Find the angle between the surfaces $xy^2z=3x+z^2$ and $3x^2-y^2+2z=1$ at the point (1, -2, 1).	7	L2	CO2
	b.	If $\vec{F}=\nabla(xy^3z^2)$ find $\operatorname{div}\vec{F}$ and $\operatorname{curl}\vec{F}$ at the point (1, -1, 1).	7	L2	CO2
	c.	Define solenoidal vector. Find the values of a, b, c such that $\vec{F}=(x+y+az)i+(bx+2y-z)j+(x+cy+2z)k$ is irrotational.	6	L2	CO2
		OR			
Q.4	a.	Apply Green's theorem to evaluate $\int_C(3x-8y^2)dx+(4y-6xy)dy$, where C is the boundary of the region bounded by x = 0, y = 0, x + y = 1.	7	L3	CO2

<table>
<tr><td></td><td>b.</td><td>Use Stoke's theorem to evaluate $\int_C \vec{F}.dr$, where $\vec{F}=(x^2+y^2)i-2xyj$ taken round the rectangle bounded by x = 0, x = a, y = 0 and y = b.</td><td>7</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Write the modern mathematical tool program to find the divergence of the vector field $\vec{F}=x^2yzi+y^2zxj+z^2xyk$.</td><td>6</td><td>L3</td><td>CO5</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td>Q.5</td><td>a.</td><td>Form the PDE by eliminating the arbitrary function from the relation $f(x+y+z, x^2+y^2-z^2)=0$.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x \partial y}=\frac{x}{y}$, subject to the conditions $\frac{\partial z}{\partial x}=\log_e x$ when y = 1 and z = 0 when x = 1.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Derive one-dimensional heat equation.</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.6</td><td>a.</td><td>Form the PDE by eliminating the arbitrary function from the relation $z=e^y f(x+y)$.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x^2}+z=0$ given that when x = 0, z = e^y and $\frac{\partial z}{\partial x}=1$.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Solve $x(y^2-z^2)p+y(z^2-x^2)q=z(x^2-y^2)$ using Lagrange's multiplier.</td><td>6</td><td>L3</td><td>CO3</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td>Q.7</td><td>a.</td><td>Find a real root of $x^3-9x+1=0$ in (2, 3) by the Regula-Falsi method in three iterations.</td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Use an appropriate interpolation formula to compute f(42) using the following data:
<table><tr><td>x</td><td>40</td><td>50</td><td>60</td><td>70</td><td>80</td><td>90</td></tr><tr><td>f(x)</td><td>184</td><td>204</td><td>226</td><td>250</td><td>276</td><td>304</td></tr></table></td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Using Simpson's $\frac{1}{3}^{rd}$ rule, evaluate $\int_0^{0.6} e^{-x^2}dx$ by considering seven ordinates.</td><td>6</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Find a real root of the equation $x\sin x+\cos x=0$ near x = π correct to four decimal places using Newtons-Raphson method.</td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Using Lagrange's interpolation formula. Find f(5) from the following data :
<table><tr><td>x</td><td>1</td><td>3</td><td>4</td><td>6</td><td>9</td></tr><tr><td>f(x)</td><td>3</td><td>9</td><td>30</td><td>132</td><td>156</td></tr></table></td><td>7</td><td>L3</td><td>CO4</td></tr>
</table>

	c.	Use Simpson's $\frac{3}{8}^{th}$ rule to obtain the approximate value of $\int_0^{0.3}(1-8x^3)^{\frac{1}{2}}dx$, by considering 3 equal intervals.	6	L3	CO4
Module – 5					
Q.9	a.	Use Taylor's method to find x = 0.1 considering terms up to the third degree given that $\frac{dy}{dx} = x^2 + y^2$ and y(0) = 1.	7	L2	CO4
	b.	Using Runge-Kutta method of order 4, find y at x = 0.1 given that $\frac{dy}{dx} = 3e^x + 2y$, y(0) = 1.	7	L3	CO4
	c.	Given that $\frac{dy}{dx} = x - y^2$ and the data y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762. Compute y at x = 0.8 by applying Milne's method.	6	L3	CO4
OR					
Q.10	a.	Using modified Euler's method, find y at x = 0.2 given that $\frac{dy}{dx} = 3x + \frac{1}{2}y$ with y(0) = 1 taking h = 0.1. Perform three iterations.	7	L3	CO4
	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.	7	L3	CO4
	c.	Using modern mathematical tools write a program to solve $\frac{dy}{dx} = 1 + \left(\frac{y}{x}\right)$ at y(2) taking h = 0.2. Given that y(1) = 2 by Runge-Kutta method.	6	L3	CO5

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CBCS SCHEME

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18ME32

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following terms:
(i) Strain (ii) Young's modulus (iii) True stress
(iv) Poisson's ratio (v) Factor of safety **(05 Marks)**

b. Determine the stress in each section of bar shown in Fig.Q1(b) when subjected to an axial load of 20 KN. The central section is of square cross-section. Other portions are of circular cross-section. What will be the total extension of bar? Take E = 210 GPa.

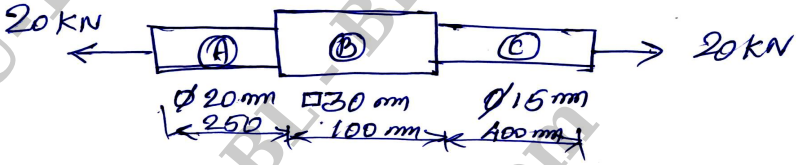

Fig.Q1(b) **(15 Marks)**

OR

2 a. Derive an expression for extension of tapered circular bar. **(08 Marks)**

b. Derive the relation between Young's modulus , Rigidity modulus and Bulk modulus E, G, K. **(12 Marks)**

Module-2

3 a. A rectangular bar of cross sectional area of 11000 mm^2 is subjected to tensile load P as shown in Fig.Q3(a). The permissible normal and shear stress on the oblique plane BC are given as 7 N/mm^2 and 3.5 N/mm^2 respectively. Determine the safe value of P.

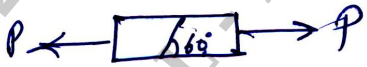

Fig.Q3(a) **(12 Marks)**

b. Explain the procedure for constructing Mohr circle for an element acted upon by two tensile stress and shear stresses. **(08 Marks)**

OR

4 a. Derive the expressions for circumferential stress and longitudinal stress in thin cylinder subjected to an axial internal pressure. **(08 Marks)**

b. A thin cylinder 60 mm internal diameter 225 mm long with wall thickness 2.7 mm subjected to an internal pressure of 6 MN/mm^2, Take E = 200 GPa, $\gamma = 0.3$. Calculate (i) Hoop stress (ii) Longitudinal stress (iii) Change in length (iv) Change in diameter. **(12 Marks)**

Module-3

5 a. What are the different types of beams? Explain briefly. **(10 Marks)**

b. Draw SFD and BMD for a simply supported beam of length L carrying a concentrated load w at mid span. **(10 Marks)**

OR

6 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$, with usual notations. **(12 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. **(08 Marks)**

Module-4

7 a. Explain the factor of safety.
Write short note on : (i) Maximum shear stress theory (ii) Normal stress theory **(10 Marks)**

b. Derive the torsion equation with usual notation and state the assumptions made in derivations. **(10 Marks)**

OR

8 a. Find the diameter of shaft required to transmit 60 KW at 150 rpm. If maximum exceeds 25% of mean torque for a maximum permissible shear stress of 60 MN/m^2. Find the angle of twist for length of 4 m. Take G = 80 GPa. **(10 Marks)**

b. Prove that Hollow shaft is stronger than solid shaft **(10 Marks)**

Module-5

9 a. Derive an expression for central load in a column with both ends hinged and mention the assumption made. **(10 Marks)**

b. A solid round for 3 m long and 5 cm in diameter is used as a strut with both end hinged. Determine the crippling load. Take $E = 2\times10^5$ N/mm^2. **(10 Marks)**

OR

10 a. Derive the expression for central load in a column with both ends fixed. **(10 Marks)**

b. Write short notes on :
(i) Strain energy
(ii) Castigliano theorem **(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

18ME33

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Distinguish between :
 i) Open system and closed system
 ii) Macroscopic and Microscopic point of view
 iii) Point function and path function
 iv) Intensive property and extensive property
 v) Quasistatic and actual process **(10 Marks)**

b. The temperature scale of certain thermometer in given by the relation $t = a\ell n(x) + b$, where 'a' and 'b' are constants and 'x' is the thermometric property of the fluid in the thermometer. If at ice and steam points, the thermometric property are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property of 3.5? **(10 Marks)**

OR

2 a. State and prove Zeroth law of Thermodynamics. **(06 Marks)**

b. Define the following :
 i) Mechanical equilibrium
 ii) Thermal equilibrium
 iii) Chemical equilibrium **(06 Marks)**

c. The emf in a thermocouple with test junction at $t^o{}_c$ on gas thermometer scale and the reference junction at ice point is given by $\in = 0.20t - 5 \times 10^{-4} t^2$ mv. The millivoltmeter is calibrated at ice and steam point. What will this thermometer reads in a place where the gas thermometer reads 50ºC. **(08 Marks)**

Module-2

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

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

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

OR

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

b. Starting from the first law of thermodynamics for a closed system undergoing a non-cyclic process derive the steady state steady flow energy equation for the control volume. **(08 Marks)**

c. A store of 20 Kg mass and a tank containing 200 Kg water comprise a system. The stone is 15 mt above the water level initially. If the stone falls into water then determine :
Change in internal energy, Kinetic energy potential energy, heat and water when
i) The stone is about the enter the water
ii) The stone has come to rest in tank
iii) The heat is transferred to the surrounding is such an amount that the stone and water come to their initial temperature. **(06 Marks)**

Module-3

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

b. A reversible heat engine works between the two reservoirs at 1400 K and 350 K respectively. A reversible heat pump receives heat from the reservoir at 250K and rejects the heat to a reservoir at 350 K to which the heat engine also rejects the heat. The work at output from the engine is used to derive the heat pump. If the total heat supplied to the reservoir at 350 K is to be 100 kW. Find the heat to be received by the heat engine. **(10 Marks)**

OR

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

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

c. A heat engine absorbs 200 kJ/sec of heat at 227ºC and rejects heat at 27ºC. Three separate case of the heat rejection are reported.
i) 180 kJ/Sec heat is rejected
ii) 120 kJ/sec heat is rejected
iii) 60 kJ/sec heat is rejected
Classify each cycle. **(06 Marks)**

Module-4

7 a. Briefly explain available and unavailable engines referred to a cyclic process. **(06 Marks)**

b. A Carnot engine works between the temperature limits of 225ºC in which water is used as the working fluid. If heat is supplied to the saturated liquid water at 225ºC until it is converted into saturated vapour, determine per Kg of water.
i) The amount heat absorbed by the fluid
ii) The available energy
iii) The unavailable energy
Take Latent heat of water = 1858.5 kJ/Kg **(06 Marks)**

c. The fuel gas leaving a boiler at 300ºC is cooled to 110ºC by the air on its way to furnace. The specific heat at constant pressure for the gas is 0.24 kJ/Kg K and the sink temperature is 20ºC. Determine the heat recovered from each kg of fuel gas and the available and unavailable portion of this heat. **(08 Marks)**

OR

8 a. With a neat sketch briefly explain the working of a throttling calorimeter to determine the quality of steam. **(08 Marks)**

b. Draw the phase equilibrium diagram for water on P-T coordinates, indicating triple and critical point. **(06 Marks)**

c. Find the specific volume enthalpy and internal energy of wet steam at 18 bar pressure and dryness fraction of 0.85. **(06 Marks)**

Module-5

9 a. State and explain Dalton's law and additive pressure and Amagat's law of volume additives. **(08 Marks)**

b. A gaseous mixture consists of 1 Kg of oxygen and 2 Kg of Nitrogen is initially at a pressure of 150 KPa and a temperature of 20 ºC. If is heated at constant pressure until its temperature reaches 100ºC. Determine :
   i) Change in enthalpy
   ii) Change in entropy
   iii) Change in internal energy **(12 Marks)**

OR

10 a. Write short notes on the following :
   i) Law of corresponding states
   ii) Compressibility factor
   iii) Generalized compressibility chart **(08 Marks)**

b. Determine the specific volume of helium at 200 KPa and 300 K using the Vander Waal's equation and the ideal gas equation of state. Take, Molecular weight of helium as 4 and the constants in the Vander Waal's equation a = 3.4 and b = 0.0234. **(06 Marks)**

c. Determine the mass of Nitrogen contained in a $35m^3$ vessel at 200 bar and 200 K by using
   i) Ideal gas equation
   ii) Generalized compressibility chart, for N_2 : P_c = 33.94 bar, T_c = 126.2ºC. **(06 Marks)**

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18ME34

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Material Science

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define atomic packing factor. Determine the atomic packing factor of an ideally packed HCP unit cell. **(10 Marks)**

b. Classify the different types of crystal imperfections. Sketch and explain the edge dislocation and screw dislocation. **(10 Marks)**

OR

2 a. Sketch and explain engineering stress-strain and true stress-strain diagram and explain the stages of fracture. **(10 Marks)**

b. Sketch and explain linear and non-linear elastic properties, when a material is subjected to static tension. **(10 Marks)**

Module-2

3 a. Sketch and explain Type – I, Type – II and Type – III fracture. **(06 Marks)**

b. Draw and explain S-N curve. **(04 Marks)**

c. Draw Fe-Fe_3C diagram and indicate the phase temperatures and also write the invariant reactions. **(10 Marks)**

OR

4 a. Explain the different types of solid solutions. **(05 Marks)**

b. Sketch and explain binary phase diagram. **(05 Marks)**

c. Sketch and explain mechanism of fatigue. Explain different types of fatigue loading with sketch. **(10 Marks)**

Module-3

5 a. Draw TTT diagram for eutectoid steel and explain briefly. **(07 Marks)**

b. Distinguish between Austempering and Martempering. **(05 Marks)**

c. Define Hardenability. Sketch and explain Jominy end quench test. **(08 Marks)**

OR

6 a. Distinguish between annealing and normalizing. **(04 Marks)**

b. Sketch and explain flame hardening and induction hardening process. **(08 Marks)**

c. Explain composition, properties and uses of grey cast iron and medium carbon steel. **(08 Marks)**

Module-4

7 a. Define composite material. Give its classifications. Explain metal matrix composites. **(08 Marks)**

b. Sketch and explain hand layup and spray layup process. **(12 Marks)**

OR

8 a. Derive an expression for Young's modulus for ISO-stress and ISO-strain condition. **(12 Marks)**

b. Calculate the tensile modulus of elasticity of unidirectional carbon fibre-reinforced composite material which contains 62% by volume of carbon fibres in ISO-strain and ISO-stress condition.

Where $E_{carbon\ fibre} = 37.86 \times 10^4\ N/mm^2$

$E_{Epoxy} = 41.98 \times 10^2\ N/mm^2$

Find Young's modulus of composite = E_C = ? **(08 Marks)**

Module-5

9 a. Define ceramic. Explain the types of ceramics. **(05 Marks)**

b. Distinguish between Thermo plastic and Thermo setting plastics. **(05 Marks)**

c. Sketch and explain processing of plastic by Injection moulding method. **(10 Marks)**

OR

10 a. Define smart material. Explain any four types of smart materials. **(10 Marks)**

b. Explain, how the residual life assessment is done using different types of non destructive testing methods. **(10 Marks)**

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Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Explain the mechanics of chip formation and types of chips in orthogonal cutting. **(09 Marks)**

b. Derive an expression for a shear angle in orthogonal cutting in terms of rake angle and chip thickness ratio. **(06 Marks)**

c. Following data refers to the orthogonal cutting process. Chip thickness ratio 0.60 mm, feed 0.2 mm, rake angle 15°, calculate chip reduction coefficient and shear angle. **(05 Marks)**

OR

2 a. Describe the Merchant's circle diagram. List the assumptions made. **(10 Marks)**

b. Differentiate between orthogonal and oblique cutting. **(05 Marks)**

c. List and explain essential properties of cutting tool material. **(05 Marks)**

Module-2

3 a. Explain classification of milling machines. **(05 Marks)**

b. With a neat sketch, explain vertical spindle milling machine. **(10 Marks)**

c. Differentiate between drilling and boring. **(05 Marks)**

OR

4 a. Explain radial drilling machine with a neat sketch. **(10 Marks)**

b. Explain shaping operations with a neat sketch. **(06 Marks)**

c. Explain principle of centreless grinding machine with a neat sketch. **(04 Marks)**

Module-3

5 a. Define tool wear. Explain crater wear and flank wear. **(07 Marks)**

b. Explain different tool wear mechanisms. **(06 Marks)**

c. A certain cutting tool during turning gave a tool life of 1 hour at a cutting speed of 30 m/min. What will be the life of the tool when it is used at the same cutting speed for finish turning? Take n = 0.125 for rough cut, and n = 0.1 for finish cut. **(07 Marks)**

OR

6 a. Discuss the effects of machining parameters on surface finish. **(06 Marks)**

b. Explain choice of cutting speed for minimum cost and maximum production. **(06 Marks)**

c. Determine the optimum cutting speed for an operation carried on a lathe using the following data : tool change time 4 min, tool regrind time 3 min, machine running cost 20 paise per min, tool depreciation cost 1 rupee. Assume values of C and n of Taylor's tool life equation as 60 and 1/5 respectively. **(08 Marks)**

Module-4

7 a. Classify metal forming processes. **(06 Marks)**

b. Write note on forging equipments. **(08 Marks)**

c. Explain different defects in forging. **(06 Marks)**

OR

8	a.	Explain different types of rolling mills.	**(08 Marks)**
	b.	Explain drawing process of pipe.	**(06 Marks)**
	c.	With a neat sketch, explain Indirect extrusion process.	**(06 Marks)**

Module-5

9	a.	Explain following sheet metal operation : (i) Blanking (ii) Punching	**(08 Marks)**
	b.	Write a note on drawing ratio in sheet metal operation.	**(04 Marks)**
	c.	Explain variables affecting in sheet metal drawing.	**(08 Marks)**

OR

10	a.	Explain embossing and coining operations.	**(08 Marks)**
	b.	Explain following dies with neat sketches : (i) Progressive die. (ii) Compound die.	**(12 Marks)**

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18ME35B

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
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.	Classify and explain different manufacturing processes.	**(10 Marks)**
	b.	Sketch and explain elements of Gating system.	**(10 Marks)**
		OR	
2	a.	Briefly explain steps involved in making a casting.	**(10 Marks)**
	b.	With a neat sketch, explain investment moulding process.	**(10 Marks)**

Module-2

3	a.	Give classification of furnaces.	**(04 Marks)**
	b.	With a neat sketch, explain the working of resistance furnace.	**(08 Marks)**
	c.	Explain gravity die casting process with a neat sketch.	**(08 Marks)**
		OR	
4	a.	With a neat sketch, explain construction and working principle of cupola furnace.	**(10 Marks)**
	b.	Explain the continuous casting process with a neat sketch.	**(10 Marks)**

Module-3

5	a.	What are solidification variables? Explain briefly.	**(10 Marks)**
	b.	Explain melting of aluminum using stir casting set up.	**(10 Marks)**
		OR	
6	a.	State the advantages and limitations of casting process.	**(08 Marks)**
	b.	Define nucleation and explain.	**(04 Marks)**
	c.	Explain melting of Aluminum using lift out type crucible furnace.	**(08 Marks)**

Module-4

7	a.	With a neat sketch, explain TIG welding process. State advantages and disadvantages.	**(10 Marks)**
	b.	Sketch and explain the laser welding process.	**(10 Marks)**
		OR	
8	a.	State the advantages and limitations of welding process.	**(06 Marks)**
	b.	With a neat sketch, explain flux shielded metal arc welding.	**(10 Marks)**
	c.	Define resistance welding and mention types of resistance welding.	**(04 Marks)**

Module-5

9	a.	With a neat sketch, explain the formation of different zones, in welding.	**(08 Marks)**
	b.	Differentiate between soldiering and brazing.	**(04 Marks)**
	c.	Explain ultrasonic inspection process with a sketch.	**(08 Marks)**
		OR	
10	a.	Brief any four welding defects with a neat sketch.	**(12 Marks)**
	b.	With a neat sketch, describe oxy-acetylene welding process.	**(08 Marks)**

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18ME36B

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 meter in terms of wavelength standards. List the advantages of wavelength standard over material standards. **(06 Marks)**

b. Describe with a neat sketch:
(i) Imperial Standard Yard (ii) Wringing phenomena of slip gauges. **(08 Marks)**

c. Four length bars A, B, C and D each having a basic length 125 mm are to be calibrated using a calibrated length bar of 500 mm basic length. The 500 mm bar has an actual length of 499.9991 mm. Also it was found that
$L_B = L_A + 0.0001$ mm, $L_C = L_A + 0.0005$ mm,
$L_D = L_A - 0.0002$ mm and
$L_A + L_B + L_C + L_D = L + 0.0003$ mm
Determine L_A, L_B, L_C and L_D. **(06 Marks)**

OR

2 a. Explain with a neat sketch, adjustable slip gauges. **(06 Marks)**

b. Using M112 set of slip gauges build the following dimensions :
(i) 52.498 mm (ii) 48.3275 mm **(08 Marks)**

c. Explain with neat sketch, the principle of sine bar. **(06 Marks)**

Module-2

3 a. What are Limits, Fits and Tolerance? **(06 Marks)**

b. Explain hole basis system and shaft basis system. **(06 Marks)**

c. Determine the actual dimensions to be provided for a shaft and hole of 90 mm size for H_8e_9 type clearance fit. Diameter steps are 80 mm and 100 mm. $i = 0.45\sqrt[3]{D} + 0.001D$, Values of tolerance for IT8 = 25i and IT9 = 40i. F.D. for 'e' type shaft = $-11D^{0.41}$ and also design the Go and NoGo gauges. **(08 Marks)**

OR

4 a. Describe with a neat sketch, the construction and working of LVDT. **(10 Marks)**

b. With a neat sketch, describe the constriction and working of sigma comparator. **(10 Marks)**

Module-3

5 a. What is best wire size? Derive an expression for the best wire size in terms of the pitch and angle of the thread. **(08 Marks)**

b. Discuss briefly with neat sketches the measurement of minor diameter using taper parallels and slip gauge with rollers. **(08 Marks)**

c. Write a neat sketch of Tool Maker's microscope and label its parts. **(04 Marks)**

OR

6 a. Explain the measurement of gear tooth thickness using base tangent method. **(08 Marks)**

b. Explain with neat sketch Parkinson's gear tester. **(12 Marks)**

Module-4

7 a. Discuss with block diagram generalized measurement system with examples for each stage element. **(08 Marks)**

b. What is measurement? What is the significance of measurement system? **(08 Marks)**

c. Define the following terms:
(i) Accuracy (ii) Precision (iii) Threshold (iv) Sensitivity. **(04 Marks)**

OR

8 a. Explain with neat sketch the construction and working of Cathode Ray Oscilloscope. **(08 Marks)**

b. What are the functions of terminating devices? **(04 Marks)**

c. Describe in detail a Ballast circuit (voltage sensitive). **(08 Marks)**

Module-5

9 a. Describe with neat sketch the construction and working of McLeod gauge. **(08 Marks)**

b. Describe with neat sketch the construction and working of Prony brake dynamometer. **(08 Marks)**

c. Briefly discuss the uses of elastic members in the measurement of pressure. **(04 Marks)**

OR

10 a. What is a thermocouple? State and explain the laws of thermocouples. **(10 Marks)**

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

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21ME34

Third Semester B.E. Degree Examination, June/July 2024
Thermodynamics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. State Zeroth law of thermodynamics and state its significance. **(06 Marks)**
b. Derive an expression for work done during polytropic process. **(08 Marks)**
c. Prove that work and heat are path function. **(06 Marks)**

OR

2 a. Give the precise statement of first law of thermodynamics as applied to a closed system undergoing a process and hence prove that internal energy is a property. **(12 Marks)**
b. Clearly write the steady flow energy equation for an open system and explain the terms involved. Apply steady flow energy equation to:
(i) Turbine (ii) Steam nozzle (iii) Heat exchanger **(08 Marks)**

Module-2

3 a. Explain the limitations of first law of thermodynamics. **(06 Marks)**
b. Explain the Kelvin-Plank statement of the second law of thermodynamics. Explain the PMM I and PMM II Kind. **(08 Marks)**
c. A reversible heat engine operates with two environments. In the first it draws 12000 KW from a source at 400°C and in the second it draws 25000 KW from a source at 100°C. In both operations the engine rejects heat to a thermal sink at 20°C. Determine the operation in which the engine delivers more power. **(06 Marks)**

OR

4 a. Explain the Clausius statement of second law of thermodynamics. Explain the Carnot cycle with P-V and T-S diagram. **(10 Marks)**
b. Prove that entropy is a property. Explain available energy. **(06 Marks)**
c. A rigid tank contains air at 35°C and is stirred by a paddle wheel which does 500 kJ of work on the air. During the stirring process, the temperature of air remains constant because of heat transfer to surroundings at 15°C. Estimate the change in entropy of air in the tank and the change is entropy of the surroundings. **(04 Marks)**

Module-3

5 a. Clearly distinguish between ideal and real gases. Mention any two equations you know off. **(06 Marks)**
b. Write a note on compressibility factor. **(04 Marks)**
c. State Dalton's law of partial pressure and derive an expression for the gas constant of a mixture of ideal gases. **(06 Marks)**
d. A gas mixture consists of 6 Kmol of H_2 and 4 Kmol of N_2. Determine the mass of each gas and the gas constant of the mixture. **(04 Marks)**

OR

6 a. Explain the following terms with reference to a combustion process:
(i) Enthalpy of formation
(ii) Enthalpy and internal energy of combustion
(iii) Adiabatic flame temperature
(iv) Combustion efficiency **(08 Marks)**

b. A blast furnace gas has the following volumetric composition:
$CO_2 = 11\%$, $CO = 27\%$, $H_2 = 2\%$ and $N_2 = 60\%$
Find the theoretical volume of air required for the complete combustion of 1 m^3 of the gas. Find the percentage composition of dry flue gases by volume. Assume that air contains 21% of O_2 and 79% of N_2 by volume. **(12 Marks)**

Module-4

7 a. Define the following: (i) Pure substance (ii) Triple point (iii) Critical point **(06 Marks)**

b. Briefly explain what you understand by two property rule. **(04 Marks)**

c. Define dryness fraction and briefly explain how one could estimate the same using separating and throttling calorimeter. **(06 Marks)**

d. A rigid container is filled with steam at 600 kPa and 200°C. At what temperature the steam begins to condense when cooled? Determine the corresponding pressure. **(04 Marks)**

OR

8 a. List out the factors affecting the efficiency of the Rankine cycle. **(05 Marks)**

b. Compare the Rankine and the Carnot cycles of steam power plants. **(05 Marks)**

c. In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0.4 bar. Calculate Carnot and Rankine efficiency of the cycle neglect the pump work. **(10 Marks)**

Module-5

9 a. Compare the Otto, diesel and dual cycles on P-V diagram and T-S diagrams, when heat is supplied to each cycle is same. **(10 Marks)**

b. Derive air standard efficiency for dual combustion cycle. **(10 Marks)**

OR

10 a. With a schematic diagram, explain a closed cycle gas turbine. **(10 Marks)**

b. Consider on air standard cycle in which air enters the compressor at 1 bar and 20°C, the pressure of air leaving the compressor is 3.5 bar and temperature at turbine inlet is 600°C, determine per kg of air.
(i) Thermal efficiency
(ii) Heat supplied
(iii) Work available at the shaft
(iv) Heat rejected to the cooler
(v) Temperature of air leaving the turbine
(vi) Work ratio
Take $\gamma = 1.4$ and $C_p = 1.005$ kJ/kg°K. **(10 Marks)**

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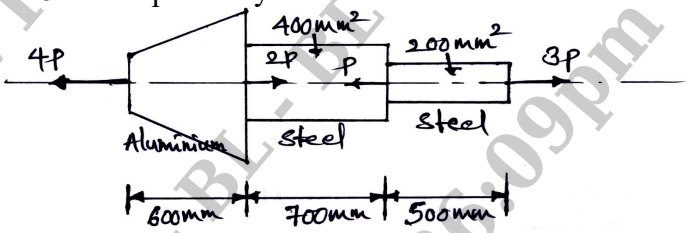
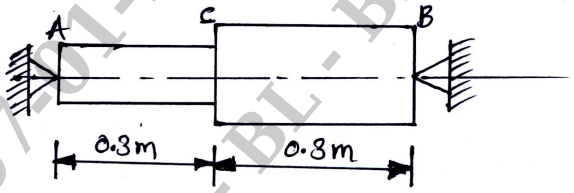
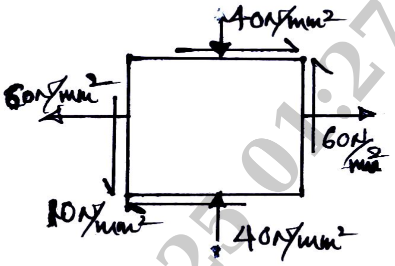
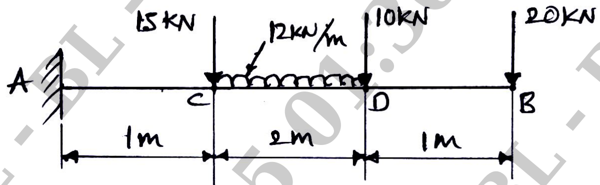
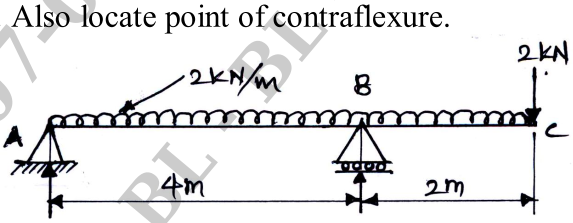
BME301

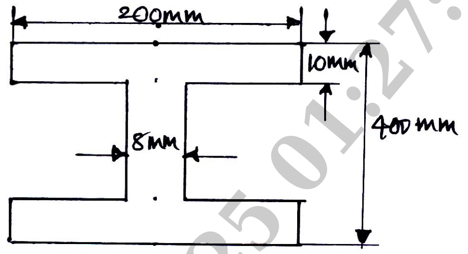
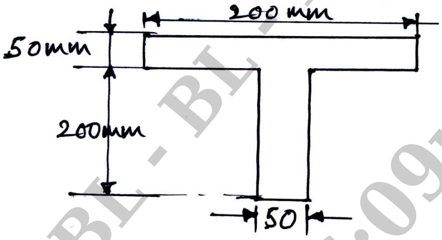
Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	**a.**	Define the following terms: (i) Poisson's ratio (ii) Factor of safety	**04**	**L1**	**CO1**
	b.	Show that the expression for the extension of uniformly tapering circular bar subjected to an axial load 'P' is given by, $\delta = 4PL/\pi d_1 d_2 E$	**06**	**L1**	**CO1**
	c.	A bar with stepped portion is subjected to the forces shown in Fig.Q1(c). Solve for the magnitude of force 'P' such that net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa and that of aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively.  Fig.Q1(c)	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	How do you relate Modulus of Elasticity and Bulk modulus?	**10**	**L1**	**CO1**
	b.	Solve for the values of stress and strain in portion AC and CB of the steel bar shown in Fig.Q2(b). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75°C. Take E = 200 GPa and $\alpha = 12\times10^{-6}$/°C for steel. Area of cross-section of AC is 400 mm^2 and of BC is 800 mm^2.  Fig.Q2(b)	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	A rectangular bar is subjected to two direct stresses 'σ_x' and 'σ_y' in two mutually perpendicular directions. Show that the normal stress 'σ_n' and shear stress 'τ' on an oblique plane which is inclined at an angle 'θ' with the axis of minor stress are given by $\sigma_n = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta$ and $\tau = -\left(\frac{\sigma_x-\sigma_y}{2}\right)\sin 2\theta$	**10**	**L1**	**CO2**

	b.	The state of stress at a point in a stained material is shown in Fig.Q3(b). Identify (i) Direction of principal planes (ii) Magnitude of principal stresses (iii) Magnitude of maximum shear-stress and its direction.  Fig.Q3(b)	10	L3	CO2
		OR			
Q.4	a.	Show that the change in volume of thin cylindrical shell is given by $\delta_V = \frac{Pd}{4tE}(5-4M)v$	10	L1	CO2
	b.	A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Solve for the maximum and minimum hoop stress across the cross-section of the cylinder. Also construct the radial pressure and hoop stress distribution sketch across the section.	10	L3	CO2
		Module – 3			
Q.5	a.	Explain with sketches, the different types of loads acting on a beam.	10	L2	CO3
	b.	A cantilever beam carries UdL and point loads as shown in Fig.Q5(b). Construct SFD and BMD.  Fig.Q5(b)	10	L3	CO3
		OR			
Q.6	a.	Explain SFD and BMD for a cantilever beam with a uniformly varying load.	10	L2	CO3
	b.	An overhanging beam ABC is located as shown in Fig.Q6(b). Develop the SFD and BMD. Also locate point of contraflexure.  Fig.Q6(b)	10	L3	CO3
		Module – 4			
Q.7	a.	Explain the assumptions made in simple bending and show that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular section.	10	L2	CO4

	b.	The cross-section of a beam is as shown in Fig.Q7(b). If permissible stress is 150 N/mm^2. Find its moment of resistance and compare it with equivalent section of the same area for a square section.  Fig.Q7(b)	**10**	**L4**	**CO4**
		OR			
Q.8	**a.**	Illustrate an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending.	**10**	**L2**	**CO4**
	b.	A 'T' shaped cross-section of a beam shown in Fig.Q8(b) is subjected to a vertical shear force of 100 KN. Inspect the shear stress at the neutral axis junction and flange. MI about the horizontal neutral axis is 0.0001134 m^4.  Fig.Q8(b)	**10**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the assumptions made in pure torsion-theory and show that $\frac{T}{J_p} = \frac{\tau}{R} = \frac{G\theta}{L}$	**10**	**L2**	**CO5**
	b.	A hallow shaft having internal diameter 40% of its external diameter, transmits 562.5 KW power at 100 rpm. List the internal and external diameters of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5m should not exceed 1.3 degrees. The maximum torque being 25% greater than mean. $G = 9\times10^4$ N/mm^2.	**10**	**L4**	**CO5**
		OR			
Q.10	**a.**	Show the variation of Euler's critical load with slenderness ratio. Explain the limitations of Euler's theory and mention for formulae to overcome these limitations.	**10**	**L2**	**CO5**
	b.	A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, analyze the safe load using (i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = 1/1600$. (ii) Euler's formula, taking $E = 1.2\times10^5$ N/mm^2.	**10**	**L4**	**CO5**

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BME302

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Manufacturing Process

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define manufacturing process. Classify manufacturing process.	**8**	**L1**	**CO1**
	b.	Define pattern and explain with a neat sketches any four pattern allowances.	**6**	**L2**	**CO1**
	c.	With a neat sketch explain Jolt machine.	**6**	**L2**	**CO1**
		OR			
Q.2	**a.**	Discuss briefly the requirements of base sand in sand mould preparation.	**6**	**L2**	**CO1**
	b.	List the commonly mixed ingredients in moulding sand. Illustrate the properties contribute by each of them to the sand mould.	**10**	**L2**	**CO1**
	c.	What is core? List the different types of cores.	**4**	**L1**	**CO1**
		Module – 2			
Q.3	**a.**	With a neat sketch explain resistance furnace.	**10**	**L2**	**CO2**
	b.	Explain with a neat sketch CUPOLA furnace.	**10**	**L2**	**CO2**
		OR			
Q.4	**a.**	With a neat sketches explain casting defects and remedies.	**10**	**L2**	**CO2**
	b.	With a neat sketches explain slush casting.	**10**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Define Forming. With sketches explain the classification of forming process.	**10**	**L2**	**CO3**
	b.	Differentiate between Hot Working and Cold Working.	**10**	**L2**	**CO3**
		OR			
Q.6	**a.**	Explain the principle of : i) Forging ii) Extrusion.	**10**	**L2**	**CO3**
	b.	Explain : i) Blanking ii) Piercing.	**10**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	Define Welding. Explain oxy-acetylene gas welding.	**10**	**L2**	**CO4**
	b.	With a neat sketch explain TIG welding.	**10**	**L2**	**CO4**
		OR			
Q.8	**a.**	With a neat sketch explain Submerged Arc Welding (SAW).	**10**	**L2**	**CO4**
	b.	With a neat sketches explain types of flames produced in oxy-acetylene gas welding.	**10**	**L2**	**CO4**
		Module – 5			
Q.9	**a.**	With suitable sketches explain defects in welding and their remedial measures.	**10**	**L2**	**CO5**
	b.	With a neat sketch, explain : i) Soldering ii) Brazing.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	With a neat sketches explain resistance welding process.	**10**	**L2**	**CO5**
	b.	With a neat sketch, explain friction stir welding process.	**10**	**L2**	**CO5**

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CBCS SCHEME

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BME303

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Material Science and Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Differentiate between crystalline and non-crystalline solids.	06	L4	CO1
	b.	Explain briefly atomic bonding, ionic bonding and metallic bonding.	08	L2	CO1
	c.	Define (APF) Atomic Packing Factor. Calculate APF for BCC cell.	06	L4,L1	CO1
		OR			
Q.2	a.	Explain slip and twinning.	06	L2	CO1
	b.	Explain point defects and Edge dislocation with necessary diagram.	08	L2	CO1
	c.	With necessary diagram, explain Bragg's law.	06	L3	CO1
		Module – 2			
Q.3	a.	State and explain Hume-Rothery Rule governing the formation of substitutional solid interstitial solid solution with examples.	08	L2	CO2
	b.	Explain with neat sketch, substitutional and interstitial solid solutions with examples.	06	L2	CO2
	c.	State and explain Fick's laws of Diffusion.	06	L3	CO2
		OR			
Q.4	a.	Explain Lever Rule and Gibbs phase rule with an example.	08	L3	CO2
	b.	Draw Fe-Fe_3C diagram. Label all phases, temperatures. Explain solidification process for 0.8% C.	12	L2	CO2
		Module – 3			
Q.5	a.	Draw TTT diagram for 0.8% C and superimpose the cooling curves. Explain briefly.	10	L2	CO3
	b.	With neat sketch, explain hardening and tempering heat treatment processes.	10	L3	CO3
		OR			
Q.6	a.	Explain Age hardening of Al – Cu alloys.	06	L2	CO3
	b.	With neat sketches, explain flame hardening.	06	L3	CO3
	c.	Draw the TTT diagram of austenite for eutectoid steel. Explain the various transformations product of austenite.	08	L2	CO3
		Module – 4			
Q.7	a.	Explain briefly common types of coatings.	10	L2	CO4
	b.	With a neat sketch, explain Physical Vapour Deposition (PVD) and Chemical Vapour Deposition (CVD) process.	10	L3	CO4
		OR			
Q.8	a.	Explain briefly about particle shape and particle size.	10	L2	CO4
	b.	Explain any two methods of powder production technique.	10	L2	CO4
		Module – 5			
Q.9	a.	Define composite. Give its classification.	06	L1,L2	CO5
	b.	Explain Metal Matrix Composite and Ceramic Matrix Composites.	08	L2	CO5
	c.	List the advantages and disadvantages of composite materials.	06	L4	CO5
		OR			
Q.10	a.	Explain the evolution of Engineering materials with the help of block diagram.	10	L2	CO5
	b.	With the necessary flowchart, explain the design flow process chart.	10	L3	CO5

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CBCS SCHEME

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BME304

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of steam table and thermodynamics data hand is permitted.

		Module – 1	M	L	C
Q.1	a.	State and explain zeroth law of thermodynamics.	10	L1	CO1
	b.	Two Celsius thermometers 'A' and 'B' agree at ice point and steam point and the related equation is $t_A = L + Mt_B + Nt_B^2$, where L, M and N are constants, when both thermometer are immersed in fluid, 'A' registers 26°C while 'B' registers 25°C. determine the reading of 'A' when 'B' reads 37.4°C	10	L3	CO1
		OR			
Q.2	a.	Derive an expression for work done during : i) Isothermal process ii) Adiabatic process.	10	L2	CO1
	b.	A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position, heat is then added reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the network done by the fluid for an initial volume of 0.05 m^3 and draw a neat PV diagram.	10	L3	CO1
		Module – 2			
Q.3	a.	Explain Joule's experiment with sketch.	10	L1	CO2
	b.	Air flows steady at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of 0.16 m^3/kg. The internal energy of the air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 W. Calculate the power required to drive the compressor and the inlet and outlet cross-sectional areas.	10	L3	CO2
		OR			
Q.4	a.	Derive Steady Flow Energy Equation (SFEE) with a neat sketch.	10	L2	CO2
	b.	A turbine operates in a steady flow conditions, receiving steam at the following state : pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 34 m/s, and elevation 3 m. The steam leaves the turbine at the following state : pressure 20 KPa, enthalpy 2512 kJ/kg, velocity 100 m/s and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of the steam flow through the turbine is 0.42 kg/s. What is the power output of the turbine in KW?	10	L3	CO2
		Module – 3			
Q.5	a.	State and explain Kelvin – Plank and clausius statements of II law of thermodynamics.	10	L2	CO3
	b.	A heat engine receives half of its heat at 1000 K and the rest at 500 K while rejecting heat to a sink at 300 K. What is the maximum possible efficiency of this heat engine?	10	L3	CO3

		OR			
Q.6	**a.**	State and prove clausius inequality.	**10**	**L1**	**CO3**
	b.	A heat engine working on a Carnot cycle absorbs heat from three thermal reservoirs at 1000 K 800 K and 600 K respectively. The engine does 10 KW of net work and rejects 400 kJ/min of heat to the sink at 800 K, if heat supplied by the reservoir at 1000 K 60% heat supplied by reservoir at 600 K. Find the quantifier of heat supplied by each reservoir.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the concept of available and unavailable energy referred to a cycle.	**10**	**L1**	**CO4**
	b.	In a steam generator, water evaporated at 260°C, while the combustion gas (C_P = 1.08 kJ/kg K) is cooled from 13000°C to 320°C. The surrounding are at 30°C. Determine loss in energy available due to the above heat transfer per kg of water evaporated (Latent heat of vaporization of water at 260°C = 1662.5 m^3 kgmole.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Sketch and explain throttling calorimeter.	**10**	**L2**	**CO4**
	b.	A vessel of 0.04 m^3 contains a mixing of saturated water and saturated steam at temperature of 240°C. The mass of the liquid is 8 kg. Find the pressure, specific volume, enthalpy, entropy and internal energy.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Explain : i) Vander Waal's equation of state ii) Compressibility factor iii) Law of corresponding states.	**10**	**L2**	**CO5**
	b.	1 kg of CO_2 has a volume of 0.86 m^3 at 120°C compute pressure using : i) Ideal gas equation ii) Vander Waal's equation. Take Vander Waal's constants for CO_2 a = 365.6 KNM^4/kg mole and b = 0.0423 m^3/kg mole.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Discuss Maxwell's equations and Tds equation.	**10**	**L2**	**CO5**
	b.	Volumetric analysis of a gaseous mixture yields the following results : CO_2 = 12%, O_2 = 4%, N_2 = 82%, CO = 2%. Determine the analysis on mass basis, molecular weight and gas constant for the mixture, assume ideal gas behavior.	**10**	**L3**	**CO5**

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CBCS 2022 – SCHEME

BMEL305/BRIL305

USN | | | | | | | | | |

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025

INTRODUCTION TO MODELLING AND DESIGN FOR MANUFACTURING

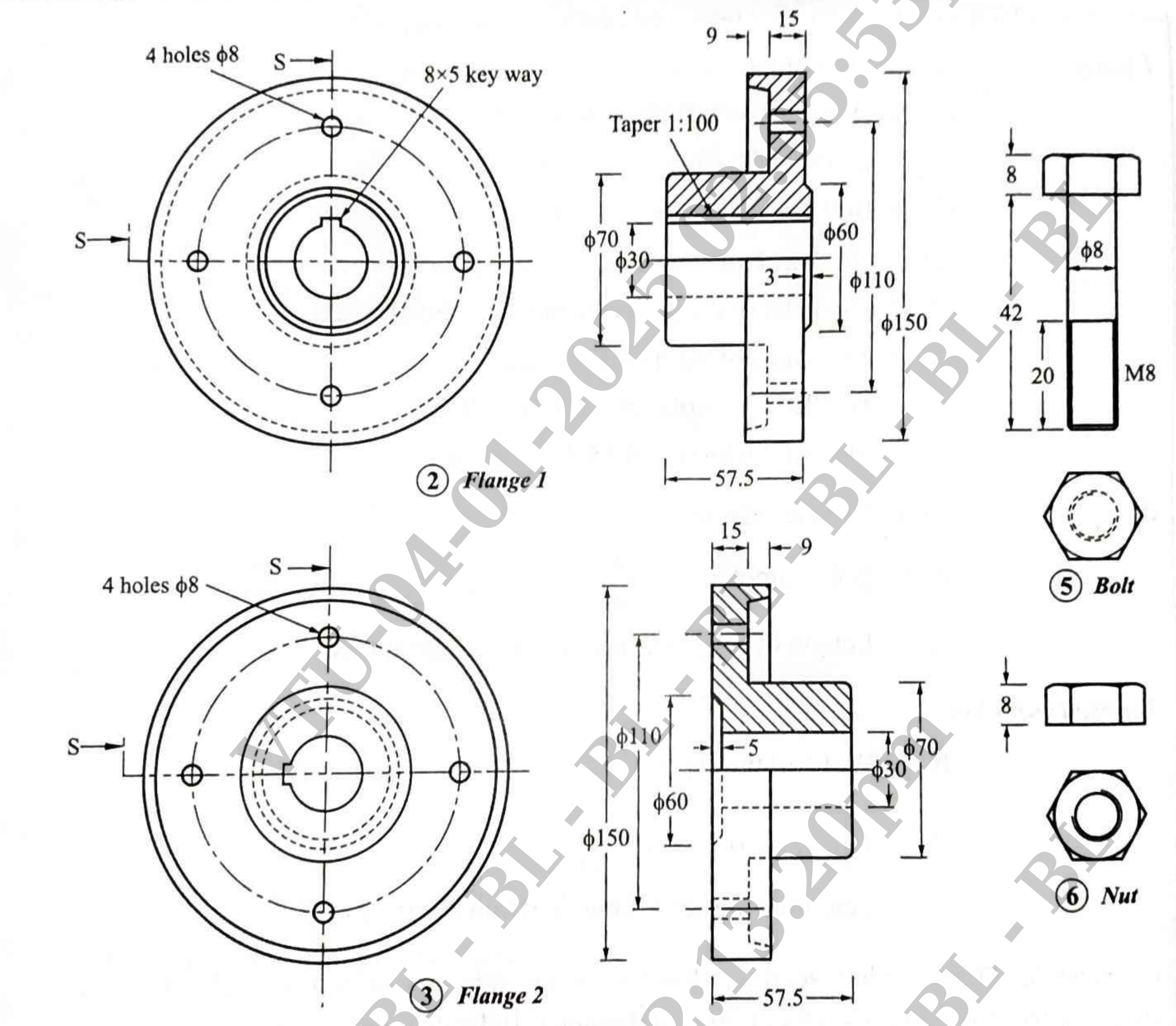
Time: 3 Hours **Max.Marks:100**

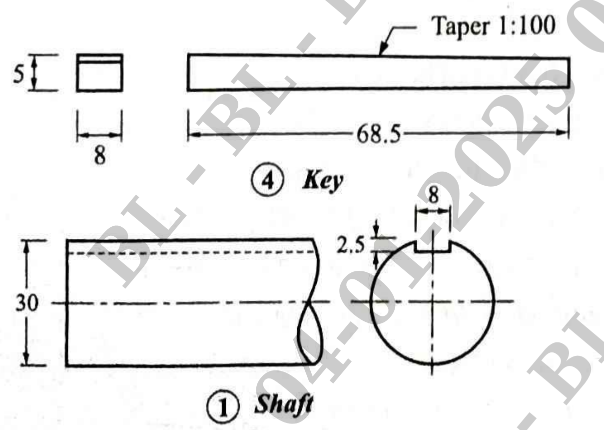
Note: 1. Answer all questions
2. Use first angle projections only
3. All the dimensions are in mm
4. If any data is missing, it may be suitably assumed and mentioned.

Q. No.		Marks
	Module - 1	
1	Draw the profile of BSW screw thread of pitch 40mm and diameter d=20mm.Show at least two threads	20
	Module - 2	
2	A protected type flange coupling is used to connect the two shaft of 30 mm diameter. Draw the half sectional front view and side view. Take number of bolts as 4.	30
	Module – 3	
3	The details parts of screw jack are shown in Fig Q3. Assemble the parts and show the following views: 1. Half sectional front view. 2. top view	50

Examiner 1:
Name:
Signature:

Examiner 2:
Name:
Signature:





Particulars of parts

Part No	*Description*	*Material*	*No. off*
1	Shaft	Steel	2
2	Flange 1	Cast iron	1
3	Flange 2	Cast iron	1
4	Tapered sunk key	Steel	2
5	Hexagonal bolt	Steel	4
6	Hexagonal nut	Steel	4

Details of protected type flange coupling

Fig. Q2

Examiner 1:	Examiner 2:
Name:	Name:
Signature:	Signature:

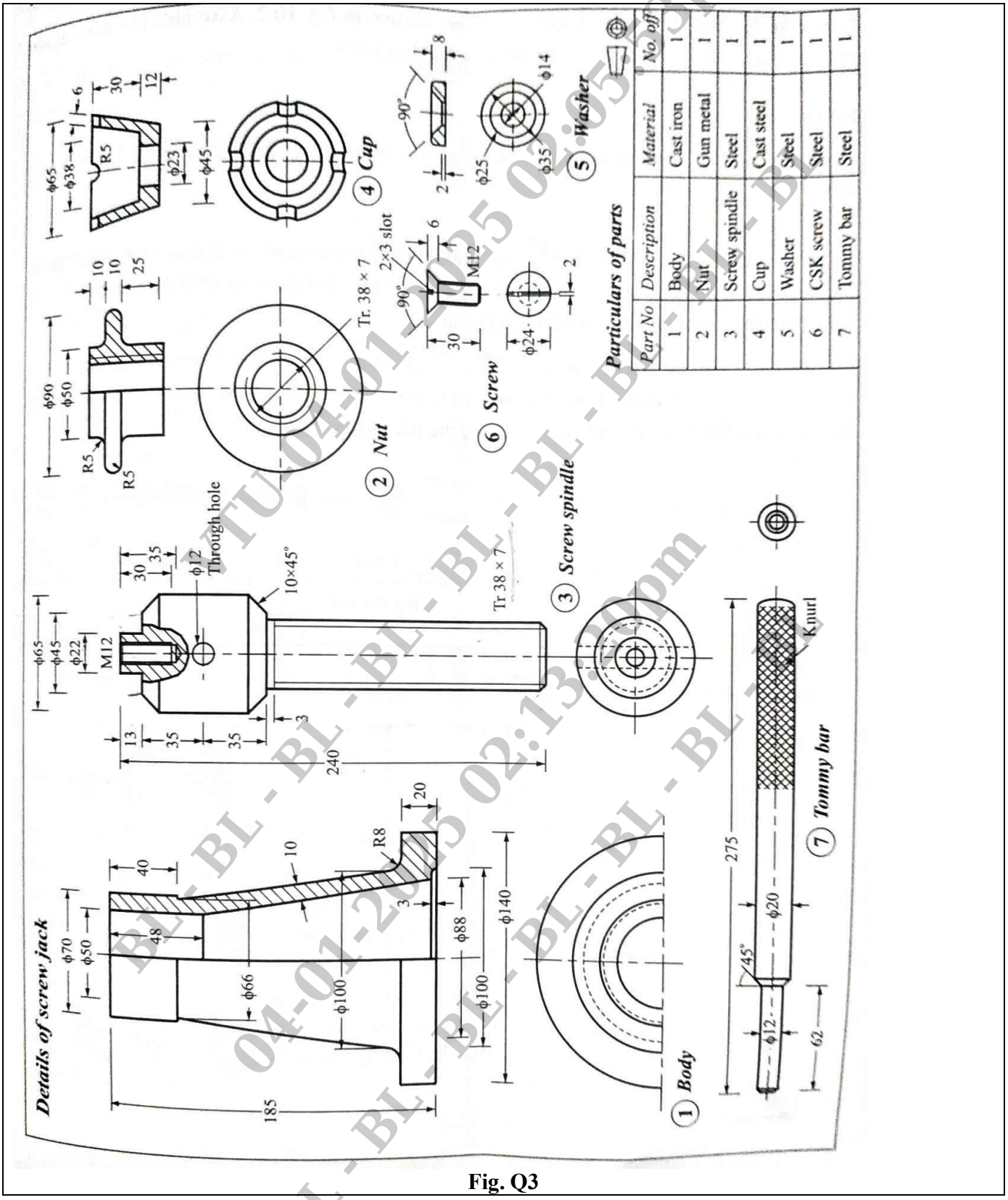


Fig. Q3

Examiner 1:
Name:
Signature:

Examiner 2:
Name:
Signature:

CBCS SCHEME

USN | | | | | | | | | | | **18ME42**

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025

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 steam tables / Molar circuit / Psychrometric chart permitted.

Module-1

1 a. Obtain an expression for the mean effector pressure for an engine operation based on air standard Otto cycle. **(08 Marks)**

b. The volume of air at the beginning of compression in a single cylinder engine operated on dual cycle is 0.0168 m^3. The maximum pressure in the cycle is limited to 60 bar. The pressure and temperature of the air at the beginning of the cycle are 1 bar and 27 °C. Heat is added during constant pressure process upto 3% of the stroke. Assuming cylinder diameter as 25 cm and stroke as 30 cm find the following :

(i) Work done per cycle
(ii) Air standard efficiency of the cycle.
(iii) Power developed if the number of working cycles are 200 per minute. **(12 Marks)**

OR

2 a. Describe the phenomenon of detoxation or knocking in S.I. Engine. How can it be controlled? **(06 Marks)**

b. The following observations were made during a trial of a single cylinder four stroke gas engine having cylinder diameter of 18 cm and stroke of 24 cm.

Duration of trial = 30 min; Total N = 9000; Total number of explosion=4200;
1 m.c.p = 5 bar ; Net load = 390 N ;
Effective diameter of brake wheel = 1 m ;
Calorific value of gaseous fuel at NTP = 19 MJ/m^3 ;

Total fuel used at NTP = 2.4 m^3 ;	Total air used = 36 m^3 ;
Pressure of air = 720 mm of mercury ;	Density of air at NTP = 1.29 kg/m^3 ;
Temperature of air =17 °C ;	Temperature of exhaust gases = 350 °C ;
Sp.Heat of exhaust gases = 1 kJ/kgK ;	Room temperature = 17 °C ;
Cooling water circulated = 80 kg ;	Rise in temperature of cooling water=30 °C

Draw up a heat balance sheet and estimate the mechanical and indicated thermal efficiencies of the engine take R = 287 kJ/kgK. **(14 Marks)**

Module-2

3 a. Sketch the flow diagram and corresponding temperature entropy diagram of a gas turbine plant having 2 stage compression with intercooling, a regenerator and a 2 stage expansion with reheating in between the stages. Mark the state points clearly on both the diagrams. (Also description is necessary) **(06 Marks)**

b. In an open cycle gas turbine plant air enters the compressor at 1 bar and 27 °C. The pressure of air after compression is 4 bar. The isentropic efficiency of the turbine and compressor are 85% and 80% respectively. Air fuel ratio is 80 : 1. Calorific value of fuel used is 42000 KJ/kg. Mass flow rate of air is 2.5 kg/sec. Determine the power output from the plant and the cycle efficiency. Assume that C_P and V to be same for both air and products of combustion. **(14 Marks)**

OR

4 a. Explain briefly the methods used to increase the thermal efficiency and work output of a gas turbine power plant. **(08 Marks)**

b. In a gas turbine plant, the air at 10°C and 1 bar is compressed to 4 bar with compression efficiency of 80%. The air is heated in the regenerator and combustion chamber till the temperature is raised to 700°C and during the process, the pressure falls by 0.14 bar. The air is then expanded in the turbine and passes to regenerator which has 75% effectiveness and causes a pressure drop of 0.14 bar. If the isentropic efficiency of the turbine is 85%, determine the thermal efficiency of the plant. **(12 Marks)**

Module-3

5 a. Explain with the help of TS diagrams the effect of varying the boiler pressure and condenser pressure on the performance of a simple Rankine cycle. **(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. The steam leaving the turbine is 90% dry. Calculate the adiabatic efficiency of the turbine and also the cycle efficiency neglecting pump work. **(10 Marks)**

OR

6 a. Why is Carnot cycle not practicable for steam power plant? Explain briefly. **(06 Marks)**

b. Steam at 30 bar and 350°C is supplied to a steam turbine in a practical regenerative cycle and the steam is bled at 4 bar. The bled steam comes out as dry saturated steam and heats the feed water in an open type feed water, heater to its saturated liquid state. Rest of the steam in the turbine expands to a condenser pressure of 0.1 bar. Assuming the turbine efficiency to be same before and after bleeding determine,

(i) The turbine efficiency.
(ii) Steam quality at inlet to the condenser.
(iii) Mass flow rate of bled steam per unit mass flow rate at turbine inlet.
(iv) Cycle efficiency. **(14 Marks)**

Module-4

7 a. With the help of a neat sketch, elucidate the working of a vapour compression refrigeration system with the help of TS and hs diagram. Obtain the expression for the C.O.P. and capacity of refrigeration system. **(08 Marks)**

b. In a Bell-Colemann cycle, environment temperature is 302 K and the refrigerant temperature is 282 K. The pressure in the refrigerator is 1 bar and that in the cooler is 8 bar, Find the following :

(i) Maximum pressure and temperature in the cycle.
(ii) Refrigerant effect and heat rejected per kg of air.
(iii) Net work required per kg of air
(iv) Compressor and expander swept volume per kg of air
(v) C.O.P of the cycle.
(vi) η_e (relative efficiency)

Assume compression and expansion follow the Law $PV^{1.35} = C$. **(12 Marks)**

OR

8 a. Define the following terms with respect to air conditioning :
(i) Dry bulb temperature
(ii) Wet bulb temperature
(iii) Dew point temperature
(iv) Specific humidity
(v) Relative humidity **(10 Marks)**

b. The sling psychrometer in a laboratory test recorded the following readings:
(i) Dry bulb temperature = 35 $^\circ$C
(ii) Wet bulb temperature = 25 $^\circ$C
Calculate the following :
(i) Specific humidity (ii) Relative humidity
(iii) Vapour density in air. (iv) Dew point temperature
(v) Enthalpy of mixture per kg dry air.
Take atmospheric pressure = 1.0132 bar. **(10 Marks)**

Module-5

9 a. Define the following with respect to a reciprocating air compressor,
(i) Isothermal efficiency
(ii) Adiabatic efficiency
(iii) Mechanical efficiency
(iv) Overall efficiency
(v) Volumetric efficiency **(10 Marks)**

b. The following data refer to a single stage air compressor :
Atmospheric conditions = 1 bar and 25 $^\circ$C
Receiver pressure = 10 bar,
Cylinder diameter = 12 cm,
Stroke to Bore ratio is unity,
Clearance volume is $\frac{1}{25}^{th}$ of the stroke volume.
Index for both the compression and expansion = 1.25,
Mechanical efficiency = 80%, if the receiver capacity is 600 liters and it takes 8 minutes to fill the receiver till its pressure is 10 bar starting from 1 bar, determine
(i) Actual volumetric efficiency.
(ii) Mass of air compressed per second
(iii) Speed of compressor
(iv) Power input.
Assume that receiver temperature to remain at 25 $^\circ$C throughout the filling process. **(10 Marks)**

OR

10 a. What are the disadvantages of a single stage compressor? Obtain an expression for optimum pressure ratio in case of a 2 stage reciprocating air compressor with perfect inter cooling. Also derive an expression for minimum work for the same. **(10 Marks)**

b. A single acting two stage air compressor with complete inter cooling delivers 6 kg/min of air at 15 bars pressure. Assuming an intake state of 1 bar and 15 $^\circ$C and that of compression and expansion processes are polytropic with n = 1.3. Calculate the power required and isothermal efficiency if the speed is 410 rpm. Assuming the clearance volume of L.P. and H.P. cylinders to be 4% and 5% of the respective cylinder swept volumes, calculate the swept and clearance volumes for the cylinder. **(10 Marks)**

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CBCS SCHEME

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18ME43

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define the following with SI units :
i) weight density ii) kinematic viscosity iii) capillarity iv) Bulk modulus. **(08 Marks)**

b. What is the effect of pressure and temperature on mass density? **(04 Marks)**

c. A cubical block of 200 mm edge and weight 196 N is allowed to slide down an inclined plane 20º to horizontal on which there is thin film of oil of viscosity 2.156×10^{-3} Pa-See. What terminal velocity will be attained by the block. It the film thickness is estimated to be 0.025 mm. **(08 Marks)**

OR

2 a. Define the following :
i) Atmospheric pressure ii) Vacuum pressure iii) Absolute pressure. **(06 Marks)**

b. Derive an expression for the hydrostatic force exerted on a plane surface immersed vertically in a liquid and to locate centere of pressure. **(08 Marks)**

c. Find intensity of pressure required to suck fruit juice by a straw through a height of 200 mm from a vessel in absolute scale. Take relative density of fruit juice as 1.20. **(06 Marks)**

Module-2

3 a. Explain the following terms :
i) Buoyancy ii) Centere of buoyancy iii) Meta centre iv) Meta centric height **(06 Marks)**

b. A rectangular pontoon is 5 m long, 3 m wide and 1.2 m high. The depth of immersion of the pontoon is 0.8 m in seawater. If the centre of gravity is 0.6 m above the bottom of the pontoon. Determine the metacentric height. The density of sea water = 1025 Kg/m^3. **(08 Marks)**

c. Explain the conditions of equilibrium of submerged and floating bodies. **(06 Marks)**

OR

4 a. Explain the following :
i) Study and unstudy flows
ii) Uniform and nonuniform flows
iii) Laminar and turbulent flows
iv) Compressible in incompressible flows. **(08 Marks)**

b. Derive continuity equation for 3D, flow for Cartesian coordinate system. **(08 Marks)**

c. Calculate the unknown velocity component so that the following velocity components represent a possible case of incompressible flow
$u = 2x^2$, $v = xyz$, $w = ?$ **(04 Marks)**

Module-3

5 a. Derive Euler's equation of motion along a stream line, Also derive Bernoulli's equation from Euler's equation of motion and list the assumptions made for deriving Bernoulli's equations. **(10 Marks)**

b. A 50 mm diameter tube gradually expands to 100 mm diameter in a length of 10 m. If the tube makes an angle of 20º in the upward direction with the horizontal. Determine the pressure at the exist. If the tube carries a discharge of 3.125 liters/sec and the inlet pressure is $60 kN/m^2$, when
   i) When there is no loss of energy
   ii) Loss of energy is 0.2 m, flow being upwards. **(10 Marks)**

OR

6 a. Derive Darcy-Weisbach relation for fluid flow through a pipe. **(04 Marks)**

b. Differentiate between venturimeter and orifice meter. **(08 Marks)**

c. Prove that the ratio of maximum velocity to average velocity for Laminar Flow between two stationary parallel plates is 1.5. **(08 Marks)**

Module-4

7 a. Explain the terms :
i) Lift ii) Drag iii) Displacement thickness iv) Momentum thickness. **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 kM/hr in stationary air of density 1.15 Kg/m^3. If the coefficient of drag and life are 0.15 and 0.75 respectively. Determine :
   i) The life force
   ii) The drag force
   iii) The resultant force
   iv) The power required to keep the plate in motion. **(06 Marks)**

c. Write a short note on boundary layer separation method to control it. **(04 Marks)**

OR

8 a. What is fundamental quantities and derived quantities with respect to dimensional analysis. **(04 Marks)**

b. Explain the following :
   i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity **(06 Marks)**

c. Using Buckingham's π theorem show that discharge of a centrifugal pump is given by $Q = ND^3\phi\left[\frac{gH}{N^2D^2};\frac{\mu}{ND^2\rho}\right]$. **(10 Marks)**

Module-5

9 a. Derive an expression for velocity of sound in terms of bulk modulus. **(08 Marks)**

b. Define the following :
i) Mach number ii) Sub sonic flow iii) Sonic flow iv) Super Sonic flow. **(06 Marks)**

c. An aeroplane is flying at on height of 15 km , where the temperature is -50ºC. The speed of the plane is corresponding to M = 2.0 (Mach number). Assuming K = 1.4 and R = 287 J/Kgº K. Find the speed of the plane. **(06 Marks)**

OR

10 a. Derive an expression for stagnation temperature. **(06 Marks)**

b. Write a note on oblique and normal shocks. **(04 Marks)**

c. Define; computational fluid dynamics (CFD) also mention their applications and limitations. **(10 Marks)**

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CBCS SCHEME

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18ME44

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Kinematics of Machines

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. Define the following with an example : i) Kinematic pair ii) Kinematic chain iii) Mechanism iv) Degree of freedom. **(08 Marks)**

b. Sketch and explain the following mechanisms :
i) Oscillating cylinder mechanism ii) Scotch yoke mechanism. **(12 Marks)**

OR

2 a. What is quick return motion mechanism? Sketch and explain crank and slotted lever mechanism. **(08 Marks)**

b. With neat sketches, explain the following mechanisms :
i) Ratchet and Pawl mechanism ii) Pantograph. **(12 Marks)**

Module-2

3 a. With a simple sketch, explain Corioli's component of acceleration. **(06 Marks)**

b. In a four bar mechanism ABCD. The link AD is fixed and crank AB rotates at 100 rpm clockwise. The link AB make 60º with fixed link AD. The lengths of link AB , BC ,CD and AD are 90, 120, 120 and 180 mm respectively. Determine angular velocity of link BC and CD by relative velocity method. **(14 Marks)**

OR

4 a. What is Instantaneous centre? Explain the types of instantaneous centres. **(08 Marks)**

b. The crank of an engine mechanism is 200 mm long and ratio of connecting rod to crank is 4. The crank speed is 240 rpm clockwise. When the crank has turned through 45º from inner dead centre determine the following using instantaneous centre method.
i) Angular velocity of connecting rod ii) Velocity of the slider. **(12 Marks)**

Module-3

5 a. What is Loop closure? Explain loop closure equation for Four bar mechanism. **(06 Marks)**

b. In a slider crank mechanism the crank and connecting rods are 150 mm and 600 mm long respectively. The crank rotates at uniform speed of 100 rpm clockwise. When the crank makes 30º with IDC. Find
i) Angular velocity and angular acceleration at the connecting rod.
ii) Velocity and acceleration of the slider.
Use Complex algebra method. **(14 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(08 Marks)**

b. Design a four bar mechanisms when the motions of the input and output links are governed by a function $y = 2x^2$ and x varies from 2 to 4 with an interval of 1. Assume θ to vary from 40º to 120º and ϕ from 60º to 132º. **(12 Marks)**

Module-4

7 Draw the profile of the cam with 30 mm minimum radius is rotating clockwise and has to give motion to the knife edge follower with follower axis offset to the right by 10 mm. The cam lifts the follower for 120º of cam rotation with SHM , followed by a dwell period of 60º. Then the follower returns to starting position through 90º with UARM and then dwells for the remaining period. Stroke = 300 mm. **(20 Marks)**

OR

8 The following data relate to a cam profile which operates a reciprocating inline roller follower.
Minimum radius of the cam = 30 mm
Roller diameter = 15 mm
Stroke of the follower = 30 mm
The follower moves outward during 150º with UARM.
Dwell for next 30º
Return during next 120º with SHM. Dwells for the rest of the rotation.
Draw the cam profile if the cam rotates in clockwise. **(20 Marks)**

Module-5

9 a. What is Interference in gears? Explain in brief the methods to avoid interference. **(08 Marks)**

b. Two spur gears have 24 and 30 teeth of module 10 mm. The standard addendum is 1 module and pressure angle is 20º. Determine
i) Length of path of contact ii) Length of arc of contact iii) Contact Ratio. **(12 Marks)**

OR

10 a. Sketch and explain i) Simple gear train ii) Reverted gear train. **(06 Marks)**

b. An epicyclic gear train consists of three gears A, B and C as shown in Fig. Q1(b). The internal gear A has 72 teeth and gear C has 32 teeth. The gear B meshes with both gear A and C and is carried on an arm F, which rotates about the centre of gear A and C at 20 rpm. If the gear A is fixed determine the speed of gears B and C using Tabular column method. **(14 Marks)**

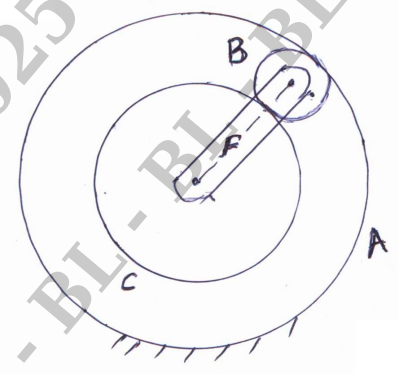

Fig. Q10(b)

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USN | | | | | | | | | | 18ME46B

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Mechanical Measurement 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. Explain the objectives of metrology. **(06 Marks)**
b. With neat sketches, explain material standards. **(08 Marks)**
c. Explain adjustable slip gauge. How is it different form regular slip gauge? **(06 Marks)**

OR

2 a. Explain the working principle of autocollimeter with a neat sketch. **(08 Marks)**
b. Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with a 300 mm bar. There was an error of 0.03 mm and three bars together have total error of 0.064 mm less than the standard bar. Bar A is 0.02 mm longer than bar B and 0.025 mm longer than bar C. Determine the actual dimensions of all the end bars. **(08 Marks)**
c. List the range and number of pieces available in a standard set of M112 slip gauge. **(04 Marks)**

Module-2

3 a. Discuss unilateral and bilateral tolerance. **(04 Marks)**
b. With a neat sketch, explain hole basis and shaft basis system. **(08 Marks)**
c. A shaft of 35 ± 0.004 mm is to be checked by GO-NOGO gauge. Design the required dimension for gauge. Also, draw the diametric representation. **(08 Marks)**

OR

4 a. Sketch and explain Johnson Mikrokator. **(06 Marks)**
b. List the characteristics and applications of comparators. **(08 Marks)**
c. Give the classification of comparators. Explain any one in detail. **(06 Marks)**

Module-3

5 a. Explain the method of measurement of pitch diameter. **(10 Marks)**
b. With a neat sketch, explain the construction and working of toolmaker's microscope. **(10 Marks)**

OR

6 a. Sketch and explain the various types of standard tooth profile of a gear. **(10 Marks)**
b. Write short notes on base tangent method. **(05 Marks)**
c. Discuss the errors produced in manufacturing of gears. **(05 Marks)**

Module-4

7 a. Explain generalized measurement system with block diagram. **(06 Marks)**

b. Define the following terms:
   - i) Accuracy
   - ii) Precision
   - iii) Sensitivity
   - iv) Loading effect
   - v) Hysteresis. **(10 Marks)**

c. Explain the working principle of strain gauge. **(04 Marks)**

OR

8 a. With a neat sketch, explain the construction and working of cathode ray oscilloscope. **(10 Marks)**

b. Explain electrical intermediate modifying device. **(05 Marks)**

c. Write short notes on terminating devices. **(05 Marks)**

Module-5

9 a. List force measuring devices. Explain any one in detail. **(08 Marks)**

b. Explain the working of McLeod gauge. **(06 Marks)**

c. Briefly explain the types of dynameters. **(06 Marks)**

OR

10 a. Explain the laws of thermocouple. **(08 Marks)**

b. List the devices used for strain measurement. Explain any one in detail. **(08 Marks)**

c. Explain the method of preparation and mounting of strain gauges. **(04 Marks)**

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CBCS SCHEME

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BME401

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. Use of Thermodynamics Data hand book and Steam tables are permitted.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Derive an expression for the air standard efficiency of an Otto cycle. Represent the processes of the cycle on P – V and T – S diagrams. List the assumptions.	**12**	**L3**	**CO1**
	b.	The compression ratio of a Diesel cycle is 14 and the cut off ratio is 2.2. At the beginning of the cycle, air is at 0.98 bar and 100ºC. Find : i) Temperature and pressure at all the salient points. ii) Air standard efficiency.	**8**	**L3**	**CO1**
		OR			
Q.2	**a.**	Explain the Willan's line method of determining the frictional power of an IC engine.	**8**	**L2**	**CO1**
	b.	In a test on three cylinder, 4 – stroke IC engine with 22cm bore and 26cm stroke, the following were the observations during a trial period of one hour Fuel consumption = 8kg , Calorific value = 45,000 kJ/kg , Total revolutions of the crank shaft = 12,000 , MEP = 6 bar , Net load on brake = 1500N , Brake drum diameter = 1.8m , Rope diameter = 3cm , Mass of cooling water = 550kg , Inlet temperature of water = 27ºC , Exit temperature of water = 55ºC , Air used = 300kg , Ambient temperature = 30ºC , Exhaust gas temperature = 310ºC , Specific heat of exhaust gases = 1.1 kJ/kg K , Calculate : i) Mechanical efficiency ii) Indicated thermal efficiency. Also draw a heat balance sheet in kJ/min.	**12**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Derive an expression for the optimum pressure ratio for maximum work output in case of an ideal Brayton cycle in terms of maximum and minimum temperature of the cycle.	**10**	**L3**	**CO2**
	b.	In an open cycle gas turbine plant, air enters the compressor at 1 bar and 20ºC. The pressure after compression is 4 bar. The isentropic efficiency of turbine and compressor are 85% and 80% respectively. The air – fuel ratio is 90 : 1. Calorific value of fuel used to 42,000 kJ/kg. Mass flow rate of air is 3kg/s. Determine the power output from the plant and the cycle efficiency. Assume that Cp = 1kJ/kg K and r = 1.4 for air and gases.	**10**	**L3**	**CO2**
		OR			

Q.4	a.	With a neat sketch, explain the following methods used to improve the performance of an open cycle gas turbine plant : i) Reheating ii) Inter cooling.	12	L2	CO2
	b.	With a neat sketch, explain the working of a Ramjet and a Turbo propeller engine.	8	L2	CO2
		Module – 3			
Q.5	a.	With a neat schematic diagram and T – S diagram, derive an expression for the thermal efficiency of the Rankine cycle.	8	L3	CO3
	b.	Explain the effect of the following on Rankine cycle efficiency : i) Boiler pressure ii) Condenser pressure.	4	L2	CO3
	c.	A simple ideal Rankine cycle works between the pressure of 30 bar and 0.04 bar, the initial condition of steam being dry saturated. Calculate the cycle efficiency and work ratio.	8	L3	CO3
		OR			
Q.6	a.	With a neat schematic diagram and T – S diagram, briefly explain the regenerative vapour power cycle with single open feed water heater. Derive and expression for its thermal efficiency.	10	L3	CO3
	b.	A steam power plant operates on a reheat cycle. Steam in boiler at 150 bar , 550ºC expands through high pressure turbine. It is reheated at constant pressure of 40 bat to 550ºC and expands through low pressure turbine to a condenser at 0.1 bar. Find i) Quality of steam at turbine exist ii) Cycle efficiency iii) Steam rate in kg/Kw hr.	10	L3	CO3
		Module – 4			
Q.7	a.	With a neat sketch, explain the working principle of an Ammonia vapour absorption refrigeration system.	8	L2	CO4
	b.	A 10 ton Ammonia ice plant operates between an evaporator temperature of -15ºC and condenser temperature of 35ºC. The Ammonia enters the compressor as dry saturated vapour. Assuming isentropic compression, determine i) mass flow rate or Ammonia ii) COP iii) Power input in KW iv) Tons of ice at -10ºC produced from water at 25ºC in a day. Enthalpy of fusion of ice = 334 kJ/kg , Cp = 4.187 kJ/kg K for water and Cp = 2.1 kJ/kg K for ice.	12	L3	CO4
		OR			
Q.8	a.	With a neat sketch, explain the working principle of a winter air conditioning system. Represent the processes of the system on a psychrometric chart.	10	L2	CO4

	b.	It is required to design an air conditioning plant for an office room with the following conditions : Outdoor conditions = 14ºC DBT , 10ºC WDT , Required conditions = 20ºC DBT , 60% RH , Amount of air circulation = 0.3m^3/min/person , Seating capacity of office = 60. The required condition is achieved first by heating and then by adiabatic humidifying. Determine : 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**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Derive an expression for the volumetric efficiency of a reciprocating air compressor.	**10**	**L3**	**CO5**
	b.	Air at 1 bar and 27ºC is compressed to 7 bar by a single stage reciprocating compressor according to the law $PV^{1.3}$ = C. The free air delivered was 1m3/min. Speed of the compressor is 300rpm , Stroke to bore ratio is 1.5:1. Mechanical efficiency is 85% and motor transmission efficiency is 90%. Determine i) Indicated power and Isothermal efficiency. ii) Cylinder dimensions and power of the motor required to drive the compressor.	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive an expression for condition of maximum discharge through a nozzle.	**10**	**L3**	**CO5**
	b.	A convergent – divergent nozzle is required to discharge 360 kg/hr of steam. The nozzle is supplied with steam and 10 bar and 0.97 dry and discharges against a back pressure of 0.5 bar. Neglecting the effect of friction, find the throat and exit diameters. Assume the condition for maximum discharge.	**10**	**L3**	**CO5**

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CBCS SCHEME

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BME402

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Machining Science and Metrology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	With a neat sketch, explain single point cutting tool geometry.	07	L2	CO1
	b.	Explain the merchant circle diagram for the analysis of power requirement for the machine tool.	08	L2	CO1
	c.	Describe the orthogonal and oblique cutting.	05	L2	CO1
		OR			
Q.2	a.	With neat sketches, explain the tool layout for producing a hexagonal bolt on a capstan lathe.	07	L2	CO1
	b.	Briefly discuss the broad classification of lathes.	07	L2	CO1
	c.	Explain any two operations of the lathe.	06	L2	CO1
		Module – 2			
Q.3	a.	With a neat diagram, explain column and knee type milling machine.	07	L2	CO2
	b.	Explain with neat sketches up milling and down milling methods of milling operations. Discuss the significance of both.	08	L2	CO2
	c.	Use compound indexing method for calculating the index crank movement to divide the peripheral of a job into 87 divisions.	05	L3	CO2
		OR			
Q.4	a.	Explain with neat sketch constructional features of radial drilling machine.	08	L2	CO2
	b.	Explain driving mechanisms of shaper.	06	L2	CO2
	c.	Briefly explain the classification of grinding machines.	06	L2	CO2
		Module – 3			
Q.5	a.	Define tool life. Discuss the parameters which influences the tool life.	08	L2	CO3
	b.	With a neat sketch, explain the different heat zones that are present during the metal cutting process.	06	L2	CO3
	c.	Discuss the different wear mechanisms.	06	L2	CO3
		OR			
Q.6	a.	List the different types of cutting tool materials and explain them.	08	L2	CO3
	b.	Explain different properties of cutting fluids.	06	L2	CO3
	c.	Define machinability and discuss the factors affecting machinability.	06	L2	CO3
		Module – 4			
Q.7	a.	Discuss the following standards of measurement: (i) Line standard (ii) Wavelength standard (iii) End standard	07	L2	CO4
	b.	With a neat sketch, explain international prototype meter.	07	L2	CO4
	c.	Explain wringing phenomenon.	06	L2	CO4
		OR			
Q.8	a.	Define fit. Describe the types of fit and their designation.	08	L2	CO4
	b.	What is the purpose of limit system?	06	L2	CO4
	c.	With a neat sketch, explain snap gauges.	06	L2	CO4

Module – 5					
Q.9	**a.**	With a neat sketch explain Taylor's principle in the design of limit gauges.	**08**	**L2**	**CO5**
	b.	Sketch and explain two types of plug and ring gauges.	**08**	**L2**	**CO5**
	c.	Explain briefly the different gauge tolerances.	**04**	**L2**	**CO5**
OR					
Q.10	**a.**	Explain the basic characteristics and classification of comparators.	**06**	**L2**	**CO5**
	b.	With a neat sketch, explain sigma comparator.	**08**	**L2**	**CO5**
	c.	Explain the principle and working of a sine bar.	**06**	**L2**	**CO5**

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BME403

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following properties of fluids and write their SI units. i) Density ii) Specific weight iii) Specific volume iv) Kinematic viscosity.	8	L1	CO1
	b.	If the velocity distribution over a plate is given by $u = \frac{2}{3}y - y^2$ in which 'u' is the velocity in meter per second at a distance 'y' meter above the plate, Determine the shear stress at y = 0 and y = 0.15m. Take dynamic viscosity of fluid as 8.63 poises.	6	L3	CO1
	c.	Define capillarity. Derive an expression for capillary rise.	6	L2	CO1
		OR			
Q.2	a.	State and prove Pascal's law.	6	L2	CO2
	b.	Define the following and indicate their relative position on a chart: i) Absolute pressure ii) Gauge pressure iii) Vacuum pressure iv) Atmospheric pressure.	6	L1	CO2
	c.	The right limb of a simple u-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm.	8	L3	CO2
		Module – 2			
Q.3	a.	Define the following types of fluid flows: i) Steady and unsteady flow ii) Uniform and non-uniform flow iii) Compressible and incompressible flow.	6	L1	CO2
	b.	Derive the continuity equation in three dimensional Cartesian co-ordinates for a steady, incompressible fluid flow.	8	L2	CO2
	c.	Explain stream function and velocity potential function.	6	L2	CO2

		OR			
Q.4	**a.**	Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe.	**10**	**L2**	**CO2**
	b.	A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow.	**6**	**L3**	**CO2**
	c.	Define Reynolds number. Explain its significance in fluid flow.	**4**	**L2**	**CO2**
		Module – 3			
Q.5	**a.**	Derive Euler's equation of motion along a stream line. Deduce Bernoulli's equation from Euler's equation. State the assumptions made.	**10**	**L2**	**CO3**
	b.	A pipeline carrying oil of specific gravity 0.87, changes in diameter from 200 mm diameter at a position 'A' to 500 mm diameter at a position 'B' which is 4 m at a higher level. If the pressures at A and B are 9.81 N/cm^2 and 5.886 N/cm^2 respectively and the discharge is 200 lit/s, determine the loss of head and direction of flow.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive Darcy – Weisbach equation for loss of head due to friction in pipe.	**10**	**L2**	**CO3**
	b.	A horizontal pipe line 40 m long is connected to a water tank at one end and discharge freely into the atmosphere at the other end. For the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Explain the following terms: i) Drag ii) Lift iii) Friction drag iv) Pressure drag.	**8**	**L2**	**CO4**
	b.	Briefly explain what is meant by boundary layer and hence define the following: i) Boundary layer thickness ii) Displacement thickness.	**6**	**L2**	**CO4**
	c.	State and explain Buckingham's π theorem.	**6**	**L2**	**CO4**
		OR			
Q.8	**a.**	What is similitude? Explain the different types of similitude.	**7**	**L2**	**CO4**
	b.	Explain the dimentional homogeneity with examples.	**3**	**L2**	**CO4**

	c.	The frictional torque (T) of a disc of diameter (D) rotating at a speed (N) in a fluid of viscosity (μ) and density (ρ) in a turbulent flow is given by $T = D5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by Buckingham's - π theorem.	10	L3	CO4
		Module – 5			
Q.9	a.	Define Mach number. Explain the significance of Mach number in compressible fluid flow.	6	L2	CO5
	b.	Derive an expression for velocity of sound wave in a fluid.	8	L2	CO5
	c.	Find the velocity of bullet fired in standard air if Mach angle is 30°. Take R = 287.14 J/kg K and γ = 1.4 for air and temperature of air is 15°C.	6	L3	CO5
		OR			
Q.10	a.	An air plane is flying at an altitude of 15 km where the temperature is -50°C. The speed of plane corresponds to Mach number 1.6. Assume γ = 1.4 and R = 287 J/kg K for air. Find speed of plane and Mach angle.	8	L3	CO5
	b.	Define: i) Mach Number ii) Sub-Sonic flow iii) Sonic flow iv) Super-Sonic flow	4	L1	CO5
	c.	Mention the advantages and disadvantages of CFD.	8	L2	CO5

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18ME51

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Management and Economics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define management and explain the characteristics of management. **(08 Marks)**
b. Define planning and briefly discuss the steps involved in planning. **(08 Marks)**
c. Briefly explain different levels of management. **(04 Marks)**

OR

2 a. Explain the various steps in decision making process with a block diagram. **(12 Marks)**
b. Explain briefly the contribution of F.W Taylor for the scientific management. **(08 Marks)**

Module-2

3 a. List the different types of organization, explain briefly line and staff organization with a chart. **(10 Marks)**
b. Define motivation and explain briefly different leadership styles. **(10 Marks)**

OR

4 a. Explain Maslow's hierarchy of need theory in brief. **(10 Marks)**
b. What is controlling and explain the steps in controlling process **(10 Marks)**

Module-3

5 a. Explain briefly the following :
i) Law of demand
ii) Law of supply
iii) Equilibrium point
iv) Elasticity of demand
With demand/supply graph v/s price. **(10 Marks)**
b. Find the effective rate of interest for an actual rate of interest of 8% when compounded :
i) Yearly ii) Biannually iii) Quarterly iv) Daily. **(06 Marks)**
c. Differentiate between micro and macro economics. **(04 Marks)**

OR

6 a. Define law of returns and explain the three phases of law of returns. **(06 Marks)**
b. A 45 years old person is planning for his retired life. He plans to invest Rs. 2500/- every month in a private Chitfund which assures him a rate of interest 11% compounded monthly. Find the maturity value of his account when he is 60 years old. **(06 Marks)**
c. A person wants to gift a car to his daughter when she would turn 18 years six years from now. He decides to put away money in her name during her next six birth days. He wants to deposit Rs. 25,000/- in the first year and go on increasing it by Rs. 5000/- every year for the next 6 years. If he estimates that a car would cost Rs. 5 lakhs when he wants to buy, how much more money should be added to the maturity amount that he receives from the bank. If it is assumed to grow at compounded 11.5% annually. Draw the cash flow diagram. **(08 Marks)**

Module-4

7 a. Define present worth and explain the conditions for present worth comparison. **(10 Marks)**

b. The following alternatives are available to accomplish an objective of 12 years duration.

	Plan 'A'	Plan 'B'	Plan 'C'
Life cycles (Y)	6	3	4
First cost (Rs.)	2000	8000	10,000
Annual cost (Rs.)	3200	700	500

Compare the present worth of the alternatives using interest rate of 7 percent (7%). **(10 Marks)**

OR

8 a. Explain briefly rate of returns :
i) MARR
ii) IRR
iii) ERR. **(10 Marks)**

b. A company has developed a unique prototype and spent Rs. 5 lakhs. A return of Rs. 7 lakhs is expected at the year end and it is expected to fetch Rs. 3 lakhs for the next three years calculate the rate of returns for his prototype. **(10 Marks)**

Module-5

9 a. Discuss the various causes of depreciation. **(05 Marks)**

b. List and explain five methods of depreciation. **(08 Marks)**

c. A company has purchased an equipment whose first cost is Rs.1,00,000 with an estimate life of 8 years. The estimated salvage value of the equipment at the end of its life time is Rs. 20,000. Find the depreciation and book value for the 5 years using the sum of the years digit method of depreciation. **(07 Marks)**

OR

10 a. Explain how selling price is determined for a product with a neat diagram. **(08 Marks)**

b. Explain briefly the standard cost and marginal cost. **(04 Marks)**

c. A factory produces CFL tubes in batches of 1000. The direct material cost for a batch is Rs. 1600 and direct labour cost is Rs. 2000. The factory overheads is 32 percent of material and labour costs. Selling and distribution cost are 20 percent of factory cost. If the management wants to make a profit of 20 percent of gross cost. Determine the selling price of each tube. **(08 Marks)**

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CBCS SCHEME

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Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 hand book is permitted.
3. Assume suitable missing data.

Module-1

1 a. Define mechanical engineering design, Explain the steps involved in design with a block diagram. **(08 Marks)**

b. Determine the max stress induced in the semicircular grooved shaft as shown in Fig. Q1 (b), if it is subjected to,
(i) An axial load of 50 kN
(ii) A bending moment of 500 Nm.
(iii) A twisting moment of 400 Nm. **(12 Marks)**

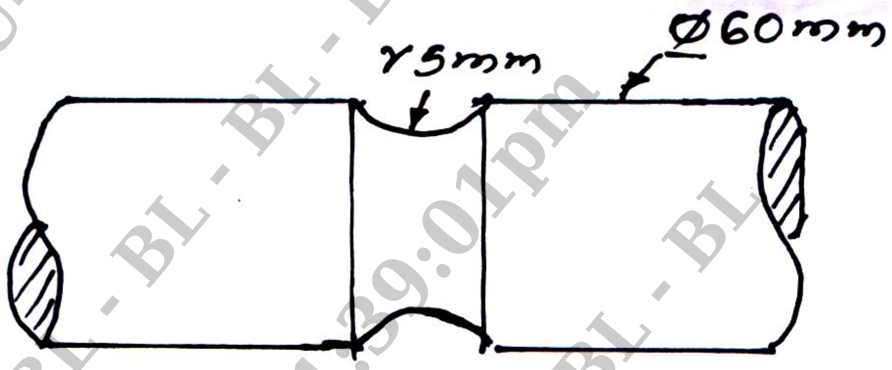

Fig. Q1 (b)

OR

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

b. A Cantilever beam of rectangular cross section with a depth of 200 mm is subjected to an axial tensile load of 50 kN and a transverse load of 40 kN acting downwards at the free end of 500 mm length beam. The material of the beam has allowable tensile stress of 80 N/mm^2. Determine the width of rectangular section of the beam. **(12 Marks)**

Module-2

3 a. Derive an expression for impact stress in an axial bar of cross section ‘A’ and length ‘L’ due to the impact load of ‘W’ falling from a height ‘h’ on the collar. **(08 Marks)**

b. A Cantilever beam of rectangular section with the depth twice the width is subjected to varying load that varies from 6 KN downwards to 2 KN upwards. If the span is 100 mm, determine the dimensions of cross section of the beam. The material has yield strength of 400 N/mm^2 and a tensile strength of 560 N/mm^2. Assume no stress raisers, size factor and surface finish factors as 1. Factor of safety is 2. **(12 Marks)**

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.

OR

4 a. Explain with neat sketches, the different types of varying stresses. **(06 Marks)**

b. A beam of 400 mm depth I-section is resting on two supports 6 m apart. It is loaded by a weight of 5 KN falling through a height of 10 mm and striking the beam at mid point. Moment of Inertia of the section is 12×10^7 mm^4. Take Modulus of Elasticity of 2×10^5 N/mm^2. Determine,
   (i) Impact stress
   (ii) Impact factor
   (iii) Instantaneous max deflection
   (iv) Instantaneous max load. **(14 Marks)**

Module-3

5 A shaft mounted between bearings 1200 mm apart receives a power of 20 kW at 1000 rpm through a pulley 600 mm diameter located 400 mm from the left bearing from antoher pulley directly below it. The power is delivered through a gear of 200 mm diameter located 700 mm from the left bearing to another gear in front of it. The shaft rotates clockwise when viewed through the left bearing. The belt has ratio of tensions of 2.5 and the gear is of 20° pressure angle. The weight of the pulley is 500 N and that of the gear is 200 N. Determine the shaft diameter if the shaft material has yield shear stress of 180 MPa and factor of safety is 3. Take shock and endurance factors for bending and torsion as 1.5 and 1.00 respectively. **(20 Marks)**

OR

6 a. Prove that a square key is equally strong in shear and compression. **(06 Marks)**

b. A Cast Iron Flange coupling is used to connect two shafts of 80 mm diameter. The shaft runs at 250 rpm and transmits a torque of 4300 N.m. The permissible shear stress for key and bolt materials is 50 MPa and permissible shear stress for Flange material is 8 MPa. Design the Flange key and bolts for the coupling. **(14 Marks)**

Module-4

7 a. Explain with neat sketch, the failure of rivets. **(06 Marks)**

b. Determine the size of weld required for an eccentricity loaded weld as shown in Fig.Q7 (b). The allowable stress in the weld is 75 MPa. **(14 Marks)**

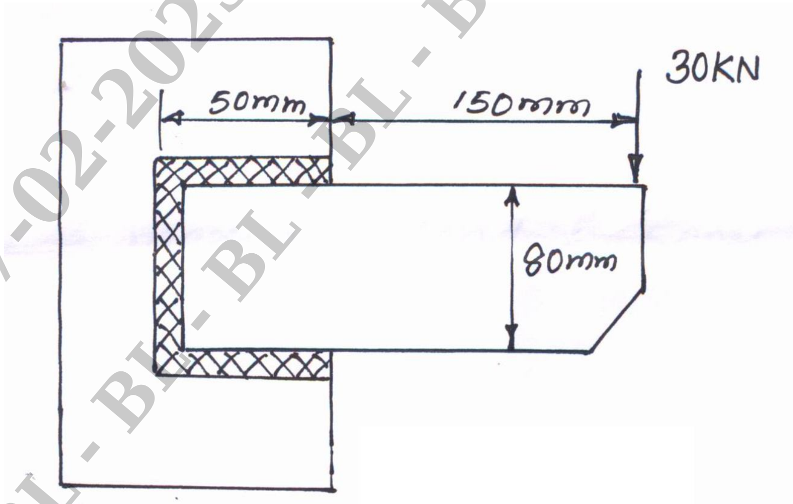

Fig. Q7 (b)

OR

8 a. A plate of 80 mm wide and 10 mm thick is welded to another plate by means of two parallel welds. Shear stress at the joint is 75 N/mm^2. Determine the length of weld of the plates are subjected to a load of 50 kN. **(06 Marks)**

b. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.9 MPa. Assume joint efficiency of 75%. Allowable stress in tension for the plate is 83 MPa in compression 138 MPa and shear stress in rivets may be assumed as 55 MPa. Assume chain riveted joint. **(14 Marks)**

Module-5

9 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses:
$\sigma_t = 100\ N/mm^2,\ \sigma_C = 120\ N/mm^2,\ \tau = 60\ N/mm^2.$ **(10 Marks)**

b. A single threaded power screw of 25 m diameter with a pitch of 5 mm is used take a maximum load of 500 N. The coefficient of frictions are 0.05 for the collar and 0.08 for the screw. The frictional diameter of the collar is 30 mm. Find the torque required to raise and lower the load. Also find the efficiency of the power screw. **(10 Marks)**

OR

10 a. Explain self locking and overhaul in power screws. **(05 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double start. Load on the screw is 6 kN and the mean diameter of the trust collar is 40 mm. The co-efficient of friction for screw is 0.1 and for collar is 0.09. Determine
(i) Torque required to raise load.
(ii) Torque required to lower the load.
(iii) Overall efficiency
(iv) Is the screw self locking? **(15 Marks)**

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CBCS SCHEME

USN

18ME53

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. What are conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque? **(06 Marks)**

b. A slider crank mechanism with the following dimensions is acted upon by a Force F = 2 KN at B as shown in Fig. Q1 (b). OA = 100 mm, AB = 450 mm. Determine the input torque T on the link OA for the static equilibrium of the mechanism for the given configuration.

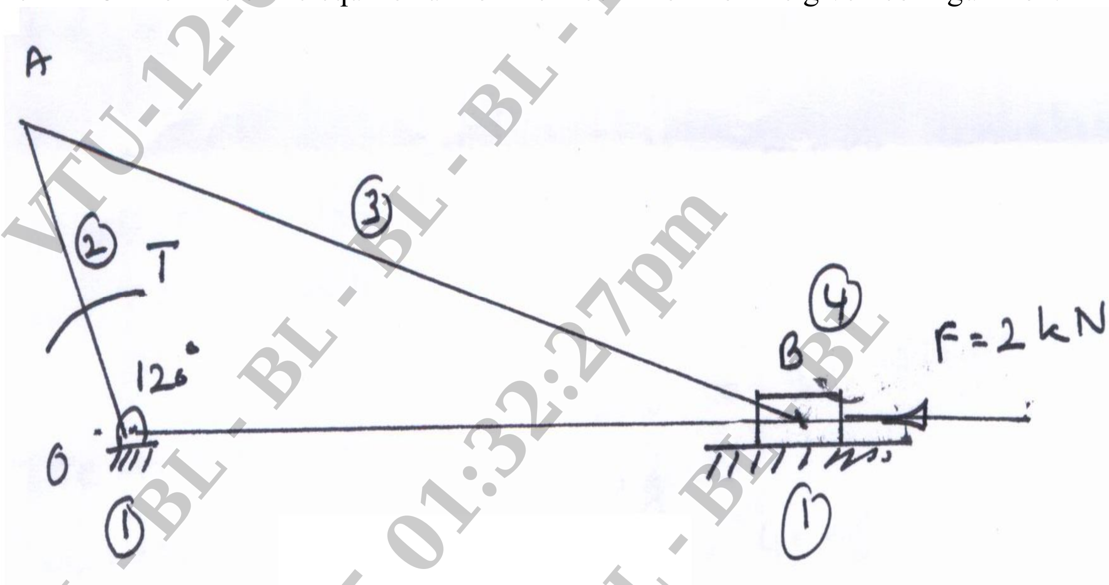

Fig. Q1 (b) **(14 Marks)**

OR

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

b. The Crank and connecting rod of a vertical petrol engine, running at 1800 rpm are 60 mm and 270 mm respectively. The diameter of the piston is 100 mm and the mass of the reciprocating part is 1.2 kg. During the expansion stroke when the crank has turned 20° from the top dead centre, the gas pressure is 650 KN/m^2. Determine the

(i) Net force on the piston

(ii) Net load on the gudgeon pin.

(iii) Thrust on the cylinder walls.

(iv) Speed at which the gudgeon pin load is reversed in direction. **(14 Marks)**

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-2

3 a. What is meant by static and dynamic unbalance in machinery? Why balancing is necessary for rotors of high speed engines. **(06 Marks)**

b. Three masses of 8 kg, 12 kg and 15 kg are attached at radial distance of 80 mm, 100 mm and 60 mm respectively to a disc on a shaft are in complete balance. Determine the angular position of the masses of 12 kg and 15 kg relative to 8 kg mass. **(14 Marks)**

OR

4 a. What do you mean by primary unbalance in reciprocating engine? **(05 Marks)**

b. The following data relate to a single cylinder reciprocating engine :
Mass of reciprocating part = 40 kg
Mass of revolving part = 30 kg at crank radius
Speed = 150 rpm,
Stroke = 350 mm
If 60% of the reciprocating parts and all the revolving parts are to be balanced,
Determine the
(i) Balance mass required at a radius of 320 mm
(ii) Unbalanced force when the crank has turned 45° from the top deed centre. **(15 Marks)**

Module-3

5 a. Explain the terms sensitiveness, hunting and stability relating to governor. **(06 Marks)**

b. Each arm of a porter governor is 250 mm long. The upper and lower arms are pivoted to the links at 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve mechanism is 40 N. Determine the range of speed of the grievance for the extreme radii of 125 mm and 150 mm **(14 Marks)**

OR

6 a. Explain the gyroscopic effect of steering pitching and rolling of ship moving in sea. **(06 Marks)**

b. An aeroplane makes a complete quarter circle of 40 m radius towards left when flying at 175 km/hr. The mass of rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. In what way is the effect changes when aeroplane turns towards right. **(14 Marks)**

Module-4

7 a. With a neat sketch, explain longitudinal vibration, transverse vibration, torsional vibration. **(10 Marks)**

7 b. Determine the equation of motion and natural frequency of the system shown in Fig. Q7 (b) using Newton's method. **(10 Marks)**

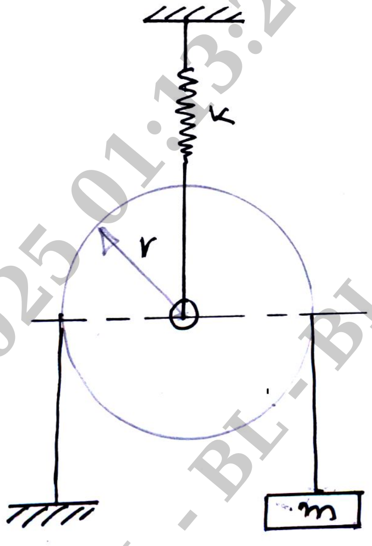

Fig.Q7 (b)

OR

8 a. Define Logarithmic decrement and derive the equation for same. **(10 Marks)**

b. A spring mass damper system has m = 3 kg K = 100 N/m, C = 3 N-S/m. Determine

- (i) Damping factor
- (ii) Natural frequency of damped vibration
- (iii) Logarithmic decrement
- (iv) The ratio of two successive amplitudes
- (v) Number of cycles after which the original amplitude is below 20%. **(10 Marks)**

Module-5

9 a. Define : (i) Magnification factor (ii) Critical speed of the shaft (iii) Vibration isolation (iv) Transmissibility ratio. **(10 Marks)**

b. A machine total mass 200 kg is supported on springs of total stiffness 1600 kN/m has unbalanced rotating element which results is a disturbing force 800 N at a speed of 3,000 rpm. Assuming $\xi = 0.2$. Determine

- (i) Amplitude of motion due to unbalanced and its phase angle.
- (ii) Transmissibility. **(10 Marks)**

OR

10 a. Obtain Natural frequency of free transverse vibration due to point load. **(10 Marks)**

b. A steel shaft simply supported in bearings 50 mm diameter and 1.5 m long carries a solid rotor of weight 1600 N at its centre, find its critical speed if E = 200 GN/m^2. **(10 Marks)**

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18ME54

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Turbo Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Compare turbo machines and positive displacement machines. **(06 Marks)**

b. Define the following for a trubomachine.
i) Flow coefficient ii) Power coefficient iii) Capacity coefficient **(06 Marks)**

c. A turbine model wolking under a head of 2m runs at 170 rpm and has a diameter of 1m. A prototype turbine develops 22 MW under a head of 250 m with a specific speed of 100. Calculate: i) Scale ratio ii) Power development by the model. **(08 Marks)**

OR

2 a. Define total to total, total-to-static, static-to-static and static-total efficiencies for power generator and power absolving turbo machine with the help of T-S diagram. **(10 Marks)**

b. Air flows through an air turbine where its stagnation pressure is decreasing in the ratio 5:1. Total to total efficiency is 0.8 and air flow rate is 5 Kg/s. The inlet total temperature is 280K. Calculate :
i) Actual power output
ii) Actual exit total temperature
iii) Actual exit static temperature if the exit flow velocity is 100 m/s and
iv) Total-to-static efficiency of the device. **(10 Marks)**

Module-2

3 a. Derive an expression for maximum utilization factor in an axial flow type :
i) Impulse turbine and ii) 50% Reaction turbine. Draw also the velocity triangles. **(10 Marks)**

b. In an radial inward flow turbine, the degree of reaction is 0.8 and utilization factor is 0.9. The tangential speeds of wheel at the inlet and outlet are 11m/s and 5.5 m/s. Draw the velocity triangle at inlet and outlet assuming radial velocity is constant and equal to 5 m/s. Flow is radial at exit. Find the power output for a volumetric flow rate 2 m^3 of water per second. **(10 Marks)**

OR

4 a. A radial outward flow machine has no inlet whirl. The blade speed at the exit is twice that at inlet. Radial velocity is constant throughout. Taking the inlet blade angle as 45 degree show that degree of action, $R = \frac{2+\cot\beta_2}{4}$. Where β_2 is the blade angle at exit with respect to tangential direction. **(10 Marks)**

b. The mean rotor blade speed of an axial flow turbine with 50% reaction is 210 m/s. Steam emerges from the nozzle inclined at 28º to the plane of wheel with axial component equal to blade speed. Assuming symmetrical inlet and outlet velocity triangle, find :
   i) Rotor blade angles
   ii) ii) Utilization factor. Find also
   iii) Degree of reaction to make the utilization factor maximum, if the axial velocity blade speeds as well as nozzle angle remains constant. **(10 Marks)**

Module-3

5 a. Define compounding. Explain any two types of compounding with a neat sketch, showing variations of pressure and velocity of the stream. **(10 Marks)**

b. Steam emerges from a nozzle to an impulse De-Laval turbine with a velocity of 1000m/s. The nozzle angle is 20º. The mean blade speed is 400 m/s. The blades are symmetrical. The mass flow rate of steam is 1000 Kg/hr. Friction factor is 0.8. Calculate the following – i) Blade angles ii) Axial thrust iii) Work done per Kg of steam iv) Power developed. **(10 Marks)**

OR

6 a. Derive the expression for maximum efficiency of impulse steam turbine and show that maximum efficiency is [$\cos^2 \alpha_1$]. **(10 Marks)**

b. The following data refers to a particular stage of a Parson's reaction turbine. Speed of the turbine = 1500 rpm. Mean diameter of rotor = 1m, Stage efficiency = 0.8, blade outlet angle = 20º. Speed ratio = 0.7. Determine the available isentropic enthalpy drop in the stage. **(10 Marks)**

Module-4

7 a. Derive an expression for maximum hydraulic efficiency of pelton wheel. **(10 Marks)**

b. A double jet pelton wheel is required to generate 7500 KW when the available head at the base of the nozzle is 400 m. The jet is deflected through 165º and the relative velocity of the jet is reduced by 15% in passing over the buckets. Determine the
i) Diameter of each jet ii) Total flow iii) Force exerted by the jets in the tangential direction. Assume generator efficiency is 95%, overall efficiency = 80% and speed ratio = 0.47. **(10 Marks)**

OR

8 a. Define the following :
i) Functions of draft tube ii) Hydraulic efficiency iii) Overall efficiency iv) Mechanical efficiency v) Volumetric efficiency. **(10 Marks)**

b. Following data are given for a Francis turbine net head = 60m, speed = 700 rpm, Power at the shaft = 294.3 KW, Overall efficiency = 84%, hydraulic efficiency = 93%, flow ratio = 0.2, width ratio = 0.1, outer diameter to inner diameter ratio = 2. Thickness of vane occupy 5% of circumference area of runner velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine :
i) Guide blade angle ii) Runner vane angles iii) diameter of runner at inlet and outlet iv) width of wheel at inlet. **(10 Marks)**

Module-5

9 a. Define :

i) Manometric efficiency

ii) Manometric head **(04 Marks)**

b. Derive an expression for minimum starting speed of pump. **(06 Marks)**

c. A centrifugal pump runs 950 rpm. its outer and inner diameter are 500 mm and 250 mm. The vanes are set back at 35º to the wheel rim. If the radial velocity of water through the impeller is constant at 4 m/s, find
i) vane angle at inlet ii) velocity of water at outlet iii) Direction of water at outlet and iv) work done per kg of water. Entry of water at inlet is radial. **(10 Marks)**

OR

10 a. Define :
i) Slip factor ii) Power input factor. **(04 Marks)**

b. Explain: i) Surging ii) Choking iii) Pre notation. **(06 Marks)**

c. A centrifugal compressor running at 6000 rpm having an impeller tip diameter of 101 cm has the following test data :

i) Mass flow rate = 25 Kg/s

ii) Static pressure ratio = 2.12

iii) Pressure at inlet = 100 KPa, temperature at inlet = 28ºC

iv) Mechanical efficiency = 0.97.

Find :

i) Slip coefficient

ii) Temperature of air at exit

iii) Power input

iv) Power coefficient **(10 Marks)**

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CBCS SCHEME

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18ME55

Fifth Semester B.E. Degree Examination, June/July 2024
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. Define Fluid Power System. Sketch and explain the structure of a hydraulic Control System **(08 Marks)**

b. State Pascals law. Explain the concept of force multiplication. **(08 Marks)**

c. A haydraulic press has a ram of 25cm diameter and a plunger of diameter 4cm. If a load of 40 kN is to be lifted, find the magnitude of the minimum force to be applied on the plunger to keep the 40 kN in balance. **(04 Marks)**

OR

2 a. What are the desirable properties of hydraulic fluid? Explain briefly any 8 of them. **(08 Marks)**

b. Define Seal. Explain briefly how hydraulic seals are classified. **(06 Marks)**

c. Explain the various filtering locations used in filtering the oil in hydraulic system **(06 Marks)**

Module-2

3 a. Explain with a neat sketch the working principle of an external gear pump. **(08 Marks)**

b. Explain pump theory of a positive displacement pump and what are the factors to be considered for selecting a hydraulic pump. **(08 Marks)**

c. A vane pump has a rotor of diameter 50mm, a cam ring of diameter 80mm and the vane width of 40mm. Compute the volumetric displacement if the eccentricity is 10mm. **(04 Marks)**

OR

4 a. Explain single acting and double acting hydraulic cylinder with diagram and their graphic symbol. **(08 Marks)**

b. With is an accumulator? Explain with a neat sketch the working principle of gas loaded accumulator with graphic symbol. **(06 Marks)**

c. A hydraulic motor has a volumetric displacement of 123 cm^3 operating at a pressure of 60 bar and speed 1800 rpm. If the actual flow rate consumed by the motor is 0.004 m^3/sec and the actual torque delivered by the motor is 100Nm. Find i) Volumetric efficiency ii) mechanical efficiency iii) overall efficiency. **(06 Marks)**

Module-3

5 a. Define control valves. Explain the classification of control valves. **(05 Marks)**

b. Explain the following valves with graphical symbol.
   i) Compound pressure relief valve
   ii) Pressure reducing valve
   iii) Shuttle valve **(15 Marks)**

OR

6 a. Explain the concept of meter-in and meter-out circuits. List the advantages and limitations of the circuit. **(10 Marks)**
b. What is regenerative circuit? Mention its applications. **(04 Marks)**
c. Explain with a neat sketch, sequencing circuits. **(06 Marks)**

Module-4

7 a. Explain with a neat sketch the working of pneumatic filter. **(06 Marks)**
b. List the characteristics of compressed air in pneumatic system. **(06 Marks)**
c. Explain with a neat sketch
i) Rodless cylinder ii) Impact cylinder. **(08 Marks)**

OR

8 a. Explain with a neat sketch with graphical system
i) Quick exhaust valve ii) Time delay valve iii) Twin pressure valve. **(15 Marks)**
b. Briefly explain cylinder cushioning. **(05 Marks)**

Module-5

9 a. Explain the following with truth table X symbol
i) OR gate ii) AND gate **(10 Marks)**
b. Explain the sequencing of two cylinders A and B using cascading method circuit for cylinder sequence A^+ B^+ B^- A^- **(10 Marks)**

OR

10 a. Explain the following pneumatic circuit
i) Supply air throttling ii) Exhaust air throttling **(10 Marks)**
b. Write short notes on the following :
i) Solenoid ii) Electromagnetic Relay **(10 Marks)**

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CBCS SCHEME

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18ME56

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. What is Operations Management? Identify the three major functional areas of business organizations and describe how they are interrelated. **(10 Marks)**

b. A firm manufactures two products A and B on which the profits earned per unit are Rs.3 and Rs.4 respectively. Each product is processed on two machines M_1 and M_2. Product A requires one minute of processing time on M_1 and two minutes on M_2. Product B requires one minute each on machine M_1 and M_2. Machine M_1 is available for not more than 7 hours 30 minutes per day, while machine M_2 is available for 10 hours per day. Find the number of units of products A and B to be manufactured to get maximum profit. Solve graphically. **(10 Marks)**

OR

2 a. What is productivity? List the various measures of productivity. **(04 Marks)**

b. What is decision making? Describe the steps in decision making. **(10 Marks)**

c. A firm of compiling the monthly of productivity report for its Board of Directors. From the following data, compute :

i) Labour productivity
ii) Machine productivity
iii) Mulit-factor productivity of rupees spent on labour, machine, materials and energy. The average labour rate is Rs. 15/hour, and the average machine usage rate is Rs.10/hour.

Units produced = 1,00,000
Labour hours = 10,000
Machine hours = 5,000
Cost of materials = Rs. 35,000
Cost of energy = Rs.15,000. **(06 Marks)**

Module-2

3 a. What is demand forecasting? What are the reasons for an organization to carry out demand forecasting? Give a broader classification of forecasting methods. **(08 Marks)**

b. The manager of a 'building construction materials' company has collected the demand data for a specific material (in tons) for the past eight periods. The demand for this material is based on the number of construction permits approved by the local authority.

Construction permits	15	9	40	20	25	25	15	35
Demand (tons)	6	4	16	6	13	9	10	16

i) Plot a graph of number of instruction permits vs demand and check for a linear relationship.
ii) Develop a regression model and forecast the demand when the number of construction permits given is 30 ; 45 ; 50. **(12 Marks)**

OR

4 a. Explain with suitable examples, the approaches used for qualitative forecasting. **(08 Marks)**

b. The manager of a large manufacturer of industrial pumps must choose between two alternative forecasting techniques. Both techniques have been used to prepare forecasts for a six months period. Using MAD and MAPD as criteria, which technique has the better performance record? Compute also the tracking signal for both the forecasting techniques and offer your comments.

Month	Demand (units)	Forecast (units)	
		Technique – 1	Technique – 2
1	492	488	492
2	470	484	482
3	485	480	478
4	493	490	488
5	498	497	492
6	492	493	493

(12 Marks)

Module-3

5 a. Explain the following terms with example :

i) Design capacity

ii) System capacity. **(04 Marks)**

b. Describe the factors that determine effective capacity. **(06 Marks)**

c. An auto component manufacturer has plan of buying hydraulic forging machines that can produce 170,000 good parts/year. These machines will be a part of a product line. The system efficiency of the product line is 85%.

i) What is the required system capacity?

ii) Assume that it takes 100 seconds to forge each part and the plant operates 2000 hours/year. If the machines will be utilized only 60% of the time and are 90% efficient, what is the actual output of machines/hour?

iii) How many forging machines would be required? **(10 Marks)**

OR

6 a. With neat sketches, explain :

i) Product layout

ii) Fixed position layout. **(06 Marks)**

b. List the factors affecting location decisions. **(04 Marks)**

c. Potential locations A, B and C have the cost structure shown in the table for a product expected to sell at Rs. 130.

Potential location	Fixed cost per year Rs.	Variable cost/unit Rs.
A	150,000	75
B	200,000	50
C	400,000	25

i) Find the most economic location for an expected volume of output of 6000 units/year

ii) What is the expected profit, if the selected site is used?

iii) For what output range each location is suitable? **(10 Marks)**

Module-4

7 a. With suitable sketches, explain :
i) Level production strategy
ii) Chase strategy of aggregate planning. **(06 Marks)**

b. A company would like to prepare an aggregate plan for the next four periods. Given the following information, set up the problem in a transportation table and solve for the minimum cost plan.

Regular time cost = Rs.20/unit

Overtime cost = Rs.25/unit

Subcontracting cost = Rs.28/unit

Inventory carrying cost = Rs.3/unit/period

Beginning inventory = 300 units.

Period	Expected demand	Regular time capacity	Overtime capacity	Subcontract capacity
1	900	1000	100	500
2	1500	1200	150	500
3	1600	1300	200	500
4	3000	1300	200	500

(14 Marks)

OR

8 a. Explain the master scheduling process (the inputs and outputs). **(08 Marks)**

b. The following information is available regarding a product :

Capacity, units/month — Cost, Rs./unit

RT = 50 — RT = 20

OT = 10 — OT = 26

Inventory carrying/month = 3 , SC = Rs 29.

Develop an economic production plan for the following demand :

Month	1	2	3	4	5	6	7	8	9	10	11	12
Demand units	10	12	15	40	130	200	100	40	30	20	40	10

(12 Marks)

Module-5

9 a. With a neat block (flow) diagram, explain the inputs and outputs of a Material Requirement Planning (MRP). **(06 Marks)**

b. Use the information given in the Fig.Q9(b) (product structure tree) and determine the quantities of B, C, D, E and F needed to assemble one X.
Taking into account the on-hand inventory of various components given below determine the quantity of these components required to assemble 10 Xs.

On hand inventory :

Component	On-hand, units
B	4
C	10
D	8
E	60

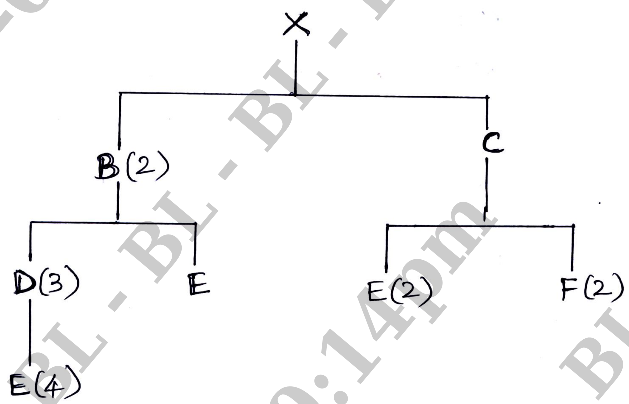

Fig.Q9(b) **(08 Marks)**

c. Complete the following MRP matrix for an item X. Determine when orders should be released? What is the on-hand inventory at the end of the last period?

Item : X Lead time : 2 weeks	Period							
Lot size : minimum 50 units	1	2	3	4	5	6	7	8
Gross requirements	25	30	56	25	100	40	30	20
Scheduled receipts		50						
Projected on–hand 30								
Net requirements								
Planned order receipts								
Planned order releases								

(06 Marks)

OR

10 a. What is purchasing? Explain in brief the factors to be considered while selecting a supplier (or vendor) **(10 Marks)**

b. Explain why Supply Chain Management has become an import aspect for most organizations. **(10 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **21ME51**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Theory of Machines

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. Define Kinematic pair and explain different types of kinematic pairs. **(08 Marks)**

b. In a 4 bar mechanism, the dimensions of links are AB = 50 mm, BC = 66 mm, CD = 56 mm and AD = 100 mm. At the instant when the angle DAB = 60°, the link AB has an angular velocity of 10.5 rad/s in counter clockwise direction. Determine,
(i) Linear velocity at point C. (ii) Velocity of point E on BC, when BE = 40 m,
(iii) Angular velocity of links BC and CD. **(12 Marks)**

OR

2 a. What is Coriolis component of acceleration? Explain with neat sketch. **(08 Marks)**

b. In an IC engine mechanism, crank radius is 50 mm and connecting rod length is 200 mm. The crank rotates at 100 rad/s in clockwise direction. At a particular instant, the crank is at 40° from TDC position. For this position, find the velocity of the piston using complex algebra method. **(12 Marks)**

Module-2

3 a. State the condition of equilibrium of a body subjected to a system of,
(i) 2 force
(ii) 3 force. **(06 Marks)**

b. Link O_4C of a four bar mechanism C shown in Fig.Q3 (b) is subjected to a torque T_4 = 1 Nm in counter clockwise direction. The link BC is subjected to a force Q = 45 N downwards. Determine the torque T_2 on link O_2B and the reactions at O_2 and O_4. The lengths of the links are as follows :
O_2O_4 = 90 mm, O_2B = 50 mm, BC = 55 mm, O_4C = 30 mm, BD = BC = 27.5 mm.

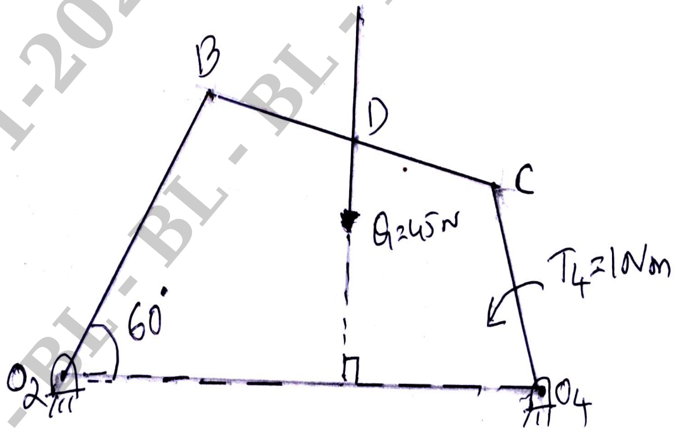

Fig. Q3 (b) **(14 Marks)**

OR

4 a. Explain D'Alembert's principle for dynamic force analysis. **(06 Marks)**

b. The slider crank mechanism of a single cylinder diesel engine is shown in Fig.Q4 (b). A gas force 17800 N acts to the left through piston C. The crank rotates counter clockwise direction at a constant speed of 1800 rpm.
Determine the force F_{14} on the piston for the following details :
$O_2B = 75$ mm, $O_2G_2 = 50$ mm, $BC = 280$ mm, $BG_3 = 125$ mm
$m_2 = 2.25$ kg, $m_3 = 3.65$ kg, $m_4 = 2.75$ kg, $I_2 = 0.0055$ kg.m^2, $I_3 = 0.041$ kg.m^2 **(14 Marks)**

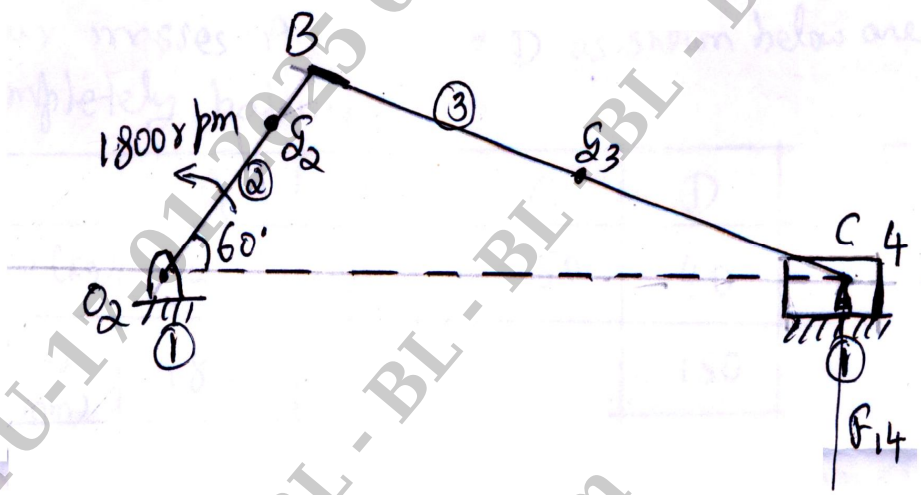

Fig. Q4 (b)

Module-3

5 a. Derive an expression for length of path of contact and length of arc of contact for a pair of involute gears in contact. **(08 Marks)**

b. Two mating gears with module pitch of 6.5 mm have 19 and 47 teeth of 20° pressure angle and 6.5 mm addenda. Determine the number of pairs of teeth in contact and the angle turned through by the larger wheel for one pair of teeth in contact. **(12 Marks)**

OR

6 a. Explain with neat sketch, classification of gear trains. **(08 Marks)**

b. The arm of an epicycle gear train rotates at 100 rpm in anticlockwise direction. The arm carries two wheels A and B having 36 and 45 teeth respectively. The wheel A is fixed and the arm rotates about the centre of wheel A. Find the speed of wheel B. What will be the speed of B, if the wheel A instead of being fixed, makes 200 rpm clockwise. **(12 Marks)**

Module-4

7 a. Explain static and dynamic balancing of rotating masses. **(08 Marks)**

b. Four masses A, B, C and D as shown below are completely balanced.

	A	B	C	D
Mass(kg)	-	30	50	40
Radius (mm)	180	240	120	150

The planes containing masses B and C are 300 mm apart. The angle between planes containing B and C is 90°, B and C make angles of 210° and 120° respectively with D is same sense. Find :

(i) The magnitude and the angular position of mass A.

(ii) The position of planes A and D. **(12 Marks)**

OR

8 a. Explain primary and secondary balancing as used for balancing of reciprocating masses. **(08 Marks)**

b. The cranks and connecting rods of a 4 cylinder in-line engine running at 1800 rpm and 60 mm and 240 mm respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 15 kg. Determine unbalanced primary and secondary forces and couples, if any, with reference to central plane of the engine. **(12 Marks)**

Module-5

9 a. Explain the different methods used to get the solution for longitudinal vibration. **(12 Marks)**

b. A vibrating system consists of a mass of 30 kg, a spring of stiffness 20 kN/m and a damper of damping factor 0.25. Calculate :

(i) The critical damping co-efficient.
(ii) The natural frequency of damped vibrations.
(iii) The logarithmic decrement and
(iv) The ratio of two successive amplitudes. **(08 Marks)**

OR

10 a. Derive an expression for magnification factor for a damped forced vibrations. **(12 Marks)**

b. An industrial machine of mass 450 kg is supported on springs with a statistical deflection of 5 mm. If the machine has a rotating unbalance of 0.25 kg m, determine,

(i) The force transmitted to the floor at 1200 rpm.
(ii) The dynamical amplitude at this speed. **(08 Marks)**

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CBCS SCHEME

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21ME52

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Thermo Fluids Engineering

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain Morse test. **(06 Marks)**

b. A test on 3 cylinder, 4 stroke IC engine with 22 cm bore and 26 cm stroke. The following observations were made during trial period of 1 hour.
Fuel consumption = 8 kg
Air consumption = 300 kg
Ambient temperature = 30°C
Calorific value of fuel = 45000 kJ/kg
Net load on the brake = 1.5 kN
Brake drum diameter = 1.8 m
Rope diameter = 3 cm
Mass of cooling water = 550 kg
Inlet and exit temperature of cooling water = 27°C and 55°C
Total revolution of crank = 12000
MEP = 6 bar
Exhaust gas temperature = 310°C
Specific heat of exhaust gas = 1.1 kJ/kg
Calculate mechanical efficiency. Draw heat balance sheet in kJ/min. **(14 Marks)**

OR

2 a. Define with respect to a compressor:
(i) Isothermal efficiency (ii) Adiabatic efficiency (iii) Mechanical efficiency
(iv) Overall efficiency (v) Volumetric efficiency **(10 Marks)**

b. A single-cylinder reciprocating air compressor has a bore of 120 mm and stroke of 150 mm and is driven at a speed of 1200 rpm. It is compressing air from a pressure of 120 kPa and temperature of 20°C, to a temperature of 215°C. Assuming polytropic compression with n = 1.3, no clearance and volumetric efficiency of 100%, calculate:
(i) Pressure ratio
(ii) Indicated power
(iii) Shaft power with mechanical efficiency of 80%
(iv) Volume flow rate **(10 Marks)**

Module-2

3 a. With a neat sketch, explain vapour absorption refrigeration. **(08 Marks)**

b. A simple R-12 plant is to develop 5 tonnes of refrigeration. The condenser and evaporator temperature are 40°C and −10°C respectively. Determine:
(i) Refrigerant flow rate in kg/s (ii) Volume flow rate in m^3/s
(iii) Compressor exit temperature (iv) Pressure ratio
(v) Heat rejected to condenser in KW (vi) COP **(12 Marks)**

OR

4 a. Define dry bulb temperature, wet bulb temperature, specific humidity, relative humidity. **(04 Marks)**

b. With a neat sketch, explain winter air conditioning system with process on psychometric graph. **(06 Marks)**

c. For a hall to be air conditioned, the following conditions are given:
Outdoor conditions = 40°C DBT, 20°C WBT
Required comfort condition = 20°C DBT, 60% RH
Seating capacity of hall = 1500
Amount of outdoor air supplied = 0.3 m^3/min per person
If the required condition is achieved first by adiabatic humidification and then by cooling, estimate, the capacity of cooling coil and the capacity of humidifier. **(10 Marks)**

Module-3

5 a. Define turbomachine. With neat sketch, explain its different parts. **(06 Marks)**

b. Define degree of reaction and utilization factor. **(04 Marks)**

c. The velocity of steam outflow from a nozzle in delaval turbine is 1200 m/s. The nozzle angle is 22° and rotor blades are equiangular. Assuming relative velocity of fluid at inlet and exit are equal. The tangential speed of rotor is 400 m/s. Compute:
(i) The blade angles at inlet and exit
(ii) Power output in KW if mass flow rate is 1 kg/s
(iii) Utilization factor **(10 Marks)**

OR

6 a. Differentiate between turbomachine and positive displacement machine. **(08 Marks)**

b. With a neat sketch, explain the construction and working of internal gear pump. **(08 Marks)**

c. Define slip, slip coefficient and negative slip. **(04 Marks)**

Module-4

7 a. With a neat sketch, explain the parts of Pelton wheel. Also draw its velocity triangles. **(08 Marks)**

b. Explain the need of draft tube. **(02 Marks)**

c. A Kaplan turbine working under a head of 20 m develops 1172 KW shaft power. The outer diameter of the runner is 3.5 m and hub diameter is 1.75 m. The guide blade angle at the extreme edge of the runner is 35°. The hydraulic and overall efficiency of the turbine are 88% and 84% respectively. If the velocity of whirl is zero at outlet. Find:
(i) Runner vane angles at inlet and outlet
(ii) Speed of the turbine **(10 Marks)**

OR

8 a. Explain the following with mathematical expression:
(i) Manometric efficiency
(ii) Static head
(iii) Volumetric efficiency
(iv) Manometric head **(08 Marks)**

b. Derive expression for minimum starting speed of centrifugal pump. **(06 Marks)**

c. The outer diameter of the impeller of centrifugal pump is 40 cm and width of the impeller at outlet is 5 cm. The pump is running at 800 rpm and working against a total head of 1.5 m. The vane angle at outlet is 40° and manometric efficiency is 75%. Find:
(i) Velocity of flow at outlet
(ii) Velocity of water leaving the vane
(iii) Blade speed at outlet **(06 Marks)**

Module-5

9 a. Explain with the help of schematic diagram, velocity compounding and pressure compounding steam turbine. **(08 Marks)**

b. Dry saturate steam at 10 bar is supplied to a single rotor impulse wheel, the condenser pressure being 0.5 bar. The nozzle efficiency 0.94 and nozzle angle at rotor inlet is 18° to the wheel plane. The rotor blades which move at a speed of 450 m/s are equiangular. If the coefficient of velocity for the rotor blades is 0.92, find power output/unit mass flow rotor and rotor efficiency. **(12 Marks)**

OR

10 a. Explain the surging phenomena in compressor with the help of characteristic curve. **(05 Marks)**

b. Explain reaction staging in steam turbines. **(05 Marks)**

c. Draw the velocity triangle for an axial flow compressor and show that $E = UV_m[\tan\upsilon_1 - \tan\upsilon_2]$ and $R = \frac{V_m}{2U}[\tan\upsilon_1 + \tan\upsilon_2]$. **(10 Marks)**

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CBCS SCHEME

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Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Finite Element Analysis

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. **(10 Marks)**

b. With an example, explain node numbering scheme and node location system. **(10 Marks)**

OR

2 a. Explain simplex, complex and multiplex elements with examples. **(10 Marks)**

b. Determine the displacement at the nodes for spring mass system shown in Fig Q2(b), using principle of minimum potential energy. Take $F_1 = 60$ N, $F_2 = 50$ N. **(10 Marks)**

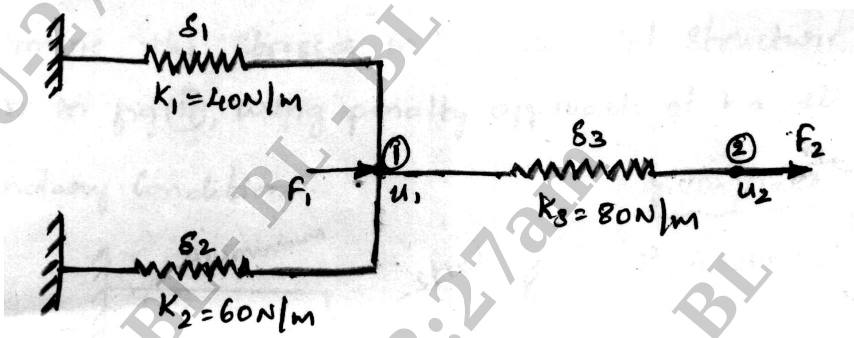


Fig Q2(b)

Module-2

3 a. Derive the elemental stiffness matrix for 1D bar element. **(10 Marks)**

b. For the two bar truss shown in Fig Q3(b), determine the nodal displacement and stress in element 1, Take, $E = 2 \times 10^5$ N/mm^2, $A = 200$ mm^2.

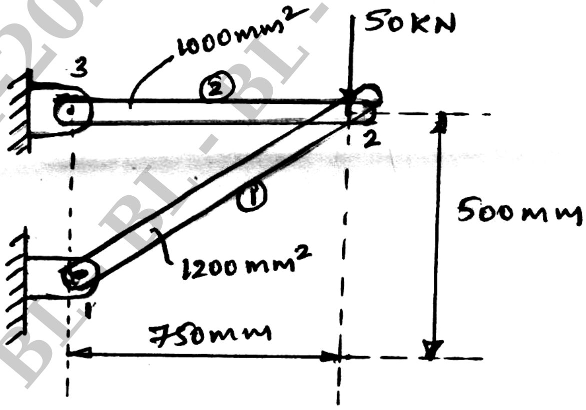
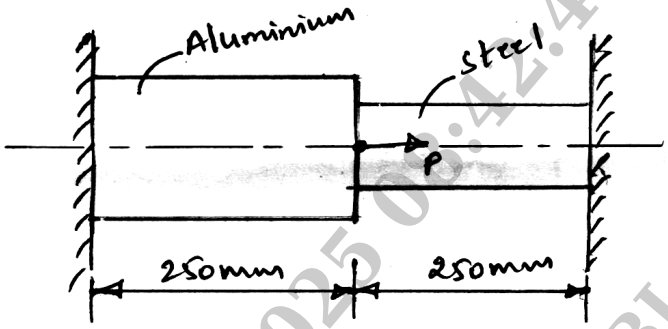


Fig Q3(b) **(10 Marks)**

OR

4 Determine the stresses in members of structure given below in Fig Q4, using penalty approach of handling boundary conditions.



Given/Take

P = 4000 N
A_1 = 1600 mm^2
A_2 = 800 mm^2
E_{Al} = 80 GPa
E_{steel} = 210 GPa

Fig Q4

(20 Marks)

Module-3

5 a. Derive Hermite shape function for beam element. **(10 Marks)**

b. Fig Q5(b), shows a simply supported beam subjected to a uniformly distributed load. Obtain the maximum deflection. Take E = 200 GPa, I = 2 × 10^6 mm^4.

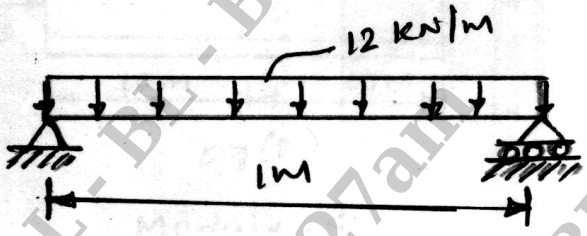


Fig Q5(b) **(10 Marks)**

OR

6 a. Derive stiffness matrix for torsion of shaft. **(10 Marks)**

b. A bar of circular cross section having a diameter of 50 mm is firmly fixed at its ends and subjected to a torque at B and C as shown in Fig Q6(b). Determine maximum angle of twist and shear stress. Take G = 7 × 10^4 N/mm^2 and E = 2 × 10^5 N/mm^2.

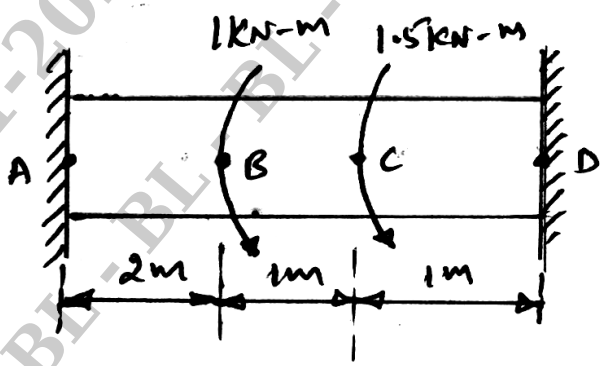


Fig Q6(b) **(10 Marks)**

Module-4

7 Determine the temperature distribution in the composite wall using 1D heat element, use penalty approach of handing boundary condition.
Take : K_1 = 25 W/mºC, K_2 = 35 W/mºC, K_3 = 55 W/mºC, h = 30 W/m^2 ºC, T_∞ = 900ºC, A = 1m^2.

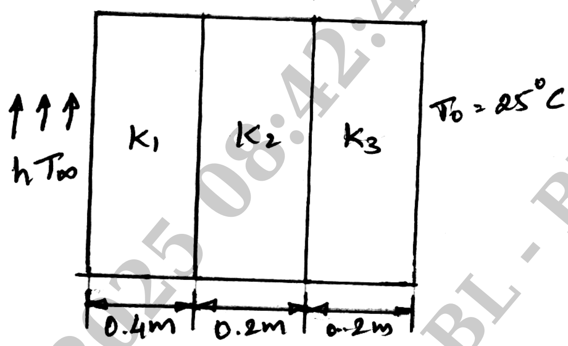


Fig Q7 **(20 Marks)**

OR

8 For the smooth pipe shown in Fig Q8, with uniform c/s of 1 m^2, determine the flow velocities at the centre and right end, knowing the velocity at the left is V_x = 2 m/s.

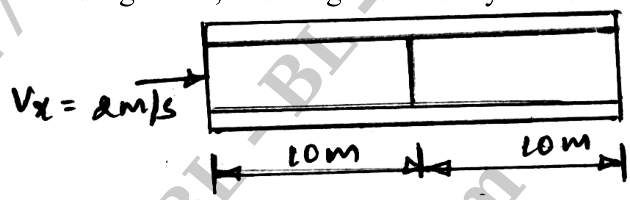


Fig Q8 **(20 Marks)**

Module-5

9 a. Derive stiffness matrix of axi-symmetric bodies with triangular elements. **(10 Marks)**

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

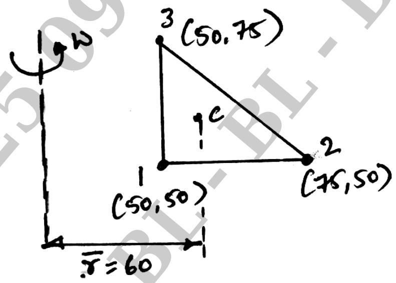


Fig Q9(b) **(10 Marks)**

OR

10 a. Derive an equation for lumped mass matrix for 1D bar element. **(10 Marks)**

b. Determine the natural frequency of vibration of the cantilever beam shown in Fig Q10(b). Take E = 200 GPa, ρ = 7840 Kg/m^3, I = 2000 mm^4, A = 240 mm^2. **(10 Marks)**

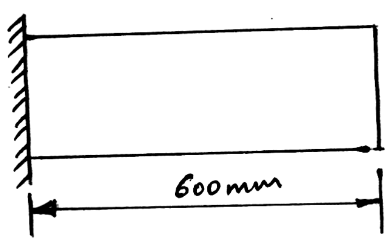


Fig Q10(b)

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CBCS SCHEME

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21ME54

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Modern Mobility and Automotive Mechanics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Write a note on the history of Automobile. **(10 Marks)**
b. Explain the main components of internal combustion engine, with neat sketch. **(10 Marks)**

OR

2 a. Explain the four main components of automobile. **(10 Marks)**
b. Write notes on: (i) Hybrid engine (ii) Modern Gt engine **(10 Marks)**

Module-2

3 a. With a neat sketch, explain the Cone Clutch in detail. **(10 Marks)**
b. Write the five differences between Gear Shifting mechanism and automatic transmission. **(10 Marks)**

OR

4 a. Explain the leaf spring and coil spring with neat sketch. **(10 Marks)**
b. Explain the requirement of good clutch and function of the clutch. **(10 Marks)**

Module-3

5 a. Explain the Ackermann principle of steering with neat sketch. **(10 Marks)**
b. With neat sketch explain Worm and Wheel Steering Gear, with neat sketch. **(10 Marks)**

OR

6 a. Explain in detail EPS (Electronic Power Steering). **(10 Marks)**
b. Write the comparison between disc and drum brakes. **(10 Marks)**

Module-4

7 a. Write a note on History of Emission Norms in India. **(10 Marks)**
b. Explain the fuel quality standards of petrol and diesel. **(10 Marks)**

OR

8 a. What are the various environmental management systems for automotive vehicles? **(10 Marks)**
b. Write a short note on Fuel Additives. **(10 Marks)**

Module-5

9 a. Explain the Electrical Components of an EV system with block diagram. **(10 Marks)**
b. With neat sketch, explain Front Wheel drive and rear wheel drive in EV vehicle. **(10 Marks)**

OR

10 a. Explain the working of lead acid battery with neat sketch. **(10 Marks)**
b. Write a note on Battery Charging in EV system. **(10 Marks)**

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CBCS SCHEME

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BME/BSA/BMT/BAG501

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Industrial Management and Entrepreneurship

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define Management. Describe its key functions.	10	L1	CO1
	b.	Explain the modern management approaches.	10	L2	CO1
		OR			
Q.2	a.	Explain the steps involved in the decision – making process.	10	L2	CO1
	b.	Differentiate between Strategic and Tactical planning.	10	L2	CO1
		Module – 2			
Q.3	a.	What is the purpose of Organization? Compare the functional type with line type organizational structure.	10	L3	CO2
	b.	Explain how each stage of staffing process contributes to the overall effectiveness of staffing.	10	L2	CO2
		OR			
Q.4	a.	Explain the role of communication in achieving effective coordination.	10	L2	CO2
	b.	Explain the various monitoring techniques used in a sound controlling.	10	L2	CO2
		Module – 3			
Q.5	a.	Describe the qualities of an Entrepreneur.	10	L1	CO2
	b.	What are the barriers of Entrepreneurship?	10	L1	CO2
		OR			
Q.6	a.	Differentiate between Entrepreneur and Intrapreneur.	10	L2	CO2
	b.	Explain the various stages of Entrepreneurship processes.	10	L2	CO2
		Module – 4			
Q.7	a.	What are the characteristics of Small Scale Industries?	10	L1	CO3
	b.	Explain the impact of Liberalization , Privatization and Globalization on Small Scale Industries (SSI's).	10	L2	CO3
		OR			
Q.8	a.	Compare General Agreement on Traffs and Trade (GATT) with World Trade Organization (WTO) in International trade.	10	L2	CO3

	b.	What are the steps involved in starting a Small Scale Industries?	**10**	**L1**	**CO3**
Module – 5					
Q.9	**a.**	Explain the role of District Industries Centres (DIC's).	**10**	**L2**	**CO3**
	b.	Write about NSIC (National Small Industries Corporation).	**10**	**L2**	**CO3**
OR					
Q.10	**a.**	Write about Project Formulation Process.	**10**	**L2**	**CO3**
	b.	Write about selection of project.	**10**	**L2**	**CO3**

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CBCS SCHEME

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BME502

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define Turbo machine and explain parts of turbomachine with neat sketch.	7	L1	CO1
	b.	What is specific speed of a pump? Derive an expression for the same?	6	L2	CO1
	c.	Tests on a turbine runner 1.25 m in diameter at 30 m head gave the following results : Power developed 736 kW, Speed 180 rpm, Discharge 2.7 m^3/s. Find the diameter, speed and discharge of a runner to operate at 45 m head and gave 1472 kW power at the same efficiency. What is the specific speed of both the turbines?	7	L3	CO1
		OR			
Q.2	a.	With reference to expansion process, define the following and write the corresponding relations: (i) Total-to-Total efficiency. (ii) Static-to-Static efficiency.	4	L1	CO1
	b.	Show that for a compressor polytropic efficiency is given by, $\eta_P = \dfrac{\frac{x-1}{x}\ln\left[\frac{P_2}{P_1}\right]}{\ln\left[\frac{T_2}{T_1}\right]}$ Where P_1 and P_2 are pressure at inlet and outlet of compressor respectively. Where as T_1, T_2 are temperatures at inlet and outlet of compressor respectively.	8	L2	CO1
	c.	A 9 stage centrifugal compressor has overall stage pressure ratio 2.82. Air enters the compressor at 1 bar and 15°C. The efficiency of the compressor is 88%. Determine the following : (i) Pressure ratio of each stage (ii) Polytropic efficiency (iii) Preheat factor	8	L3	CO1
		Module – 2			
Q.3	a.	Derive an alternate form of Euler's turbine equation and explain the significance of each energy components.	8	L2	CO2
	b.	For an axial flow compressor, show that $R = \dfrac{V_f}{2U}\left[\dfrac{\tan\beta_1 + \tan\beta_2}{\tan\beta_1 \times \tan\beta_2}\right]$ Where V_f velocity of flow, U-blade speed β_1, β_2 are blade angles at inlet and outlet respectively.	7	L2	CO2
	c.	The velocity of steam in a Delavar turbine at the inlet is 1200 m/s. The nozzle angle at the inlet is 22° and rotor blades are equiangular. Assume relative velocities of the steam at inlet and outlet to be equal and tangential speed of the rotor is 400 m/s. Determine (i) Blade angles at inlet and outlet. (ii) Power developed if mass flow rate is 1 kg/s.	5	L3	CO2

		OR			
Q.4	**a.**	Show that maximum utilization factor, where ϕ is the speed ratio, α_1 is Guide angle at inlet. $\in_{max} = \frac{2\phi\cos\alpha_1}{1+2R\phi\cos\alpha_1}$.	**8**	**L2**	**CO2**
	b.	Define utilization factor and degree of reaction also show that utilization factor, $\in = \frac{V_1^2 - V_2^2}{V_1^2 - RV_2^2}$?	**7**	**L2**	**CO2**
	c.	The impeller of a centrifugal pump has an outer diameter of 1.5 m. It lifty water at a rate of 2000 kg/s. The blade is making an angle of 145° with the direction of motion at outlet and the speed being 300 rpm. Radial velocity of flow is 3 m/s. Find the power required to drive the impeller.	**5**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	What is compounding? Name different methods of compounding and explain with neat sketch any one of the method of compounding.	**6**	**L1**	**CO3**
	b.	Prove that in 50% reaction turbine maximum blade efficiency, $\eta_{b\,max} = \frac{2\cos^2\alpha_1}{1+\cos^2\alpha_1}$ Where α_1 is nozzle exit angle.	**7**	**L2**	**CO3**
	c.	A signle stage impulse turbine has diameter of 1.5 m and running at 3000 rpm. The nozzle angle is 20°. Speed ratio is 0.45. Ratio of relative velocity at the outlet to that at inlet is 0.9. The outlet angle of blade is 3° less than inlet angle. Steam flow rate is 6 kg/s. Draw the velocity diagrams and find the following : (i) Blade angle (ii) Power developed (iii) Axial thrust	**7**	**L3**	**CO3**
		OR			
Q.6	**a.**	In a Curtis stage with two rows of moving blades, the rotors are equiangular. The first rotor has an angle of 29° each while second rotor has an angle of 32° each. The velocity of steam at the exit of nozzle is 530 m/s and blade coefficients are 0.9 in the first, 0.95 in the stator and in the second rotor. If the absolute velocity at the stage exit should be axial, find (i) Mean blade speed (ii) The rotor efficiency (iii) Power output for a flow rate of 32 kg/s.	**9**	**L3**	**CO3**
	b.	Define the following terms related to reaction steam turbine and write their relations : (i) Blade efficiency (ii) Stage efficiency	**4**	**L1**	**CO3**
	c.	The following data refers to a stage of reaction turbine: Rotor diameter = 1.5 m, Speed ratio = 0.72, Outlet blade angle 20°, Rotor speed = 3000 rpm, Determine (i) Blade efficiency (ii) Percentage increase in blade efficiency and the rotor speed, if the rotor is designed to run at the best theoretical speed.	**7**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With reference to Hydraulic turbines, define (i) Hydraulic efficiency (ii) Mechanical efficiency (iii) Overall efficiency (iv) Volumetric efficiency.	**4**	**L1**	**CO4**

	b.	Show that maximum hydraulic efficiency in a Pelton wheel $\eta_{H\max} = \frac{1 + C_b \cos\beta_2}{2}$. Where C_b – blade velocity coefficient and β_2 is blade angle at exist.	7	L2	CO4
	c.	A Pelton turbine has a water supply of 5 m^3/s at a head of 256 m and runs at 500 rpm. Assume a turbine efficiency of 0.85, a coefficient of velocity for nozzle as 0.985 and a speed ratio of 0.46. Calculate (i) Power output (ii) Specific speed (iii) Number of Jets (iv) Jet diameter (v) Diameter of wheel (vi) Number of cups (vii) Cup dimensions.	9	L3	CO4
		OR			
Q.8	a.	Explain the construction and working of Kaplan turbine with neat sketch.	6	L1	CO4
	b.	The following data is given for a Francis turbine. Net head = 70 m, Speed – 600 rpm, Shaft power = 370 kW, $\eta_C = 0.80$, $\eta_H = 0.95$, flow ratio = 0.25, Breadth ratio = 0.1, Outer diameter of the runner is = 2 times inner diameter of runner. The thickness of vanes occupy 10% of circumferential area of the runner. Velocity of flow is constant and discharge is radial at outlet? Determine (i) Guide blade angle. (ii) Runner angle at inlet and outlet. (iii) Diameter of the runner at inlet and outlet. (iv) Width of the wheel at inlet.	7	L3	CO4
	c.	Define draft tube efficiency. Derive an expression for inlet pressure head of draft tube and its efficiency.	7	L2	CO4
		Module – 5			
Q.9	a.	Define the following terminologies related to centrifugal pump : (i) Suction head (ii) Delivery head (iii) Static head (iv) Manometric head (v) Manometric efficiency (vi) Mechanical efficiency. (vii) Overall efficiency.	7	L1	CO5
	b.	Derive an expression for H-Q characteristic curve for a centrifugal pump. Discuss the H-Q curve for forward, radial and backward curved vanes.	8	L2	CO5
	c.	A single stage centrifugal pump with a impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3/s water to a height of 30 m with a manometric efficiency of 75%. Find the number of stages and diameter of each impeller of a multistage pump to lift 5 m^3/s of water to a height of 200 m when rotating at 1500 rpm.	5	L3	CO5
		OR			
Q.10	a.	With neat sketch, explain slip, slip coefficient and slip factor.	6	L1	CO5
	b.	Explain the phenomenon of surging and stalling.	4	L1	CO5

	c.	A single sided centrifugal air compressor running at a speed of 16500 rpm produced a pressure ratio of 4 : 1. The hub diameter at the eye of the compressor is 16 cm. Inlet of air to the rotor is axial and equal to 120 m/s. The stagnation temperature and pressure at inlet are 25°C and 1 bar. The mass flow rate is 8.3 kg/s and the total head isentropic efficiency is 78%. The pressure coefficient is 0.7. Determine (i) Eye tip diameter (ii) Blade angle at eye root and eye tip. (iii) Impeller tip diameter. (iv) Shaft power input to the compressor if the mechanical efficiency is 97%.	**10**	**L3**	**CO5**

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CBCS SCHEME

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BME503

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Theory of Machines

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define : (i) Kinematic link (ii) Kinematic pair (iii) Kinematic chain (iv) Mechanism (v) Machine.	10	L1	CO1
	b.	Briefly explain the following inversions : (i) Beam engine (ii) Watt's straight line mechanism	10	L1	CO1
		OR			
Q.2	a.	In a slider crank mechanism, the crank OB = 30 mm and connecting rod BC = 120 mm. The crank rotates at a uniform speed of 300 rpm clockwise. For the crank position as shown in Fig. Q2 (a) ; find (i) Velocity of Piston C and angular velocity of connecting rod BC (ii) Acceleeration of piston C and angular acceleration of connecting rod BC.	10	L3	CO1

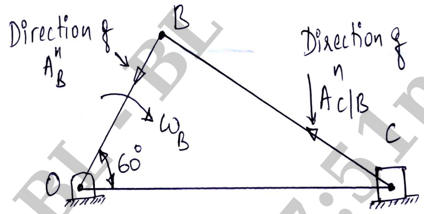


Fig. Q2 (a)

			M	L	C
	b.	If the crank and connecting rod are 150 mm and 600 mm long respectively and the crank rotates at a uniform speed of 100 rpm closckwise; determine the angular velocity and angular acceleration of connecting rod and velocity of the piston by using Raven's approach. The angle which the crank makes with the inner dead center is 30°.	10	L3	CO1
		Module – 2			
Q.3	a.	With a neat sketch, explain the following : (i) Equillibrium of Three force members (ii) Equillibrium of Four force members.	10	L1	CO2
	b.	For a slider crank mechanism as shown in Fig. Q3 (b), the force applied to the piston is 1000 N when the crank is at 60° from IDC. Given AB = 100 mm and BC = 300 mm. Calculate the driving torque T_2.	10	L3	CO2

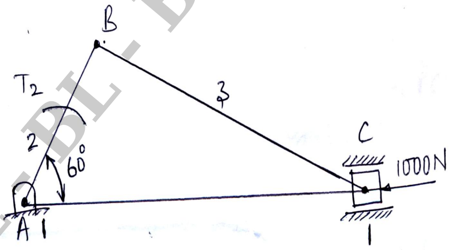
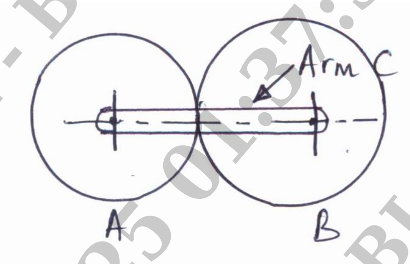
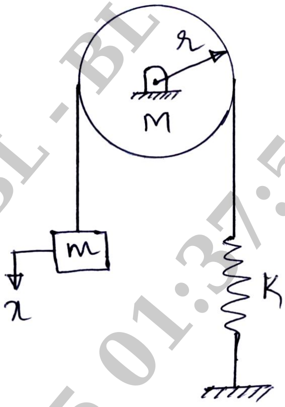


Fig. Q3 (b)

		OR			
Q.4	**a.**	Explain : (i) Dynamic force analysis. (ii) D'Alembert's principle.	**10**	**L1**	**CO2**
	b.	A punching machine punches 38 mm holes in 32 mm thick plate requires 7 N-m/mm^2 of sheared area and punches one hole in every 10 sec. The mean speed is of the flywheel given is 25 m/sec. The punch has a stroke of 100 mm. Find : (i) Power required to drive the machine. (ii) Mass of the flywheel, if total fluctuation of speed is not to exceed 3%.	**10**	**L3**	**CO2**
		Module – 3			
Q.5	**a.**	Define the following gear terminologies : (i) Pitch circle. (ii) Pitch circle diameter. (iii) Addendum (iv) Dedendum (v) Module.	**10**	**L1**	**CO3**
	b.	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact and length of arc of contact.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	Derive with usual notations ; an expression for velocity ratio of compound gear trains.	**10**	**L2**	**CO3**
	b.	In an Epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in anticlockwise direction about centre of gear A which is fixed as shown in Fig. Q6 (b); then determine speed of gear B. If the gear A instead of being fixed makes 300 rpm in clockwise direction, what will be the speed of gear B? Use Tabular method.  Fig. Q6 (b)	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	A shaft carries 4 masses A, B, C, D in parallel planes in this order along its length. The masses at B and C are 18 kg and 12.5 kg respectively. Each of B and C has an eccentricity of 60 mm. The masses at A and D have an eccentricity of 80 mm. The angle between B and C is 100° and in between B and A is 190°, both being measured in same direction. The axial distance between A and B is 100 mm and in between B and C is 200 mm. For the shaft to be in complete balance, determine magnitude of masses at A and D as well as the angular position of mass at D.	**10**	**L3**	**CO4**
	b.	A four cylinder vertical engine has cranks 150 mm long. The planes of rotation of the 1st, 2nd and 4th cranks are 400 mm, 200 mm and 200 mm respectively from 3rd crank and their reciprocating masses are 50 kg, 60 kg and 50 kg respectively. Find the mass of the reciprocating parts of 3rd cylinder and relative angular positions of the cranks in order that the engine may be in complete primary balance.	**10**	**L3**	**CO4**

		OR			
Q.8	**a.**	Define the following terminologies : (i) Sensitiveness (ii) Stability (iii) Hunting (iv) Effort (v) Power.	**10**	**L1**	**CO4**
	b.	A Porter governor has equal arms each of 250 mm long and pivoted on the axis of rotation. Each flyball has a mass of 5 kg and the mass of central sleeve is 15 kg. The radius of rotation of the flyball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the minimum, maximum speeds and the range of speed of the governor.	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Define the following types of vibrations : (i) Free vibration. (ii) Forced vibration (iii) Damped vibration. (iv) Undamped vibration (v) Longitudinal vibration.	**10**	**L1**	**CO5**
	b.	Determine the natural frequency of the spring mass pulley system as shown in Fig. Q9 (b).  Fig. Q9 (b)	**10**	**L3**	**CO5**
		OR			
Q.10		Explain the following : **a.** Rotating unbalance. **b.** Reciprocating unbalance. **c.** Vibration isolation **d.** Critical speed.	**20**	**L2**	**CO5**

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CBCS SCHEME

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BME515D

Fifth Semester B.E./B.Tech.Degree Examination, Dec.2024/Jan.2025
Energy Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Briefly explain the various steps involved in coal handling.	**10**	**L3**	**CO1**
	b.	Explain the working principle of Benson boiler with a neat sketch.	**10**	**L3**	**CO1**
		OR			
Q.2	**a.**	Draw the layout of a diesel power plant.	**10**	**L3**	**CO1**
	b.	List and explain the different methods of starting a diesel engine.	**10**	**L3**	**CO1**
		Module – 2			
Q.3	**a.**	Explain the solar radiation incident on the earth's surface.	**10**	**L3**	**CO2**
	b.	With the help of neat sketch, explain the method of extraction of solar energy from solar ponds.	**10**	**L3**	**CO2**
		OR			
Q.4	**a.**	Explain the working of floating drum biogas plant with a neat sketch.	**10**	**L3**	**CO3**
	b.	Explain the working of down draft gasifier with a neat sketch.	**10**	**L3**	**CO3**
		Module – 3			
Q.5	**a.**	With a neat sketch, explain the working of Hot dry rock geothermal plant.	**10**	**L3**	**CO3**
	b.	With a neat sketch, explain double basin arrangement of harnessing of tidal energy.	**10**	**L3**	**CO3**
		OR			
Q.6	**a.**	With a block diagram, explain the basic components of wind energy conversion system.	**10**	**L3**	**CO3**
	b.	With a neat sketch, explain horizontal axis and vertical axis wind machines.	**10**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	With a neat sketch, explain pumped storage hydroelectric power plant.	**10**	**L3**	**CO3**
	b.	The runoff data of a river at a particular site is tabulated below :	**10**	**L4**	**CO3**

Month	Mean discharge per month (millions of m^3)
January	40
February	25
March	20
April	10
May	0
June	50
July	75
August	100
September	110
October	60
November	50
December	40

(i) Draw a hydrograph and find the mean flow.
(ii) Also draw the flow duration curve.
(iii) Find the power in MW available at mean flow if the head available is 80 m and overall efficiency of generation is 85%. Take each month of 30 days.

		OR			
Q.8	**a.**	With a neat sketch, explain closed Rankine cycle OTEC system.	**10**	**L3**	**CO2**
	b.	List the problems associated with Ocean Thermal Energy Conversion (OTEC).	**4**	**L2**	**CO2**
	c.	Explain the following terms related to hydroelectric power plant: (i) Pen stock (ii) Draft tube	**6**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Explain the principle of release of nuclear energy by fusion and fission reactions.	**10**	**L3**	**CO3**
	b.	Explain with a neat sketch, the general components of a nuclear reactor.	**10**	**L3**	**CO3**
		OR			
Q.10	**a.**	With a neat sketch, explain the working of Pressurized Water Reactor (PWR).	**10**	**L3**	**CO3**
	b.	Explain the following : (i) Reactor shielding (ii) Radio active waste disposal.	**10**	**L3**	**CO3**

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18ME54

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Turbo Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Compare turbo machines and positive displacement machines. **(06 Marks)**

b. Define the following for a trubomachine.
i) Flow coefficient ii) Power coefficient iii) Capacity coefficient **(06 Marks)**

c. A turbine model wolking under a head of 2m runs at 170 rpm and has a diameter of 1m. A prototype turbine develops 22 MW under a head of 250 m with a specific speed of 100. Calculate: i) Scale ratio ii) Power development by the model. **(08 Marks)**

OR

2 a. Define total to total, total-to-static, static-to-static and static-total efficiencies for power generator and power absolving turbo machine with the help of T-S diagram. **(10 Marks)**

b. Air flows through an air turbine where its stagnation pressure is decreasing in the ratio 5:1. Total to total efficiency is 0.8 and air flow rate is 5 Kg/s. The inlet total temperature is 280K. Calculate :
i) Actual power output
ii) Actual exit total temperature
iii) Actual exit static temperature if the exit flow velocity is 100 m/s and
iv) Total-to-static efficiency of the device. **(10 Marks)**

Module-2

3 a. Derive an expression for maximum utilization factor in an axial flow type :
i) Impulse turbine and ii) 50% Reaction turbine. Draw also the velocity triangles. **(10 Marks)**

b. In an radial inward flow turbine, the degree of reaction is 0.8 and utilization factor is 0.9. The tangential speeds of wheel at the inlet and outlet are 11m/s and 5.5 m/s. Draw the velocity triangle at inlet and outlet assuming radial velocity is constant and equal to 5 m/s. Flow is radial at exit. Find the power output for a volumetric flow rate 2 m^3 of water per second. **(10 Marks)**

OR

4 a. A radial outward flow machine has no inlet whirl. The blade speed at the exit is twice that at inlet. Radial velocity is constant throughout. Taking the inlet blade angle as 45 degree show that degree of action, $R = \frac{2+\cot\beta_2}{4}$. Where β_2 is the blade angle at exit with respect to tangential direction. **(10 Marks)**

b. The mean rotor blade speed of an axial flow turbine with 50% reaction is 210 m/s. Steam emerges from the nozzle inclined at 28º to the plane of wheel with axial component equal to blade speed. Assuming symmetrical inlet and outlet velocity triangle, find :
   i) Rotor blade angles
   ii) ii) Utilization factor. Find also
   iii) Degree of reaction to make the utilization factor maximum, if the axial velocity blade speeds as well as nozzle angle remains constant. **(10 Marks)**

Module-3

5 a. Define compounding. Explain any two types of compounding with a neat sketch, showing variations of pressure and velocity of the stream. **(10 Marks)**

b. Steam emerges from a nozzle to an impulse De-Laval turbine with a velocity of 1000m/s. The nozzle angle is 20º. The mean blade speed is 400 m/s. The blades are symmetrical. The mass flow rate of steam is 1000 Kg/hr. Friction factor is 0.8. Calculate the following – i) Blade angles ii) Axial thrust iii) Work done per Kg of steam iv) Power developed. **(10 Marks)**

OR

6 a. Derive the expression for maximum efficiency of impulse steam turbine and show that maximum efficiency is [$\cos^2 \alpha_1$]. **(10 Marks)**

b. The following data refers to a particular stage of a Parson's reaction turbine.
Speed of the turbine = 1500 rpm. Mean diameter of rotor = 1m, Stage efficiency = 0.8, blade outlet angle = 20º. Speed ratio = 0.7. Determine the available isentropic enthalpy drop in the stage. **(10 Marks)**

Module-4

7 a. Derive an expression for maximum hydraulic efficiency of pelton wheel. **(10 Marks)**

b. A double jet pelton wheel is required to generate 7500 KW when the available head at the base of the nozzle is 400 m. The jet is deflected through 165º and the relative velocity of the jet is reduced by 15% in passing over the buckets. Determine the
i) Diameter of each jet ii) Total flow iii) Force exerted by the jets in the tangential direction. Assume generator efficiency is 95%, overall efficiency = 80% and speed ratio = 0.47. **(10 Marks)**

OR

8 a. Define the following :
i) Functions of draft tube ii) Hydraulic efficiency iii) Overall efficiency iv) Mechanical efficiency v) Volumetric efficiency. **(10 Marks)**

b. Following data are given for a Francis turbine net head = 60m, speed = 700 rpm, Power at the shaft = 294.3 KW, Overall efficiency = 84%, hydraulic efficiency = 93%, flow ratio = 0.2, width ratio = 0.1, outer diameter to inner diameter ratio = 2. Thickness of vane occupy 5% of circumference area of runner velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine :
i) Guide blade angle ii) Runner vane angles iii) diameter of runner at inlet and outlet iv) width of wheel at inlet. **(10 Marks)**

Module-5

9 a. Define :
   i) Manometric efficiency
   ii) Manometric head **(04 Marks)**

b. Derive an expression for minimum starting speed of pump. **(06 Marks)**

c. A centrifugal pump runs 950 rpm. its outer and inner diameter are 500 mm and 250 mm. The vanes are set back at 35º to the wheel rim. If the radial velocity of water through the impeller is constant at 4 m/s, find
i) vane angle at inlet ii) velocity of water at outlet iii) Direction of water at outlet and iv) work done per kg of water. Entry of water at inlet is radial. **(10 Marks)**

OR

10 a. Define :
i) Slip factor ii) Power input factor. **(04 Marks)**

b. Explain: i) Surging ii) Choking iii) Pre notation. **(06 Marks)**

c. A centrifugal compressor running at 6000 rpm having an impeller tip diameter of 101 cm has the following test data :
   i) Mass flow rate = 25 Kg/s
   ii) Static pressure ratio = 2.12
   iii) Pressure at inlet = 100 KPa, temperature at inlet = 28ºC
   iv) Mechanical efficiency = 0.97.

Find :
   i) Slip coefficient
   ii) Temperature of air at exit
   iii) Power input
   iv) Power coefficient **(10 Marks)**

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Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025

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 different steps involved in Finite Element Analysis. **(08 Marks)**

b. State the principle of minimum potential energy. Using principle of minimum potential energy, determine the nodal displacements for the spring system shown in the Fig.Q.1(b). Take F_1 = 75 N and F_2 = 100 N. **(12 Marks)**

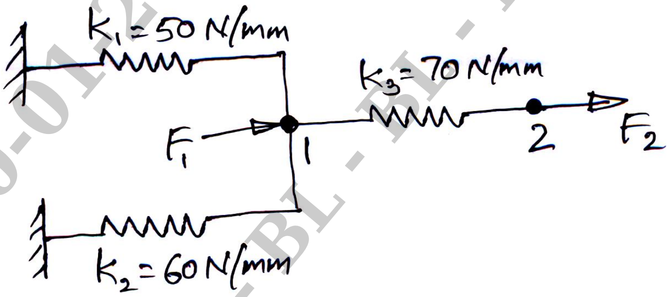


Fig.Q.1(b)

OR

2 a. Briefly explain the node numbering scheme in finite element analysis. **(06 Marks)**

b. Use Rayleigh-Ritz method to find stress at mid point of a bar shown in the Fig.Q.2(b). Take E = 70 GPa, A = 100 mm^2. Assume the displacement model to be a second order polynomial. **(14 Marks)**

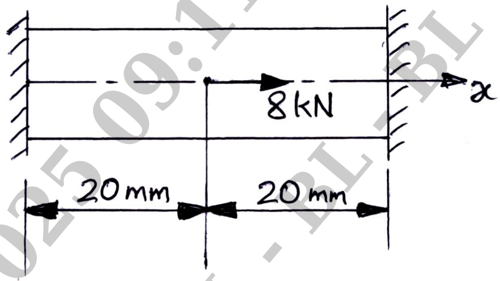


Fig.Q.2(b)

Module-2

3 a. Derive the shape functions for Constant Strain Triangular (CST) element in global coordinates. **(08 Marks)**

b. Fig.Q.3(b) shows a one dimensional bar subjected to an axial load. Taking it as a two bar element, determine the nodal displacements. Take E = 200 GPa and A = 10^4 mm^2. **(12 Marks)**

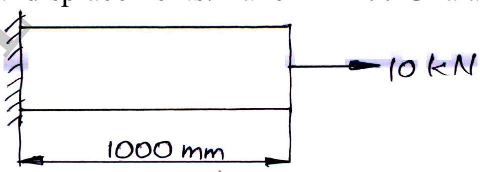


Fig.Q.3(b)

OR

4 a. Derive the shape functions for an isoparametric linear bar element in natural coordinate system. **(06 Marks)**

b. Determine the nodal displacements and stresses in each element for the two bar truss shown in the Fig.Q.4(b). **(14 Marks)**

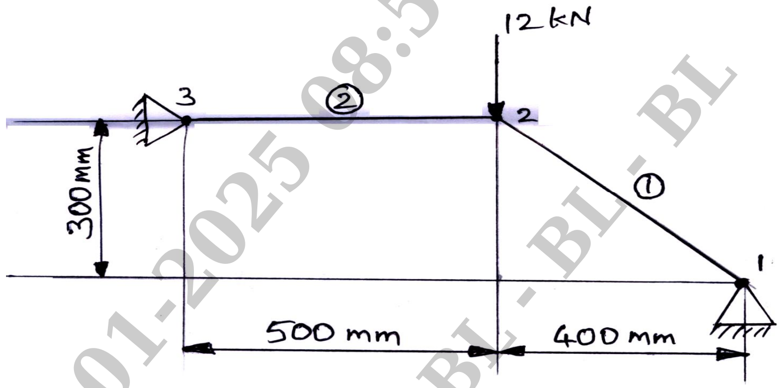


Fig.Q.4(b)

Module-3

5 a. Derive the elemental stiffness matrix for a beam element. **(10 Marks)**

b. For the beam element shown in Fig.Q.5(b) determine deflection under the given load. Take $E = 2 \times 10^5$ N/mm^2 and $I = 4 \times 10^{-6}$ m^4. **(10 Marks)**

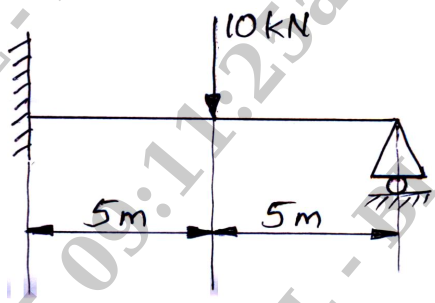


Fig.Q.5(b)

OR

6 a. Derive the shape function of a shaft element under pure torsion. **(06 Marks)**

b. Determine the angle of twist at the free end of a shaft subjected to a torque of 100 kN-m as shown in the Fig.Q.6(b). Given G = 80 GPa. Also determine the angle of twist at the center. **(14 Marks)**

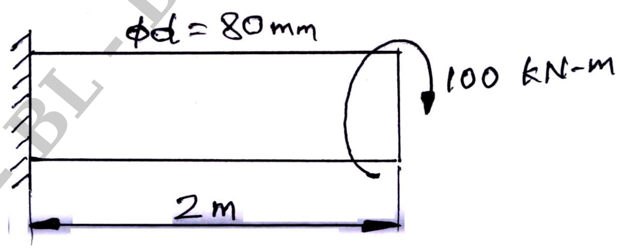


Fig.Q.6(b)

Module-4

7 a. Explain the rate equations for three modes of heat transfer. **(06 Marks)**

b. Find the temperature distribution in the one dimensional fin shown in Fig.Q.7(b).

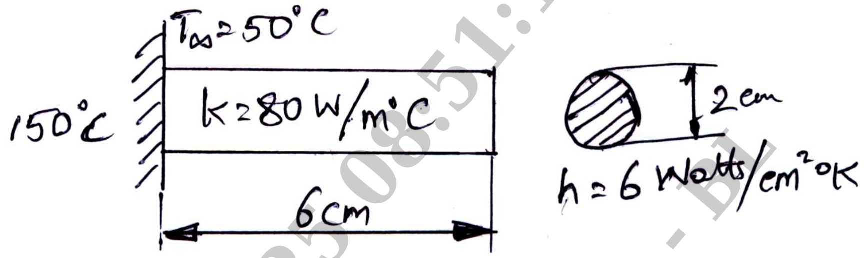


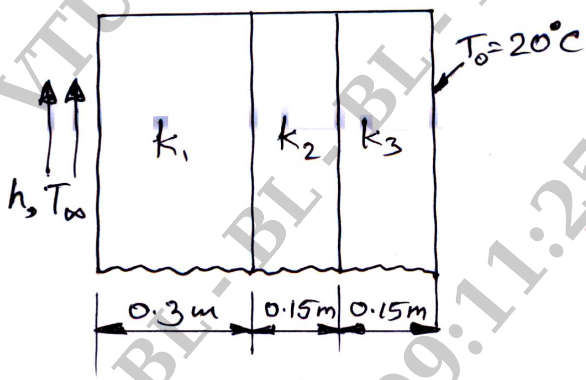
Fig.Q.7(b)

(14 Marks)

OR

8 a. Derive element conductivity matrix, element convection matrix and element heat flux vector for a two noded one dimensional fin. **(08 Marks)**

b. Solve for temperature distribution in the composite wall shown in the Fig.Q.8(b). Use penalty approach of handling boundary conditions. **(12 Marks)**



$K_1 = 20$ W/m°C
$K_2 = 30$ W/m°C
$K_3 = 50$ W/m°C
$h = 25$ W/m^2°C
$T_\infty = 800$°C

Fig.Q.8(b)

Module-5

9 a. Derive the stiffness matrix for an axisymmetric element using potential energy approach. **(10 Marks)**

b. Derive lumped mass matrix and consistent mass matrix for a bar element. **(10 Marks)**

OR

10 a. Calculate the eigen values and eigen vectors for the matrix $[A]=\begin{bmatrix} 8 & 1 \\ 1 & 2 \end{bmatrix}$. **(10 Marks)**

b. Derive the shape function for an axisymmetric triangular element. **(10 Marks)**

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18ME62

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025

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. Assume suitable missing data.

Module-1

1 a. A helical spring is made from a 8 mm diameter wire and has an outer diameter of 100 mm. if the permissible shear stress is 420 MPa and modulus of rigidity is 84 GPa. Find the axial load the spring can carry and the deflection per active turn :
(i) Neglecting curvature effect.
(ii) Considering curvature effect. **(10 Marks)**

b. A semi elliptical laminated leaf spring with two full length leaves and ten graduated leaves are to be designed to support a central load of 6 KN over two points 1000 mm apart. The central band width is 100 mm. The ratio of total depth of the spring to its width is 2.5. The design normal stress (pre-stress) of the material of the leaves is 400 MPa and the modulus of elasticity is 208 GPa. Determine,
(i) Width and thickness of the leaves.
(ii) The initial gap between full length and graduated leaves.
(iii) The central bolt load **(10 Marks)**

OR

2 a. A belt 125 mm wide and 10 mm thick is transmiting power at 900 m/min. The net driving tension is 2 times the tension on slack side. If safe permissible stress on the belt is 1.5 MPa. Calculate the power that can be transmitted at this speed. Take density of belt material as 1000 kg/m^3. Also find the maximum power that can be transmitted by this belt and the velocity at which this can be transmitted. **(10 Marks)**

b. A 8×19 steel wire rope is to hoist 50 KN of load from a depth of 1000 m. Determine the number of ropes required if the maximum speed is 2.5 m/s and acceleration is 1.25 m/sec^2 assuming the rope is made of 25 mm diameter. Neglect the weight of the tackle. **(10 Marks)**

Module-2

3 a. Derive the Lewis equation for the beam strength of a spur gear tooth. Also list the assumptions made. **(04 Marks)**

b. Specify the details of a spur gear to transmit 20 kW at 120 rpm. The teeth are of 20° full depth involute system having 16 teeth on pinion and a speed ratio of 3 : 1. Assume that the starting torque is 20% more than the mean torque. Both gears are made of steel C45, untreated with $\sigma_d = 233.4$ MPa and BHN 200. **(16 Marks)**

OR

4 a. Define formative number of teeth in helical gears and derive the expression for the same. **(04 Marks)**

b. A compressor running at 350 rpm is driven by a 120 kW motor running at 1400 rpm. The center distance is 400 mm and helix angle is 25°. The motor pinion is made of forged steel and the driven gear is cast steel. Design the gear pair using 20° FDI system. The pinion has 20 teeth. **(16 Marks)**

Module-3

5 A pair of 20° pressure angle bevel gears is used to transmit power between two perpendicular shafts. The pinion rotates at 600 rpm with a module of 8 mm and has 30 teeth while gear has 60 teeth. If both gears are made of steel having design strength of 200 MPa, determine the power that can be transmitted based on,

(i) Bending strength,

(ii) Surface endurance strength if Fen = 1.25 Fd.

Assume 8 to 10 hours service per day with medium shocks and $\hat{en}$ =350 MPa. **(20 Marks)**

OR

6 Design a worm gear drive for a speed reduction ratio of 25. The pinion rotates at 600 rpm and transmits 35 kW. Worm is made of C30 heat treated steel $(\sigma_{d_1} = 220.6\ \text{MPa})$ and gear of phosphor bronze $(\sigma_{d_2} = 82.4\ \text{MPa})$ **(20 Marks)**

Module-4

7 a. A multiple disc clutch of steel on bronze category is to tranmit 4 kN at 750 rpm. The inner diameter of contact is 80 mm and the outer diameter of contact is 140 mm. The clutch operates in oil with a co-efficient of friction of 0.1. The average allowable maximum pressure is 0.35 MPa. Assume uniform wear theory and determine,

(i) Number of steel and bronze discs.

(ii) Axial force required. **(10 Marks)**

b. A cone clutch transmits 180 N-m of torque at 1200 rpm. The larger diameter of the clutch is 300 mm and face angle of the cone is 12.5° with a face width of 60 mm and μ = 0.2. Determine

(i) Axial force required to transmit the torque.

(ii) Axial force required to engage the clutch.

(iii) Average normal pressure when maximum torque is transmitted.

(iv) Maximum and minimum normal pressures. **(10 Marks)**

OR

8 a. A cast iron disc of 0.9 m in diameter and 200 mm thick is used as a fly wheel which rotates at 400 rpm. It is brought to rest in 2.2 sec by means of a brake. Calculate

(i) Energy absorbed by the brake.

(ii) Torque capacity of the brake.

(iii) Number of turns. Take density of CI as 7200 kg/m^3 and radius of gyration = 0.125 m. **(10 Marks)**

b. A simple band brake as shown in Fig.Q8 (b) is to be designed to absorb a power of 30 kN at a rated speed of 750 rpm. Determine
  (i) The effort required to stop clockwise rotation of the brake drum.
  (ii) The effort required to stop counter clockwise rotation of the brake drum.
  (iii) The dimensions of the rectangular cross-section of the brake lever assuming its depth to be twice the width.
  (iv) The dimensions of the cross section of the band assuming its width to be ten times the thickness. **(10 Marks)**

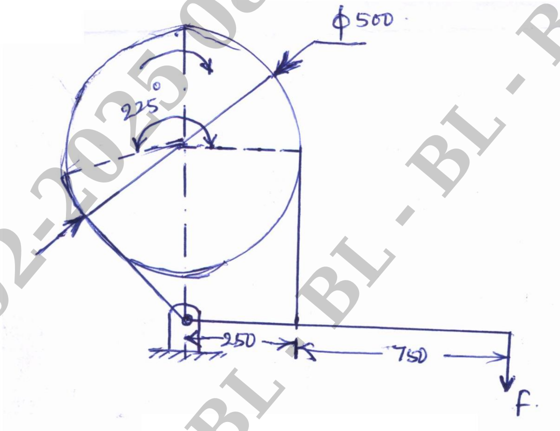

Fig. Q8 (b)

Module-5

9 a. Derive Petroff's equation for a lightly loaded bearing. **(06 Marks)**

b. Explain the formation of continuous oil film in Journal bearing. **(04 Marks)**

c. A full Journal bearing of diameter 80 mm and 120 mm long supports a radial load of 6000 N. The shaft rotates at 600 rpm and r/c = 1000. The room temperature is 30 $^{\circ}$C and the surface of the bearing is limited to 60 $^{\circ}$C. Determine the viscosity of the oil to satisfy the above requirements if the bearing is well ventilated and if no artificial cooling is required. Also determine the temperature of the oil. **(10 Marks)**

OR

10 a. Define the following :
  (i) Static load
  (ii) Dynamic load
  (iii) Bearing life
  (iv) Rating life **(06 Marks)**

b. What change in the loading of Rolling contact bearing will cause the expected life to be doubled? Derive the condition. **(04 Marks)**

c. A bell bearing is operating on a work cycle consisting of three parts namely Radial load of 2500 N at 1420 rpm for one quarter cycle, radial load of 1000 N at 710 rpm for one half cycle, radial load of 5000 N at 1420 rpm for remaining cycle. The expected bearing life is 10,000 hrs. Calculate the dynamic load capacity of the bearing. **(10 Marks)**

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CBCS SCHEME

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18ME63

Sixth Semester B.E. Degree Examination, June/July 2024
Heat Transfer

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain with suitable sketches, the 1st, 2nd and 3rd kind of boundary conditions. **(06 Marks)**

b. Explain briefly:
(i) Thermal conductivity
(ii) Thermal diffusivity
(iii) Thermal contact resistance **(06 Marks)**

c. A mild steel tank of wall thickness 20 mm is used to store water at 95°C. Thermal conductivity of mild steel is 45 W/m-°C, and the heat transfer coefficient inside and outside the tank are 2850 W/m^2-°C and 10 W/m^2-°C respectively. If the surrounding air temperature is 20°C, calculate the rate of heat transfer per unit area of the tank. **(08 Marks)**

OR

2 a. Derive an equation for critical thickness of insulation in cylinder. **(06 Marks)**

b. A small spherical vessel of outside diameter 60 mm is covered with as asbestos (K = 0.1105 W/m-K) and left in the atmospheric air at 30°C. The film coefficient between air and asbestos is 5 W/m^2-K. If it is desired to maximize the heat transfer rate from the contents of the vessel to the air, determine the thickness of asbestos cover needed and also the rate of heat flow at this thickness if the surface the vessel to be maintained at 120°C. **(06 Marks)**

c. An insulated steam pipe having outside diameter of 30 mm is to be covered with two layers of insulation each having a thickness of 25 mm. The average thermal conductivity of one material is 5 times that of the other. Assuming that the inner and outer surface temperatures of composite insulation are fixed, how much will the heat transfer be reduced when the better conducting material is next to the pipe than it is outer layer? **(08 Marks)**

Module-2

3 a. Derive the expression for temperature distribution and rate of heat transfer from a fin when its end is insulated. **(10 Marks)**

b. A handle of a ladle used for pouring molten lead at 327°C is 30 cm long and is made of 2.5 cm × 1.5 cm mild steel bar stock (K = 43 W/m-K). In order to reduce the grip temperature, it is proposed to make a hallow handle of mild steel plate 1.5 mm thick to the same rectangular shape. If the surface heat transfer coefficient is 14.5 W/m^2-K and the ambient temperature is 27°C, estimate the reduction in the temperature of the grip. Neglect the heat transfer from the inner surface of the hallow shape. **(10 Marks)**

OR

4 a. Derive the expression for temperature distribution and heat flow using lumped parameter analysis in transient heat conduction. **(10 Marks)**

b. A 50 mm thick iron plate [K = 60 W/m-K, ρ = 7350 kg/m^3, C_p = 460 J/kg-K] is initially at 225°C. Suddenly the plate is immersed in a fluid medium maintaining at a uniform temperature of 25°C with a surface heat transfer coefficient of 500 W/m^2-K. Calculate:
(i) The temperature at the centre of the plate 2 minutes after the start of cooling
(ii) Temperature at a depth of 10 mm from plate surface 2 minutes after the start of cooling
(iii) Temperature at the plate surface 2 minutes after the start of cooling
(iv) The energy removed from the plate per m^2 during this time. **(10 Marks)**

Module-3

5 a. Explain implicit and explicit method for discretization of 1-dimensional transient heat conduction problem. **(08 Marks)**

b. An iron rod L = 5 cm long of diameter D = 2 cm with thermal conductivity K = 50 W/(m-°C) protrudes from a wall and is exposed to an ambient at T_∞ = 20°C and h = 100 W/(m^2-°C). The base of the rod is at T_0 = 320°C and its tip is insulated. Assuming 1-D steady state heat flow, calculate the temperature distribution along the rod and the rate of heat flow into the ambient by using finite differences method.

Assume the initial guess for temperature as 200°C and the length of the fin is divided into 5 equal parts. **(12 Marks)**

OR

6 a. Define and explain the following:
(i) Kirchoff's law
(ii) Stefan Boltzman law
(iii) Wein's displacement law **(06 Marks)**

b. A furnace wall emits radiation at 2000 K. Treating it as black body radiation, calculate:
(i) Manochromatic radiant flux density at 1 μm wave length
(ii) Wavelength at which emission is maximum and the corresponding emissive power
(iii) Total emissive power **(06 Marks)**

c. Emissivities of two large parallel plates maintained at 800°C and 300°C are 0.3 and 0.5 respectively. Find the net radiant heat exchange per m^2 for these plates. Find the percentage reduction in heat transfer when a polished aluminium radiation shield of emissivity 0.06 is placed between them. Also find the temperature of the shield. **(08 Marks)**

Module-4

7 a. Explain with neat sketches: (i) Velocity boundary layer (ii) Thermal boundary layer **(06 Marks)**

b. Atmospheric air at 300 K flow with a velocity of 5 m/s, along a flat plate of length 1m long. The plate has a width of 0.5 m. The total drag force acting on the plate is determined to be 18×10^{-3} N. By using the Reynold's-Colburn analogy, estimate the average heat transfer coefficient for flow of air over the plate. **(06 Marks)**

c. Water flows with a mean velocity of 2 m/s inside a circular pipe of inside diameter 5 cm. The pipe is considered to be a smooth pipe and its wall is maintained at a uniform temperature of 100°C by condensing steam on its outer surface. At a location where the fluid is hydrodynamically and thermally developed, the bulk mean temperature of water is 60°C. Calculate the heat transfer coefficient by using:
(i) Dittus-Boelter equation
(ii) Sieder-Tate equation **(08 Marks)**

OR

8 a. Explain the physical significance of the following dimensionless numbers:
(i) Reynold's number (ii) Prandtl number
(iii) Nusselt number (iv) Grashof number **(08 Marks)**

b. Consider a square plate 0.5 m by 0.5 m with one surface insulated and the other surface maintained at a uniform temperature of 110°C which is placed in quiescent air at atmospheric pressure and 40°C. Calculate the average heat transfer coefficient for free convection for the following orientations of the hot surface:
(i) The plate is horizontal with hot surface faces up
(ii) The plate is horizontal with hot surface faces down
(iii) The plate is vertical **(12 Marks)**

Module-5

9 a. Derive an expression for LMTD for parallel flow heat exchanger and the assumptions made. **(10 Marks)**

b. A cross flow heat exchanger with both threads unmixed having a heat transfer area of 8.4 m^2 is to heat air (C_{pc} = 1005 J/kg-°C) with water (C_{ph} = 4180 J/kg-°C). Air enters at 15°C with 2.0 kg/s, while the water enters at 90°C with 0.25 kg/s. The overall heat transfer coefficient is 250 W/m^2-°C. Calculate the exit temperatures of both air water as well as total heat transfer rate. **(10 Marks)**

OR

10 a. Explain different regimes of pool boiling with neat sketches. **(06 Marks)**

b. Saturated water at 100°C is boiled with a copper heating element having a heating surface of 500 sq.cm, which is maintained at a uniform temperature of 115°C. Calculate the surface heat flux and rate of evaporation. **(06 Marks)**

c. Air free saturated steam at T_V = 85°C condenses on the outer surface of 225 horizontal tubes of 1.27 cm OD arranged in a 15-by-15 array. Tube surfaces are maintained at a uniform temperature T_w = 75°C. Calculate the total condensation rate per meter length of the tube bundle. **(08 Marks)**

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CBCS SCHEME

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18ME641

Sixth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Non Traditional Machining

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use neat sketch wherever necessary.***

Module-1

1 a. Define Nontraditional Machining. Discuss the physical parameters of NTM process. **(06 Marks)**

b. What is the difference between conventional and nonconventional machining process. **(08 Marks)**

c. Explain the need of NTM process in modern industry. **(06 Marks)**

OR

2 a. What are the advantages, limitations and applications of nontraditional machining process? **(12 Marks)**

b. How modern machining process are classified? **(08 Marks)**

Module-2

3 a. Explain with neat sketch construction and working of usm process. **(10 Marks)**

b. What are advantages, limitations and applications of Abrasive Jet Machining process? **(10 Marks)**

OR

4 a. Explain with neat sketch AJM process. **(10 Marks)**

b. Explain the following parameters with respect to usm process.
i) Effect of amplitude and frequency of vibration
ii) Effect of grain diameter
iii) Effect of applied static load
iv) Effect of slurry **(10 Marks)**

Module-3

5 a. Draw schematic sketch of Electro Chemical Machining process and discuss the elements of ECM process. **(10 Marks)**

b. Explain the elements of process :
i) Maskants or resists in CHM(Chemical Machining)
ii) Etchants **(10 Marks)**

OR

6 a. Discuss the Economics of ECM Process **(04 Marks)**

b. Calculate the metal removal rate and electrode feed rate when iron is electro chemically machined using copper electrode and sodium chloride solution (Specific resistance = 5.0 ohm.cm), the power supply data of electro chemical machine used are :
Supply voltage = 18 V-DC
- Current = 5000 Amps
- Tool gap = 0.5mm
- Atomic weight of iron is 56
- Valency = 2
- Density = 7.87×10^6 gm/m^3 **(06 Marks)**

c. What are the advantages, disadvantages and applications of Chemical Machining Process (CHM). **(10 Marks)**

Module-4

7 a. Explain the mechanism of metal removal in EDM with a neat sketch. **(06 Marks)**

b. List the application of Plasma Arc Machining (PAM). **(04 Marks)**

c. Mention the properties of dielectric fluid and explain various methods of circulating the dielectric fluid. **(10 Marks)**

OR

8 a. What are the various types of torches used in plasma arc machining? Explain their operation. **(08 Marks)**

b. Explain the word "Plasma". Explain how it is used for material removal process with neat sketch. **(08 Marks)**

c. Discuss the parameter to choose electrode material in EDM process. **(04 Marks)**

Module-5

9 a. Explain the generation and control of electron beam with a neat sketch. Also discuss the material removal process. **(08 Marks)**

b. List the advantages of Laser Beam Machining (LBM). **(06 Marks)**

c. Compare thermal and non-thermal metal removal process in electron beam machining. **(06 Marks)**

OR

10 a. List the limitation of Electron Beam Machining. **(04 Marks)**

b. Explain the principle and operation of Laser beam machining with a neat sketch. **(08 Marks)**

c. Explain the different theories associated with electron beam machining. **(08 Marks)**

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CBCS SCHEME

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Sixth Semester B.E. Degree Examination, June/July 2024
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. What are conventional and non-conventional energy sources? Describe briefly with examples. **(08 Marks)**
b. What are need for non-conventional energy sources? **(04 Marks)**
c. With a neat sketch explain working principle of pyranometer. **(08 Marks)**

OR

2 a. Enumerate the merits and demerits of any four non-conventional energy sources. **(16 Marks)**
b. Define Extra-terrestrial radiation and solar constant. **(04 Marks)**

Module-2

3 a. Define: i) Zenith angle ii) Solar altitude angle iii) Surface azimuth angle iv) Declination angle v) Latitude. **(10 Marks)**
b. With a neat sketch explain working principle of flat plate collectors used in water heating system. **(10 Marks)**

OR

4 a. With a neat sketch explain working principle and operational problems of solar pond. **(10 Marks)**
b. Write a short notes on latent heat storage and sensible heat storage of solar energy. **(10 Marks)**

Module-3

5 With the use of heat transfer correlations explain overall loss coefficient in flat plate collector. **(20 Marks)**

OR

6 a. Define: i) Selective surface ii) Fluid inlet temperature iii) Number of covers iv) Stagnation temperature. **(12 Marks)**
b. With a neat sketch, explain working principle of photovoltaic conversion system. **(08 Marks)**

Module-4

7 a. With a neat sketch explain working principle of horizontal axis wind turbine. **(10 Marks)**
b. Describe the main considerations in selecting a site for wind generators. **(10 Marks)**

OR

8 a. With a neat sketch, explain working principle of OTEC power plant. List the problem associated with OTEC. **(12 Marks)**
b. Write a short notes on harnessing tidal energy and its limitations. **(08 Marks)**

Module-5

9 a. What is the scope of geothermal energy? List four geothermal plants in the world. **(06 Marks)**

b. What is photosynthesis? Explain different stages of photosynthesis. **(10 Marks)**

c. What are the problems associated with bio-gas production? **(04 Marks)**

OR

10 Write a short notes on:

i) Problems associated with geothermal conversion

ii) Oxygen fixation in photosynthesis

iii) Applications of bio-gas

iv) Properties of hydrogen with respect to its utilization as a renewable form of energy

v) Anaerobic fermentation. **(20 Marks)**

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CBCS SCHEME

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18ME653

Sixth Semester B.E. Degree Examination, June/July 2024
Supply Chain 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 Supply Chain. Explain evolution of supply chain through the three major revolutions. **(10 Marks)**

b. Explain how the various decision phases in supply chain management helps in increasing the surplus. **(10 Marks)**

OR

2 a. Explain the impact of different drivers on the performance of the supply chain. **(10 Marks)**

b. Explain the various categories of supply chain strategies. **(10 Marks)**

Module-2

3 a. What are the conditions for a successful contract? Explain the risks of using a third party in a supply chain. **(10 Marks)**

b. Explain Kraljic's portfolio method if classifying items for sourcing. **(10 Marks)**

OR

4 a. Define outsourcing. Explain the strategic sourcing process with advantages and disadvantages of sourcing. **(10 Marks)**

b. Explain with examples, vertical and tapered integration in a supply chain. **(10 Marks)**

Module-3

5 a. Define Stores management. What are the major functions of the stores? **(10 Marks)**

b. Explain the various ways of carrying out inspection for incoming materials. **(10 Marks)**

OR

6 a. Explain the various factors influencing the options of distribution network design. **(10 Marks)**

b. Explain the measures which can improve warehouse efficiency. **(10 Marks)**

Module-4

7 a. What is the framework for network design decisions? Explain the impact of uncertainty on network design with an example. **(10 Marks)**

b. Define demand planning and state its importance. Explain the various aspects of demand planning. **(10 Marks)**

OR

8 a. Define pricing and explain fixed pricing and menu pricing. What are the various metrics related to pricing? **(10 Marks)**

b. What is multiple item-multiple location inventory management? Explain the challenges and advantages of multi-location inventory management. **(10 Marks)**

Module-5

9 a. Define Supply Chain Integration. What are the different stages of supply chain integration? **(10 Marks)**

b. Define Bullwhip effect. What are the prominent causes and effects of Bullwhip effect? **(10 Marks)**

OR

10 a. Explain reverse logistics and the scenarios under which a product enters back into the supply chain. What are the characteristics of reverse supply chain network? **(10 Marks)**

b. Describe E-business and classify them. Explain the role of E-commerce in supply chains. **(10 Marks)**

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21ME61

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Production and 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 briefly classification of production systems. **(10 Marks)**

b. Define productivity. List the various factors affecting and improvements of the productivity. **(10 Marks)**

OR

2 a. Enumerate in brief the importance of decision making and list the steps involved in it. **(10 Marks)**

b. Solve the following LPP by graphical method.

$Z_{max} = 3x_1 + 4x_2$

Subject to $x_1 + x_2 \leq 450$

$2x_1 + x_2 \leq 600$ and

$x_1, x_2 \geq 0$ **(10 Marks)**

Module-2

3 a. Define forecasting. What are the steps involved in forecasting process? **(10 Marks)**

b. Briefly explain a forecasting technique. **(10 Marks)**

OR

4 a. Explain the following methods:

(i) Source of redesigned product (ii) Design for manufacturing **(10 Marks)**

b. 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	6	10	8	7	12	14	14	18	19

Calculate the trend for the year 12 and 20. **(10 Marks)**

Module-3

5 a. List and briefly explain the factors affecting the capacity. **(08 Marks)**

b. Explain in brief the importance of capacity decisions. **(04 Marks)**

c. Location A would result in fixed costs of Rs.3,00,000 variable costs of Rs.63 per unit, revenues of Rs. 68 per unit. Annual fixed costs at location B are Rs. 8,00,000 with variable costs of Rs. 32 per unit revenue of Rs. 68 per unit. Sales volume is estimated to be 25,000 units/year. Which location is most attractive? **(08 Marks)**

OR

6 a. Explain characteristics of Location Decisions. **(06 Marks)**

b. Explain in brief Designing of process layout. **(08 Marks)**

c. Explain the following :

i) Identifying a country ii) Identifying a community **(06 Marks)**

Module-4

7 a. What is aggregate planning? Briefly explain strategies of aggregate planning. **(10 Marks)**

b. Explain the techniques for aggregate planning in services. **(10 Marks)**

OR

8 a. With flow chart, explain master production scheduling process. **(08 Marks)**

b. For the given data of supply, demand cost and inventory allocate the production capacity to fulfill request/demand at lowest cost method.

Supply Capacity

Period	Regular time	Overtime	Sub contract
A	70	15	750
B	65	20	1000
C	75	25	1250
D	80	30	1500

Demand and Inventory

Period	A	B	C	D
Unit of Demand	150	75	80	90

Inventory details :
Initial = 25 units ; Final = 35 units
Regular Time cost/unit = Rs. 150 (40% of cost is labour cost)
Overtime cost per unit = Rs. 140
Subcontracting cost per unit is Rs.160
Inventory carrying cost per unit period = Rs. 3
Carrying cost per unit per period = Rs. 3. **(12 Marks)**

Module-5

9 a. Briefly explain with a flowchart of capacity requirement planning. **(10 Marks)**

b. Briefly explain the structure of an Enterprise Resource Planning System (ERP). **(10 Marks)**

OR

10 a. State the importance of purchasing and supply chain management. **(08 Marks)**

b. Briefly explain the following :
i) Vender development
ii) Make or Buy decision
iii) E-procurement **(12 Marks)**

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21ME62

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Heat transfer Data book and Thermodynamics Data book is permitted.***
3. ***Assume any missing data.***

Module-1

1 a. Derive the 3 – Dimensional general heat conduction equation for steady state heat flow in terms of Cartesian co-ordinates. **(10 Marks)**

b. A wall is constructed of several layers. The first layer consists of brick (K = 0.66 w/mK), 25cm thick , the second layer 2.5cm thick mortar (K = 0.7 W/mK), the third layer 10cm thick limestone (K = 0.66 W/mK) and outer layer of 1.25cm thick plaster (K = 0.7 W/mK). The heat transfer coefficients on interior and exterior of the wall fluid layers are 5.8 W/m^2K and 11.6 W/m^2 K respectively. Find i) Overall heat transfer coefficient
ii) Overall thermal resistance per m^2.
iii) Rate of heat transfer per m^2, if the interior of the room is at 26ºC while the outer layer is at -7ºC.
iv) Temperature at the junction between mortar and limestone. **(10 Marks)**

OR

2 a. Derive the temperature distribution equation and heat transfer for a one dimensional conduction through a plane watt without heat generation. **(10 Marks)**

b. Explain the experimental procedure for determining overall heat transfer coefficient for a composite wall made up of three different materials with suitable sketch, tabulation of readings and formulae. **(10 Marks)**

Module-2

3 a. Derive the equations to determine temperature distribution and heat transfer through a pin fin of infinitely long. **(10 Marks)**

b. A mild steel rod (K = 32 W/m ºC), 12mm in diameter and 60 mm long with an insulated end is to be used as spine. It is exposed to surroundings with a temperature of 60ºC and a heat transfer coefficient of 55 W/m^2ºC. If the base temperature of the fin is 95ºC, determine
i) Fin efficiency
ii) Temperature at the edge of a spine
iii) Heat transfer rate
iv) Effectiveness of fin. **(10 Marks)**

OR

4 a. Derive temperature distribution equation for lumped parameter analysis of solids for transient heat conduction with negligible internal resistance. **(08 Marks)**

b. What is Biot number and Fourier number with their significance. **(04 Marks)**

c. A 15mm diameter mild steel sphere (K = 42 W/mºC) is exposed to cooling air flow at 20ºC with the convection coefficient h = 120 N/m^2 ºC. Determine :
   i) Time required to cool sphere from 550ºC to 90ºC.
   ii) Instantaneous heat transfer rate 2 minutes after start of cooling.
   iii) Total energy transferred from sphere during first 2 minutes.
   Take ρ = 7850 kg/m^3 , C = 475 J/kg ºC , α = 0.045 m^2/h. **(08 Marks)**

Module-3

5 a. Explain the finite difference formulation of one dimensional steady state conduction for a plane wall using energy balance approach. **(10 Marks)**

b. A large plate of thickness L = 4cm, having thermal conductivity K = 28 W/mºC in which heat is generated uniformly at a constant rate of $\dot{q}_{gm} = 5 \times 10^6$ W/m^3. One end of the plate is maintained at 0ºC and other end is subjected to environment at T_∞ = 30ºC , with heat transfer coefficient of h = 45 W/m^2C. Considering three nodes as two nodes at the boundary and one in the middle. Determine the surface temperature of plate for steady state conditions using finite difference approach. **(10 Marks)**

OR

6 a. State and prove Kirchoff's law of radiation. **(06 Marks)**

b. Explain : i) Stefan Boltzmann law ii) Planck's law iii) Wein's displacement law iv) Black body. **(08 Marks)**

c. Two large parallel plates with ε = 0.5 each are maintained at different temperatures exchanging heat by radiation. Two equally large radiation shields with surface emissivity (ε = 0.05) are introduced between plates. Find the percentage reduction in net radiative heat transfer. **(06 Marks)**

Module-4

7 a. Explain with sketch, development of a velocity boundary layer and thermal boundary layer over a smooth flat plate. **(10 Marks)**

b. Air is at 20ºC is flowing over a flat plate which is 200mm wide and 500mm long. The plate is maintained at 100ºC. Find the heat loss per hour from the plate if the air is flowing with 2m/s velocity. What will be effect the heat transfer if the flow is parallel to 200mm wide? **(10 Marks)**

OR

8 a. Define the following Dimensionless parameters :
   i) Reynolds number ii) Nusselt number iii) Prandtl number
   iv) Grashoff number v) Stanton number. **(10 Marks)**

b. A sheet metal air duct carries conditioned air at an average temperature of 10ºC. The Duct size is 320mm × 200mm and length of the duct exposed to air at 30ºC is 15m long. Find the heat gained by air in Duct. Take 200mm side as vertical and top surface of the duct is insulated. Use the following equations :
   $N_u = 0.6\,(Gr\,Pr)^{0.25}$ for Vertical surface
   $N_u = 0.27\,(Gr\,Pr)^{0.25}$ for Horizontal surface. **(10 Marks)**

Module-5

9 a. Explain the different regimes of boiling curves of water. **(10 Marks)**

b. A metal clad heating element of 10 mm dia and of emissivity 0.92 is submerged in water bath horizontally. If the surface temp of metal is 260°C, under steady boiling conditions, calculate the power dissipation per unit length for the heater water is exposed to atmospheric pressure and is at a uniform temperature. **(10 Marks)**

OR

10 a. Derive the expression for LMTD for a parallel flow heat exchanger. **(10 Marks)**

b. Steam condenses at atmospheric pressure on the external surface of tubes of condenser. The tubes are 12 in number and each is 30 mm dia and 10 m long. The inlet and outlet temperatures of cooling water flowing inside tubes are 25°C and 60°C.; if the flow rate is 1.1 kg/s. Calculate :

i) Rate of condensation of steam.
ii) Mean overall heat transfer coefficient based on inner surface area.
iii) Number of Transfer Units (NTU).
iv) Effectiveness of the condenser. **(10 Marks)**

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21ME63

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Machine Design

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 allowed.
3. Missing data can be suitably assumed.

Module-1

1 a. Draw the stress-strain curve for mild steel and cast iron. Name the salient points. **(05 Marks)**

b. An unknown weight fails through 15 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 500 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm. What is the corresponding stress and the value of un-known weight. Take E = 200 KN/mm^2. **(10 Marks)**

c. An element is acted upon by the following stresses $\sigma_x = 120$ MPa ; $\sigma_y = 90$ MPa and $\tau_{xy} = 30$ MPa.

(i) Compute stresses on a plane inclined at 20°.
(ii) Find principal stresses and their direction.
(iii) Find maximum shear stress and its direction.

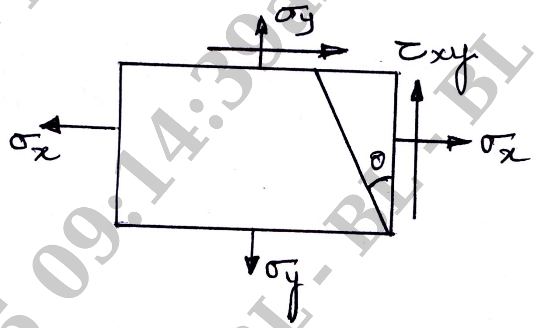

Fig. Q1 (c) **(05 Marks)**

OR

2 a. What are important mechanical properties of metals? Explain any three briefly. **(05 Marks)**

b. Derive the Soderberg's equation. **(05 Marks)**

c. Determine the Safe Load that can be carried by a bar of rectangular cross section shown in Fig. Q2 (c) limiting the maximum stress to 130 MPa. Take stress concentration into account.

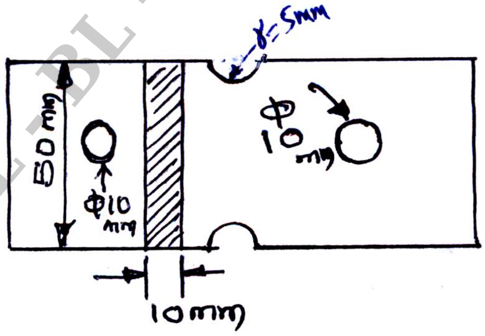

Fig. Q2 (c) **(10 Marks)**

Module-2

3 a. A hollow shaft of 50 mm outside diameter and 30 mm inside diameter, 300 mm long is subjected to a torque of 4 N-m. What is the angle of twist if modulus of rigidity is 90 GPa. **(05 Marks)**

b. Design flange coupling to connect the shafts of a motor and a centrifugal pump. Take factor of safety = 2 ; Allowable shear stress for CI flange = 15 MPa, Pump output = 3000 litre/min
Total head = 20 m
Pump speed = 600 rpm,
Pump efficiency = 70%
C40 steel shaft with $\sigma_y = 328.6$ MPa,
C30 steel for bolts and key with $\sigma_y = 294.2$ MPa. **(10 Marks)**

c. What is coupling? What are the requirements of a good coupling? **(05 Marks)**

OR

4 a. A simply supported shaft has the distance between supports as 600 mm. The load at the center is 15 KN. If the deflection at the center is to be limited to 0.02 mm. What should be the diameter of the shaft? If the shaft diameter is doubled, what will be the deflection at center? The modulus of elasticity is 210 GPa. **(10 Marks)**

b. Design a helical compression spring to sustain an axial load of 3 kN. The deflection is 60 mm, spring index is '6'. The shear stress is not to exceed 300 MPa. Rigidity modulus of the spring is 81 GPa. **(10 Marks)**

Module-3

5 a. Design a double riveted Lap joint to connect two plates each 20 mm thick. The allowable stress for rivets and plates are 90 MPa in tension, 60 MPa in shear and 150 MPa in crushing. **(10 Marks)**

b. Determine the size of weld for a joint shown in Fig. Q5 (b). The allowable stress in the weld is 70 MPa. **(05 Marks)**

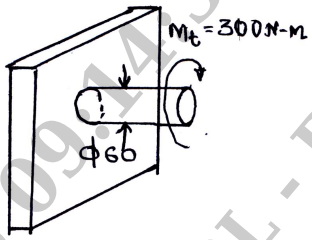

Fig. Q5 (b)

c. Classify Rivited joints, sketch them neatly. **(05 Marks)**

OR

6 a. List different types of fasteners and their uses. **(05 Marks)**

b. Determine the size of the weld to be used for a bracket as shown in the Fig. Q6 (b). The load is 30 kN. **(15 Marks)**

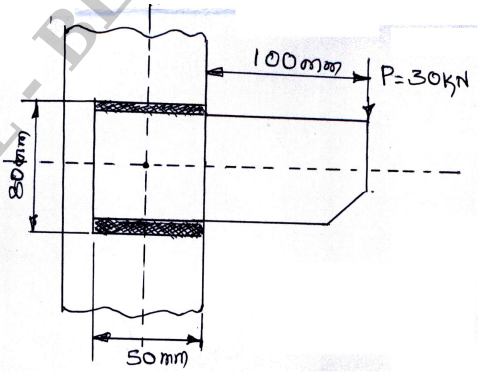

Fig. Q6 (b)

Module-4

7 Design a pair of helical gear to transmit 12 kW at 1200 rpm of pinion. The velocity ratio is 3 : 1, pinion has 24 teeth and is made of 0.4% carbon steel untreated. The gear is made of cast steel, the teeth are $14\frac{1}{2}^{\circ}$ involute form in normal plane Helix angle is 25°. **(20 Marks)**

OR

8 Design a pair of Right angle bevel gears to transmit 25 kW from a shaft rotating at 1200 rpm to another shaft to rotate at 500 rpm. **(20 Marks)**

Module-5

9 a. List important properties of Lubricants and briefly define any four. **(06 Marks)**

b. Design the main bearings of a 4-stroke diesel engine to sustain a load of 6 kN. The operating speed of the shaft is 100 rpm. **(14 Marks)**

OR

10 a. A single block brake with drum diameter of 350 mm is shown in Fig. Q10. The angle of contact is 90° coefficient of friction is 0.33. Determine safe power that can be absorbed at 1440 rpm. **(10 Marks)**

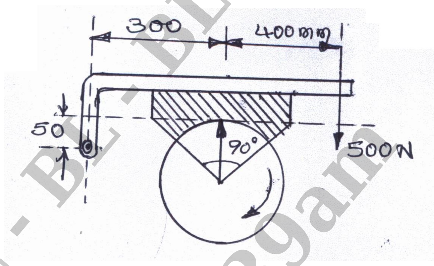

Fig. Q10 (a)

b. List various condition of Lubrication and briefly describe each. **(10 Marks)**

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21ME642

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechatronic System Design

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define mechatronics. Explain mechatronics design process. **(10 Marks)**
b. Explain Hall effect sensor. Also mention its applications. **(10 Marks)**

OR

2 a. Explain key elements in mechatronics. **(10 Marks)**
b. Explain the following temperature sensors:
(i) Bi-metallic strips (ii) Thermocouple **(10 Marks)**

Module-2

3 a. Explain manipulations and simulations in dynamic system. **(10 Marks)**
b. Explain analogy approach block diagram modeling. **(10 Marks)**

OR

4 a. Explain mechanical rotational dynamic systems. **(10 Marks)**
b. Explain electrical-mechanical couplings in dynamic modeling. **(10 Marks)**

Module-3

5 a. Explain key aspects of dynamic system modeling. **(10 Marks)**
b. Explain fault detection techniques in dynamic systems. **(10 Marks)**

OR

6 a. Explain common hardware faults in dynamic system. **(10 Marks)**
b. Differentiate between emulation and simulation techniques. **(10 Marks)**

Module-4

7 a. Explain typical PC – based DAQ system. **(10 Marks)**
b. Explain signal conditioning process in brief. **(10 Marks)**

OR

8 a. Explain the following:
(i) Devices for data conversion (ii) Data conversion process **(10 Marks)**
b. Explain two application software environments. **(10 Marks)**

Module-5

9 a. Explain spring-mass-damper system comprehensive case study. **(10 Marks)**
b. Explain testing of transportation bridge surface materials data acquisition case study in brief. **(10 Marks)**

OR

10 a. Explain briefly, PM DC gear motor comprehensive case study. **(10 Marks)**
b. Explain the following DA case studies:
(i) Transducer calibration system for automotive applications
(ii) Strain gauge weighing system **(10 Marks)**

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21ME652

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Renewable Energy Power Plants

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. What is the need for alternative energy sources? **(04 Marks)**

c. Explain with a neat sketch, Solar radiation at the earth's surface. **(06 Marks)**

OR

2 a. With a neat sketch, explain the working principle of extra terrestrial radiation. **(10 Marks)**

b. With a neat sketch, explain the working principle of shading ring pyreheliometer. **(10 Marks)**

Module-2

3 a. Define the following : i) Declination angle ii) Latitude iii) Hour angle iv) Zenith angle v) Surface azimuth angle. **(10 Marks)**

b. Describe with a neat sketch, the working principle of Solar pond. **(10 Marks)**

OR

4 a. List and explain the various parameters that effect the performance of flat plate collectors. **(10 Marks)**

b. Explain with a neat sketch, photovoltaic conversion. **(10 Marks)**

Module-3

5 a. List the types of wind mills. Explain horizontal axis wind mill with neat sketch. **(10 Marks)**

b. List the advantages , disadvantages and applications of wind energy. **(10 Marks)**

OR

6 a. Discuss the applications of biogas in engines. **(04 Marks)**

b. Explain briefly the KVIC model biogas plant with a neat sketch. **(08 Marks)**

c. With a neat sketch, explain working principle of Janta Model biogas digester (Fixed dome). **(08 Marks)**

Module-4

7 a. Discuss with a neat sketch, hydro power plant. **(10 Marks)**

b. Explain with a neat sketch, Operation of double basin tidal power plant. **(10 Marks)**

OR

8 a. What are the different types of wave energy conversion devices? **(04 Marks)**

b. With the help of neat diagram , explain wave energy conversion system by floats. **(08 Marks)**

c. What are the advantages and limitation of wave energy conversion? **(08 Marks)**

Module-5

9 a. With a neat sketch, describe the closed cycle OTEC system. **(10 Marks)**

b. What are the problems associated with OTEC? **(05 Marks)**

c. What are the advantages and disadvantages of geothermal energy over other energy sources? **(05 Marks)**

OR

10 a. Explain with a neat sketch, working principle of vapour dominated geothermal plant. **(10 Marks)**

b. Describe with a neat sketch, geothermal energy system by Hot Dry Rock. **(10 Marks)**

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21ME653

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechatronics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Mechatronics. Explain with a neat sketch, the basic elements of a closed loop system. **(10 Marks)**

b. Explain with block diagram the working of an automated washing machine. **(10 Marks)**

OR

2 a. Define transducer. Explain primary and secondary transducer with example. **(10 Marks)**

b. Explain how does the following work:
i) Hall Effect Sensor (ii) Proximity sensor **(10 Marks)**

Module-2

3 a. With the help of block diagram, explain Data Acquisition System (DAQS). **(10 Marks)**

b. Explain the signal conditioning process. **(06 Marks)**

c. What is a filter? How are filters classified? **(04 Marks)**

OR

4 a. Define Solenoids. Explain two types of solenoids and mention their applications. **(10 Marks)**

b. Explain the working of variable reluctance stepper motor with neat sketch. **(10 Marks)**

Module-3

5 a. Explain with neat block diagram, the general form of Microprocessor system. **(10 Marks)**

b. What is Microcontroller? Distinguish between Microprocessor and Microcontroller. **(10 Marks)**

OR

6 a. With a neat sketch, explain 8085A Microprocessor architecture. **(10 Marks)**

b. Explain the following:
(i) Fetch cycle (ii) Types of buses (iii) Flag registers (iv) Program counter **(10 Marks)**

Module-4

7 a. Define PLC (Programmable Logic Controller). Explain with a neat diagram working of a PLC. **(10 Marks)**

b. Explain in detail the criteria used for selection of PLC. **(10 Marks)**

OR

8 a. Explain the control of two pneumatic pistons, with neat sketch. **(10 Marks)**

b. Explain, with ladder diagram, a latch circuit and an internal relay. **(10 Marks)**

Module-5

9 a. With a neat sketch, explain any three types of guide ways. **(10 Marks)**

b. Explain the working of hydrostatic bearing with neat sketch. **(10 Marks)**

OR

10 a. Explain the mechatronics design process with neat sketch. **(10 Marks)**

b. Design a mechatronic system for pick and place robot. **(10 Marks)**

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18ME741

Seventh Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. List out advantages and disadvantages in detail. **(10 Marks)**
b. Explain with a neat diagram the process chain of additive manufacturing. **(10 Marks)**

OR

2 a. What are the eight steps in manufacturing? Explain briefly. **(10 Marks)**
b. What are the distinction between AM and CNC machining? **(06 Marks)**
c. Explain milestones in AM development. **(04 Marks)**

Module-2

3 a. Explain molten materials system for FDM in AM with a neat diagram. **(10 Marks)**
b. Explain the following with a neat sketch:
(i) Bio-Extrusion (ii) Electron Beam melting. **(10 Marks)**

OR

4 a. Explain with the help of neat diagram Sterolithography (SL). **(10 Marks)**
b. What are the applications of photo polymerization processes? **(04 Marks)**
c. Explain with neat sketch, Selective Laser Sintering (SLS). **(06 Marks)**

Module-3

5 a. Explain the laminated object manufacturing process with a neat sketch. **(10 Marks)**
b. Explain the Ultrasonic Consolidation (UC) with a neat sketch. **(10 Marks)**

OR

6 a. Explain with help of neat diagram general beam deposition process. **(10 Marks)**
b. Explain the following with a neat sketch:
(i) Ink based direct write (ii) Laser transfer (iii) Direct write thermal pray **(10 Marks)**

Module-4

7 a. Explain the following :
(i) Selection methods for sport (ii) Production planning and control **(10 Marks)**
b. Explain the STL file , problems with STL files and STL file manipulation. **(10 Marks)**

OR

8 a. Explain various steps involved in preparation for use as a pattern. **(06 Marks)**
b. Explain surface texture improvement. **(04 Marks)**
c. Explain the property enhancements using non thermal techniques and thermal techniques. **(10 Marks)**

Module-5

9 a. Explain the following :
(i) Multiple material approaches
(ii) Discrete multiple material processes
(iii) Porous multiple material processes. **(12 Marks)**

b. Write any eight applications of AM in aerospace, medical, automobile and general engineering. **(08 Marks)**

OR

10 a. Explain the following :
(i) Functional models
(ii) Engineering analysis model
(iii) New materials development. **(12 Marks)**

b. Define direct digital manufacturing and explain align technology and DDM drivers. **(08 Marks)**

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18ME751

Seventh Semester B.E. Degree Examination, Dec.2024/Jan.2025

Energy and Environment

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define energy and power. Classify and briefly explain the different types of energy. **(10 Marks)**

b. Explain the world energy production and consumption with relevant statistics. **(10 Marks)**

OR

2 a. Explain the policy and institutional framework for energy production and utilization in India. **(10 Marks)**

b. List and explain the factors affecting the energy production in India. **(10 Marks)**

Module-2

3 a. List the different types of thermal energy storage system. Explain any two of them. **(10 Marks)**

b. Define energy management. Explain the principles of energy management. **(10 Marks)**

OR

4 a. Define energy audit. Explain the need for energy audit and mention the various phases of energy audit methodology. **(10 Marks)**

b. Explain the following :
(i) Sensible heat thermal storage system (ii) Latent heat thermal storage system **(10 Marks)**

Module-3

5 a. Define Environment. Enumerate the utilization of carbon in Ecosystem. **(10 Marks)**

b. What is a Ecosystem? Explain different types of forest ecosystem. **(10 Marks)**

OR

6 a. Discuss how Oxygen cycle is utilized in the ecosystem. **(10 Marks)**

b. Explain Grassland Ecosystem and its types with neat sketch. **(10 Marks)**

Module-4

7 a. Enumerate the water pollution causes and its effects. Mention the control measures that can be initiated for mitigating the same. **(10 Marks)**

b. Explain the main sources and effects of air pollution. **(10 Marks)**

OR

8 a. Discuss strategy and techniques involved in solid waste management. **(10 Marks)**

b. Elaborate the causes, effects and control measures of (i) Soil pollution (ii) Noise pollution. **(10 Marks)**

Module-5

9 a. Write a short note on Global Warming and Climate Change. **(10 Marks)**

b. Express the need for reclaiming the wasteland and its development. **(10 Marks)**

OR

10 a. What are the regulations governing Water Pollution Prevention Act? **(10 Marks)**

b. Write a note on Ozone layer depletion. **(10 Marks)**

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21ME71

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Automation and Robotics

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Illustrate different levels of automation with neat block diagram. **(10 Marks)**

b. Explain advanced automation functions. **(10 Marks)**

OR

2 a. Illustrate the configuration of an adaptive control system in continuous process control. **(10 Marks)**

b. Compare Hydraulic and Pneumatic systems and explain the principles of hydraulic actuators. **(10 Marks)**

Module-2

3 a. What do you understand by an automated flow line? Explain it with the help of a neat sketch and also list the objectives of automated flow line. **(10 Marks)**

b. With examples, explain upper bound and lower bound approaches to analyze automated flow line without storage buffer. **(10 Marks)**

OR

4 a. A 20 station transfer line is divided into two stages of 10 stations each. The ideal cycle time of each stage is $T_C = 1.2$ min. All of the stations in the line have the same probability of stopping $P = 0.005$. Assume that downtime is constant when a breakdown occurs, $T_d = 8.0$ min. Compute the line efficiency for the following buffer capacities: i) $b = 0$ ii) $b = \infty$ iii) $b = 10$. **(10 Marks)**

b. There are two forms of linear bar codes. Name them, and explain with the sketches. Also compare bar codes and RFID. **(10 Marks)**

Module-3

5 a. Illustrate the Cartesian and cylindrical robotic configurations. **(10 Marks)**

b. Explain robot control systems i.e. i) Limited sequence ii) Playback with point-to-point iii) Play back with continuous path control iv) Intelligent control. **(10 Marks)**

OR

6 a. Define robot end effector. Explain robot accuracy and repeatability. **(10 Marks)**

b. Illustrate pitch, yaw and roll to explain degrees of freedom and also state Asimov's laws of robotics. **(10 Marks)**

Module-4

7 a. Describe how you would use sensors to control the position of a robotic arm. **(10 Marks)**

b. Illustrate the characteristics of DC motors and stepper motors in robotics applications. **(10 Marks)**

OR

8 a. A point $P_{abc} = (2, 3, 4)^T$ has to be translated through distance of +4 units along OX-axis and -2 units along OZ – axis. Determine the co-ordinates of the new point P_{xyz} by homogeneous transformation. **(10 Marks)**

b. Explain : i) Direct and inverse kinematics ii) DH convention. **(10 Marks)**

Module-5

9 a. Explain the levels of robotic programming. **(10 Marks)**

b. Explain the requirements of robot programming language. **(10 Marks)**

OR

10 a. Explain the following VAL commands with descriptions for:

i) Motion control
ii) Speed control
iii) Position control
iv) End effector operation
v) Operation of the sensor. **(10 Marks)**

b. Write a program in VAL for palletization of parts in a pallet having 4 rows that are 50 mm apart and 6 columns 40 mm apart. The robot must pick parts from an incoming chute and are 25 mm tall. Use in the program the following names for variables ROW, COLUMN, X and Y and use names for location constants PICK-UP, CORNER and DROP. **(10 Marks)**

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21ME72

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note:1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Draw neat sketches wherever necessary.

Module-1

1 a. Define open loop system and discuss its advantages and disadvantages. **(05 Marks)**
b. Explain the requirements of an ideal control system (at least five). **(05 Marks)**
c. Explain the following controllers, (i) PI controller (ii) PID controller. **(10 Marks)**

OR

2 a. What are the key elements used in the mathematical modeling of mechanical system? **(04 Marks)**
b. Explain the steps to solve problems on analogous systems. **(06 Marks)**
c. Draw the equivalent mechanical system of the given system shown in Fig. Q2 (c). **(10 Marks)**

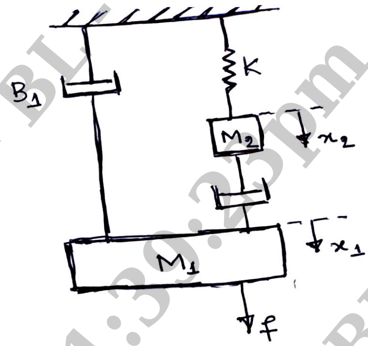

Fig. Q2 (c)

Module-2

3 a. With neat sketches, explain standard test signals in control system. **(10 Marks)**
b. A unity feedback system has, $G(s) = \dfrac{40(s+2)}{s(s+1)(s+4)}$. Determine (i) Type of system, (ii) All error coefficients (iii) Error for ramp input with magnitude 4. **(10 Marks)**

OR

4 a. With a neat sketch of transient response specifications, explain, (i) Delay time (ii) Rise time (iii) Peak time (iv) Peak overshoot (v) Settling time. **(10 Marks)**
b. A unity feedback system is characterized by open loop transfer function, $G(s) = \dfrac{10}{s^2+2s+6}$
Determine the following when the system is subjected to unit step input :
(i) Undamped natural frequency.
(ii) Damping ratio.
(iii) Peak overshoot
(iv) Peak time
(v) Settling time **(10 Marks)**

Module-3

5 a. What is block diagram? With neat sketches, explain the following rules of block diagram reduction technique :
(i) Reducing blocks in series (ii) Reducing blocks in parallel
(iii) Merging of two summing point (iv) Moving a summing point behind the block. **(10 Marks)**

b. Reduce the block diagram and obtain its transfer function $\frac{C(s)}{R(s)}$. Block diagram shown in Fig. Q5 (b). **(10 Marks)**

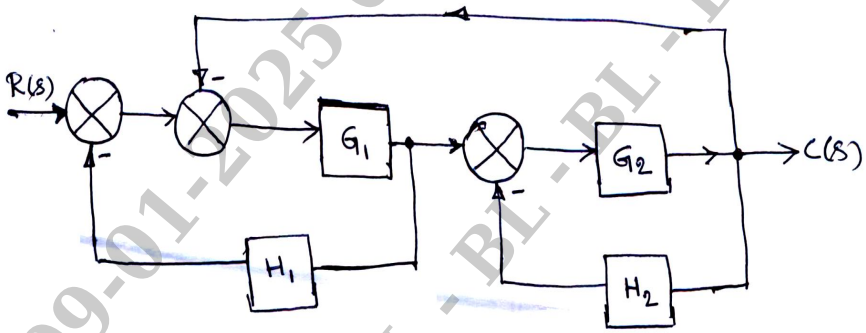

Fig. Q5 (b)

OR

6 a. For the system shown in Fig. Q6 (a), determine $\frac{C(s)}{R(s)}$ using Mason's gain formula. **(10 Marks)**

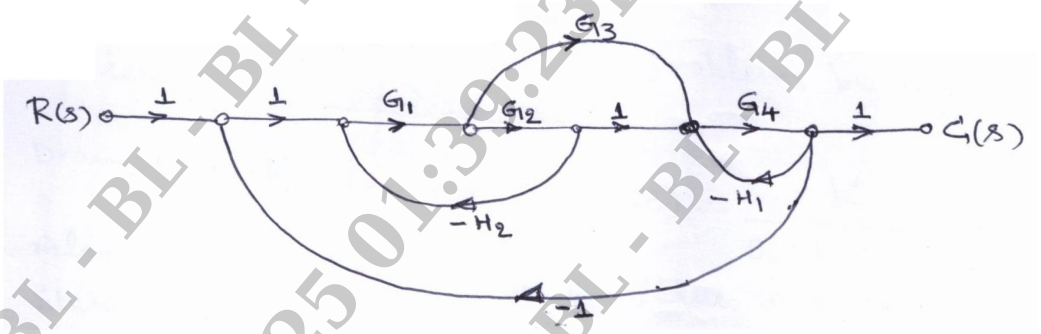

Fig. Q6 (a)

b. Find $\frac{C(s)}{R(s)}$ for the following system shown in Fig. Q6 (b). Use Mason's gain formula. **(10 Marks)**

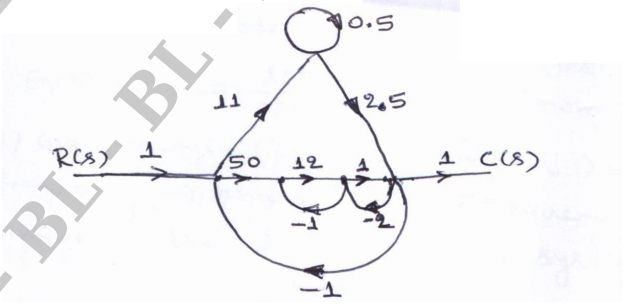

Fig. Q6 (b)

Module-4

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

b. By applying Routh Criterion, discuss the stability of the closed loop system as a function of K for the following open loop transfer function :

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

OR

8 Sketch the root locus of the system whose open loop transfer function is given by,

$$G(s)H(s) = \frac{K}{s(s+2)(s+4)(s+6)}.$$

Also comment on the stability of the system. **(20 Marks)**

Module-5

9 a. Explain the steps to solve problems by Nyquist criterion. **(04 Marks)**

b. Draw Nyquist plot for $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$. Also calculate the range of values of K for stability. **(16 Marks)**

OR

10 Sketch the Bode plot for a system having $G(s)H(s) = \frac{100}{s(s+1)(s+2)}$.

From the plot determine, (i) Gain margin (ii) Phase margin (iii) Gain cross over frequency (iv) Phase cross over frequency.

Comment on the stability of the system. **(20 Marks)**

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21ME732

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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 total quality management and describe the basic approach of TQM.	**(10 Marks)**
	b.	Describe TQM framework with neat schematic representation.	**(10 Marks)**

OR

2	a.	Explain the contributions of following Gurus of TQM. i) Walter a shewart ii) Joseph Juren.	**(10 Marks)**
	b.	Enumerate the process in the documentation of ISO 9000.	**(10 Marks)**

Module-2

3	a.	List Deming's 14 principles and describe any two principles.	**(10 Marks)**
	b.	Enumerate the characteristics of successful leader.	**(10 Marks)**

OR

4	a.	Describe the role of TQM leaders.	**(10 Marks)**
	b.	Explain the steps in decision making process.	**(10 Marks)**

Module-3

5	a.	Illustrate the customer perception of quality.	**(10 Marks)**
	b.	Analyse any four methods of collecting voice of customers.	**(10 Marks)**

OR

6	a.	Describe the Mashlow's Hierarchy of needs.	**(10 Marks)**
	b.	Illustrate KANO model, that helps in translating needs into requirements with neat sketch.	**(10 Marks)**

Module-4

7	a.	Describe Juren Triology for quality improvement.	**(10 Marks)**
	b.	Explain six sigma concept for continuous quality improvement.	**(10 Marks)**

OR

8	a.	Interpret the 4 different methods of improvement straggles used for continuous improvement in TQM.	**(10 Marks)**
	b.	Illustrate the following with a neat sketch : i) Histogram ii) Pareto diagram.	**(10 Marks)**

Module-5

9	a.	Describe 8 pillars related to TPM.	**(10 Marks)**
	b.	Illustrate the concept of '5s' foundation applied to TPM.	**(10 Marks)**

OR

10	a.	Enumerate the types of maintenance in TPM.	**(10 Marks)**
	b.	Illustrate the benefits and challenges of Quality by Design (QbD).	**(10 Marks)**

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21ME742

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Theory and Design of IC Engines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define compression ratio. State the importance of compression ratio in I.C. engines. **(10 Marks)**

b. What are the main factors affecting engine efficiency in IC engines? **(05 Marks)**

c. How does engine displacement affect engine performance in an IC engine? **(05 Marks)**

OR

2 a. Explain with a neat sketch thermostat cooling system. **(10 Marks)**

b. Discuss the advantages and disadvantages of air cooled and liquid cooled engines. **(10 Marks)**

Module-2

3 a. Explain the important qualities of an IC engine fuel. **(10 Marks)**

b. What is carburetion? Explain the mixture requirements for different loads and speeds. **(10 Marks)**

OR

4 a. What is the main function of an MPFI system in a vehicle? What are the advantages of an MPFI? **(10 Marks)**

b. What are the requirements of fuel injection system? What are the methods of fuel injection? **(05 Marks)**

c. What are the nozzles used in CI engines? Explain any one. **(05 Marks)**

Module-3

5 a. State and explain different combustion stages in SI engines with a neat crank angle diagram. **(10 Marks)**

b. Differentiate between normal and abnormal combustion phenomena in case of SI engines. **(10 Marks)**

OR

6 a. Explain the 1st stage of combustion in CI engines in detail. **(10 Marks)**

b. What are the factors tending to reduce knocking in SI and CI engines? **(10 Marks)**

Module-4

7 a. What are the major exhaust emissions? Explain any two. **(10 Marks)**

b. Which is the most effective after treatment for reducing engine emissions? **(05 Marks)**

c. What are soot particles? **(05 Marks)**

OR

8 a. List the visible and invisible emissions in IC engines. **(05 Marks)**

b. How does the oil consumption increases in IC engines and what are its effects? **(05 Marks)**

c. What is flame quenching? Explain the reasons for flame quenching process. **(10 Marks)**

Module-5

9	a.	Discuss the advantages and disadvantages of n Alcohol as a fuel.	**(10 Marks)**
	b.	Explain the working of a stratified engine with a neat diagram.	**(10 Marks)**

OR

10	a.	List the advantages and disadvantages of hydrogen as a fuel in IC engines.	**(10 Marks)**
	b.	Explain with a neat diagram the working of a wankel engine.	**(10 Marks)**

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21ME753

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Operation Research

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 Research. List and explain briefly the phases of operation research. **(08 Marks)**

b. A farmer has 100 acres form. He can sell all tomatoes, lettuce, or radishes he can raise. The price he can obtain is Rs. 1.00 per kg for tomatoes, Rs. 0.75 a head for lettuce and Rs. 2.0 per kg for radishes. The average yield per-acre is 2000 kg of tomato, 3000 heads of lettuce and 1000 kg of radishes. Fertilizer is available at Rs. 0.50 per kg and the amount required per acre is 100 kgs each for tomatoes and lettuce and 50 kgs for radishes, labour required for sowing cultivating and harvesting per acre is 5 man-day for tomatoes and radishes, and 6 man-days for lettuce. A total of 400 man-days of labour are available at Rs. 20.00 per man-day. Formulate this problem as a linear programming model to maximize the formers total profit. **(12 Marks)**

OR

2 a. Discuss the limitations of operation research and scope/applications of OR. **(08 Marks)**

b. Solve the following LPP by graphical method and indicate the solution.

Maximize $z = 2x_1 + x_2$

Subject to $x_1 + 2x_2 \leq 10$

$x_1 + x_2 \leq 6$

$x_1 - x_2 \leq 2$

$x_1 - 2x_2 \leq 1$

$x_1, x_2 \geq . 0.$ **(12 Marks)**

Module-2

3 a. Define slack variable, surplus variable and artificial variable. **(06 Marks)**

b. Solve the following LPP by simplex method :

Maximize $Z = 12x_1 + 16x_2$

Subject to constraints $10x_1 + 20x_2 \leq 120$

$8x_1 + 8x_2 \leq 80$

with $x_1, x_2 \geq . 0.$ **(14 Marks)**

OR

4 a. Solve the following linear programming problem using Big-M-Method :

Minimize $Z = 7x_1 + 15x_2 + 20x_3$

Subject to $2x_1 + 4x_2 + 6x_3 \geq 24$

$3x_1 + 9x_2 + 6x_3 \geq 30$

$x_1, x_2, x_3 \geq 0.$ **(10 Marks)**

b. Solve the following by Dual Simplex method :

Min $Z = x_1 + 2x_2 + 3x_3$

Subject to $2x_1 - x_2 + x_3 \geq 4$

$x_1 + x_2 + 2x_3 \leq 8$

$x_2 - x_3 \geq 2$

x_1, x_2 and $x_3 \geq 0$ **(10 Marks)**

Module-3

5 a. Write a brief note on 'Degeneracy in transportation problem'. **(06 Marks)**

b. Obtain the optimum solution to the following transportation problem to minimize the total transportation cost. Initial solution by Vogel's approximation method (VAM).

		Destination			
		D1	D2	D3	Supply
Origin	O_1	2	7	4	5
	O_2	3	3	1	8
	O_3	5	4	7	7
	O_4	1	6	2	14
	Demand	7	9	18	

(14 Marks)

OR

6 a. Differentiate between transportation problem and assignment problem. **(06 Marks)**

b. A company has one surplus track in each of the cities A, B, C, D and E and one deficit truck in each of the cities 1, 2, 3, 4, 5, and 6. The distance between the cities in kilo meters is shown in the matrix below Table Q6(b). Find the assignment of truck from cities in surplus to cities in deficit so that the total distance covered by vehicles in minimum.

	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

Table Q6(b)

(14 Marks)

Module-4

7 a. Define Network , Event , Dummy Activity , Critical path. **(04 Marks)**

b. An assembly is to be made from two parts X & Y. Both parts need to be worked on a Lathe before being assembled. The sequence of activities along with their predecessor requirements is given in table Q7(b). Draw the network diagram.

Activity	A	B	C	D	E	F	G	H
Predecessor Activity	-	A	A	B	B, C	E	D, F	G

(04 Marks)

c. A project is composed of 07 Jobs whose time estimates are given in Table Q7(c).

Activity	Most likely time	Optimistic time	Pessimistic time
1-2	7	8	9
1-3	16	18	20
1-4	7	9	11
2-5	9	10	11
3-5	20	24	28
4-6	14	16	18
5-6	2	3	4

i) Draw the network and calculate the Length and variance along the critical path.

ii) Find the probability of completing the project one day earlier and 2 days later. **(12 Marks)**

OR

8 a. What are the operating characteristics of a Queuing system? **(10 Marks)**

b. A self – service store employs one cashier at its counter. 9 customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service time find

i) Average number of customers in the system
ii) Average number or customers in the queue
iii) Average time a customer spends in the system
iv) Average time a customer waits before being served. **(10 Marks)**

Module-5

9 a. Define Saddle point, Zero sum game , Game value and Pay off Matrix. **(08 Marks)**

b. Reduce the game to either m × 2 or 2 × n by dominance and then solve graphically.

		B			
		B1	B2	B3	B4
	A1	19	6	7	5
A	A2	7	3	14	6
	A3	12	8	18	4
	A4	8	7	13	-1

(12 Marks)

OR

10 a. State assumptions made while applying Johnson's rule to n jobs on 2 machines. **(05 Marks)**

b. There are six jobs P, Q, R, S, T and U have been received by a manufacturing facility to be processed on a single machine. Their processing times have been given in table.

Jobs	P	Q	R	S	T	u
Processing time (min)	7	6	8	4	3	5

Determine :

i) Optimal sequence as per SPT rule
ii) Flow time or completion time of Jobs
iii) Mean flow time
iv) Average in process inventory **(05 Marks)**

c. Use graphical method to minimize the time required to process the following Jobs on the machines. For each machine specify the jobs which should be done first. Also calculate the total elapsed time.

Job 1	Sequence	A	B	C	D	E
	Time (hr)	6	8	4	12	4
Job 2	Sequence	B	C	A	D	E
	Time (hr)	10	8	6	4	12

(10 Marks)

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