SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

9/2/24

RE-EXAM EXAMINATION FEBRUARY 2024

Program: B.Tech Mechanical T.Y. B.Tech (M) Sem V **Duration: 3 hrs.**

Course Code: PC-BTM515 **Maximum Points: 100.**

Course Name: Computer Aided Machine Drawing **Semester: V**

Important Notes:

1. Question 1 is compulsory.
2. Attempt any three out of remaining five questions.
3. Create a new folder and rename it to <Reg. No._CAMD_RE-EXAM>
4. Create separate .dwg file for each question and save in the above created folder only. File name should be <Q1_Reg. no._RE-EXAM>.
5. Answers to free hand sketches should be drawn on given A4 answer sheet and submit is back.
6. Students to carry only Admit Card, Pen, Pencil, eraser and sharpener in Exam Hall. Use of scale and any geometric instrument is prohibited in Exam Hall.
7. At the end of exam, your folder with autocad and pdf files will be uploaded by the authorized person. Before leaving the exam seat, student have to confirm that his/her folder is uploaded by the authorized person.
8. Assume suitable data wherever only if necessary.
9. **Save your Work** in AutoCad Regularly.

Q. No.		Points	MO/ CO	BL	PI
Q.1	Given in the figure is the details of Sleeve and Cotter Joint. Complete the following tasks:		03/--	03	5.1.2
	a) Draw detail drawing of each part in **2d.**	06	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Sectional Front View** of Assembly in **2d.**	07	03		
	c) Create a Bill of Material and plot a pdf file of the assembly with given template layout.	04	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	i. Metric Thread.	04	02		
	ii. ACME Thread	04			

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RE-EXAM EXAMINATION FEBRUARY 2024

Q.2	A vertical square Prism, base 50 mm side and axis 100 mm is resting on its base on the H.P. with all sides of base equally inclined to V.P. A horizontal cylinder, diameter 40 mm, having its axis parallel to both the V.P. and H.P. penetrates the prism. The axis of the solids intersects each other at right angle and cylinder axis is 50 mm above the prism base.		01/--	03	5.1.2
	a) Create 3d models of the prism and cylinder.	06	01		
	b) Create a copy of 3d models of the pyramid- cylinder and assemble them as given in problem.	04	03		
	c) plot the projections of the assembly in F.V., T.V., and S.V. showing curves of intersections in the given layout template.	07	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	1. Square Nut.	04	02		
	2. Hexagonal Bolt	04			
Q.3	Given in the figure is the Details of Protected Flange Coupling. Complete the following tasks.		04/--	03	5.1.2
	a) Create the Parts drawing in **2d** space.	07	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Sectional Front View and Side View** of Assembly in **2d.**	08	03		
	c) Create a Bill of Material and plot a pdf file of the assembly within given template layout.	05	04		
	d) Draw Free Hand Sketches of the following:	05	04/	01	1.4.1
	1. Gib Headed Key		02		

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Q.4	Given in the figure is the Details of V-Belt Pulley. Complete the following tasks.		05/--	03	5.1.2
	a) Create the part model of all parts in **3d** space.	8	01		
	b) Make one copy of each part and assemble the parts at their functional positions. Plot **Sectional Front View and Side View** of Assembly in **2d** layout with template.	6	03		
	c) Create a Bill of Material and plot a pdf file of the assembly.	6	04		
	d) Calculate the limits for Ø35 H7, g6	5	02/ 02	01	1.4.1
Q.5	Given in the figure is the Expansion Valve Assembly.		06/--	03	5.1.2
	a) Plot the **2d** detail drawing for:				
	Body: i) Sectional Front View	7	01		
	ii) Side View	7	01		
	b) Create the **3d** part model of **Gland Bush.**	6	03		
	c) Plot the **Sectional Front View** of **3d** model of **Gland Bush** in 2d layout.	5	04		
Q.6	Given in the figure is the Drill Jig Assembly.		07/--	03	5.1.2
	a) Create 3d part model of Base Plate	08	03		
	b) Plot the **Sectional Front View and Top View of 3d model** in **2d layout** with given template.	10	04		
	c) Create a **3d** model for Jig Plate.	07	03		

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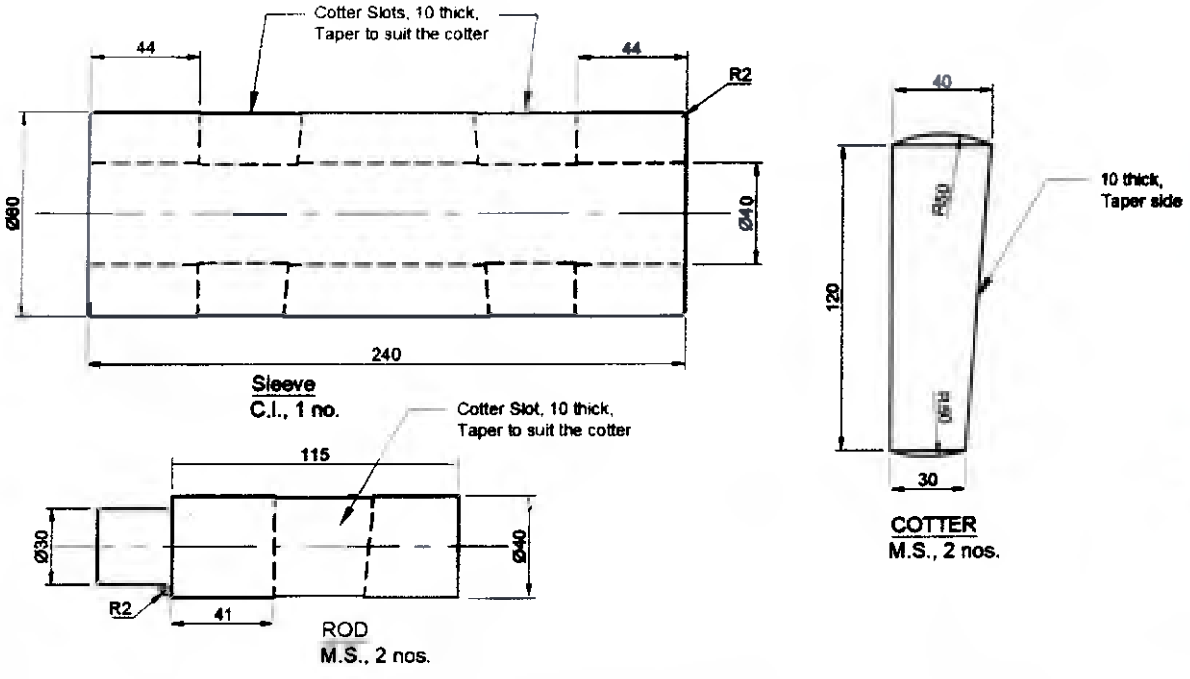
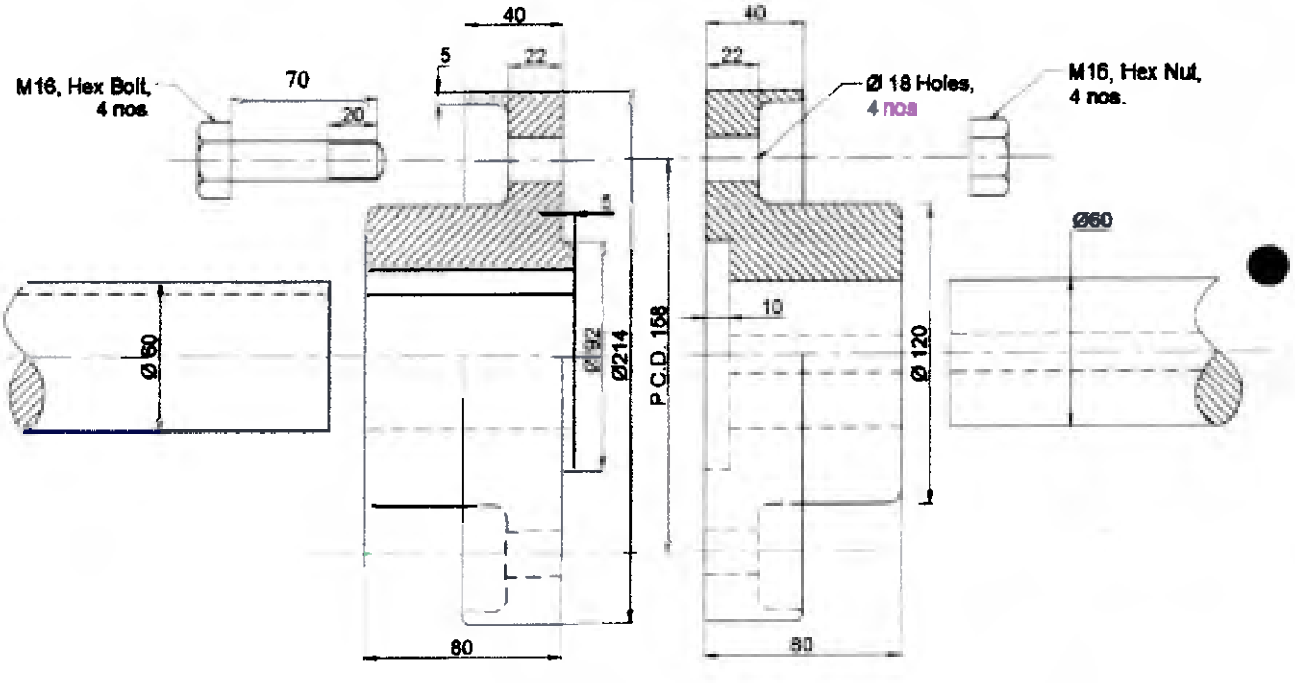
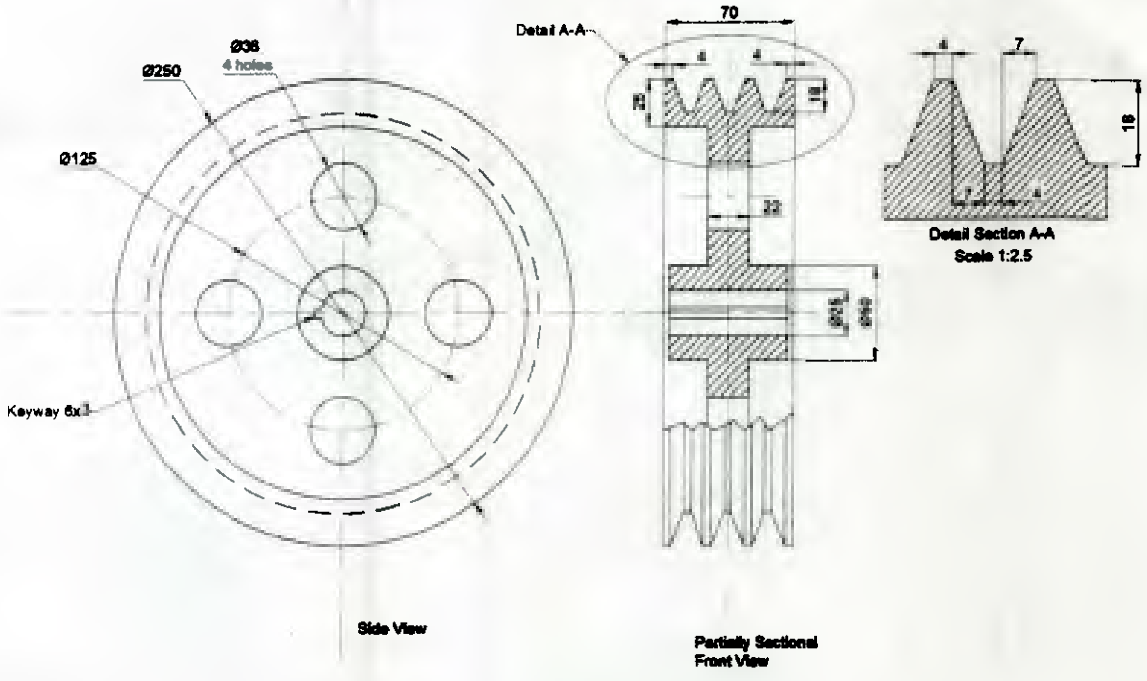


Q.1. Sleeve and Cotter Joint



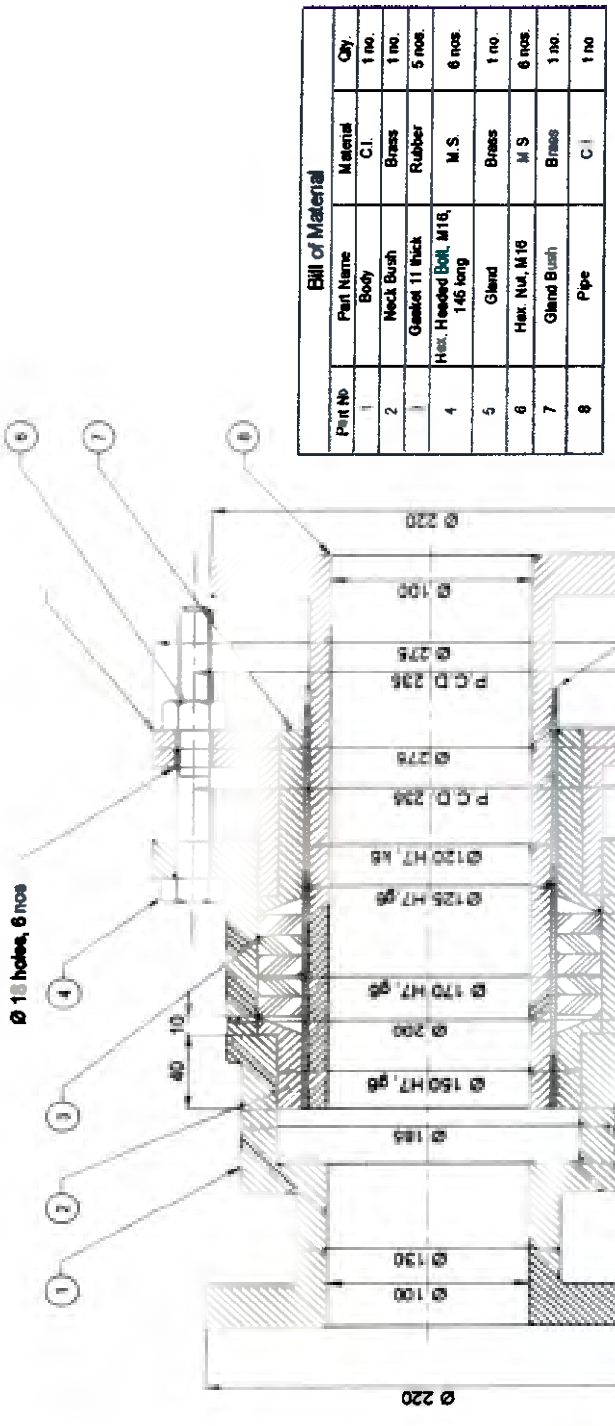
Q.3. Protected Flange Coupling

RE-EXAM EXAMINATION FEBRUARY 2024



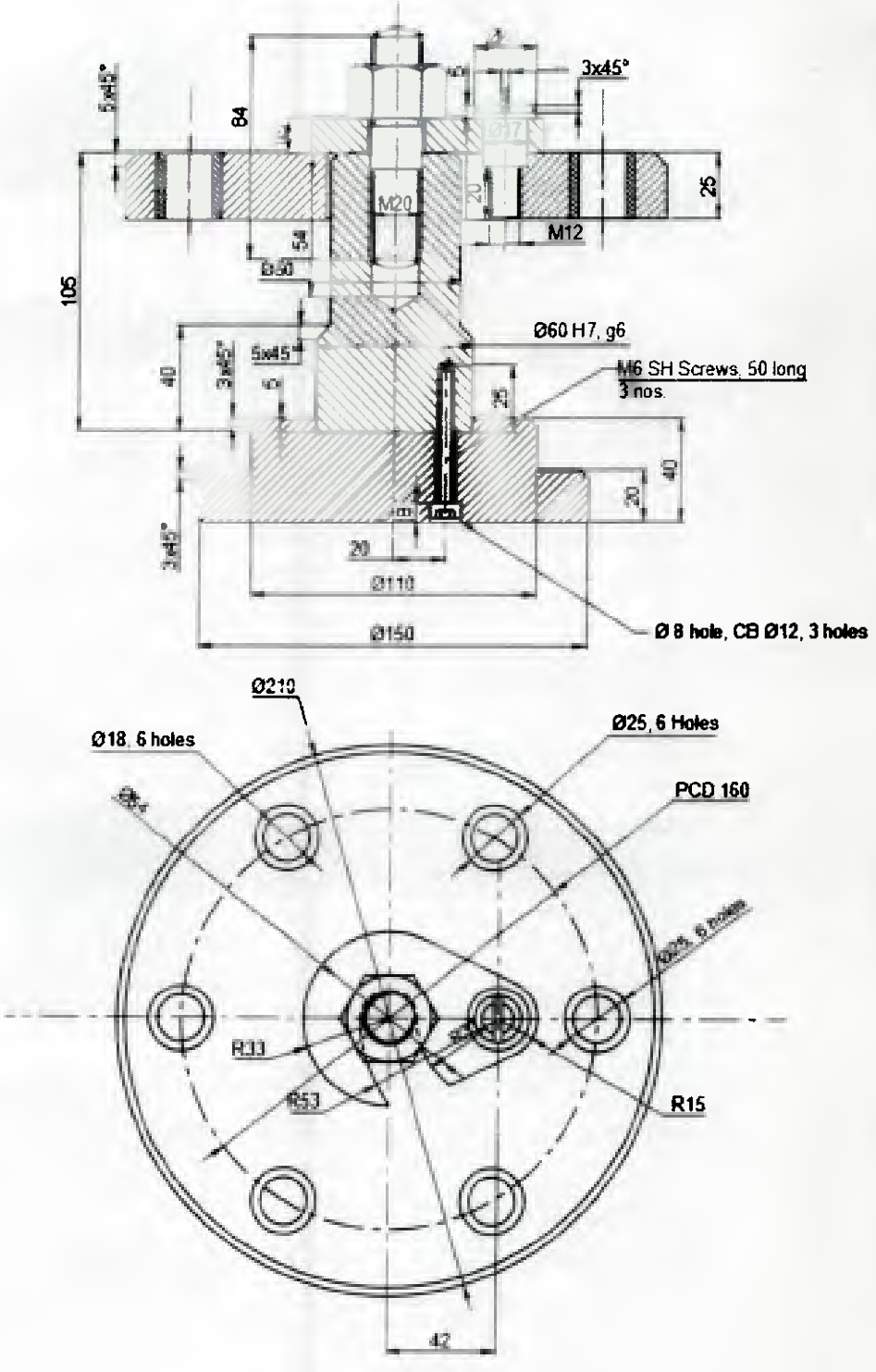
Q.4. V-Belt Pulley

RE-EXAM EXAMINATION FEBRUARY 2024



Q.5. Exapnsion Joint

RE-EXAM EXAMINATION FEBRUARY 2024



Q.6. Drill Jig Assembly

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RE-EXAM EXAMINATION FEBRUARY 2024

Limits, Tolerance Tables

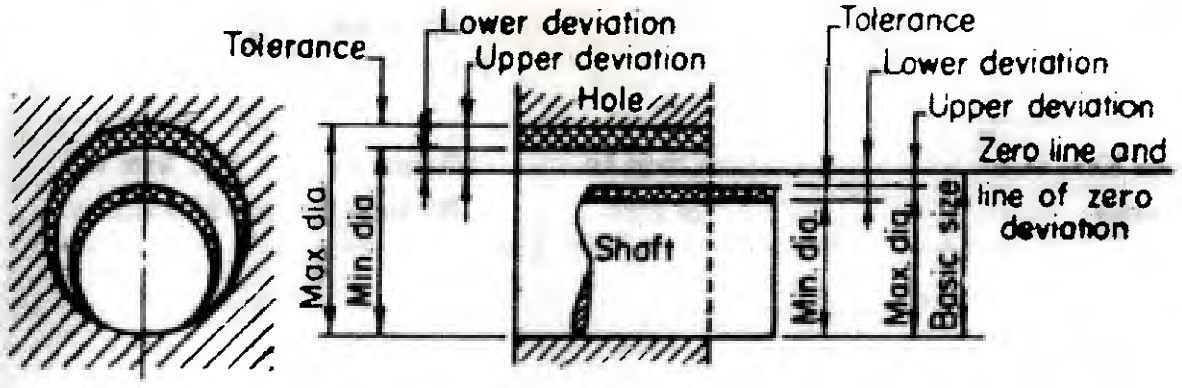

Table 1 Recommended diameter steps upto 500 mm (13 steps)

Over	-	3	6	10	18	30	50	80	120	180	250	315	400
Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia. in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm (IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	+ (IT7 – IT6)
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	+ (IT7 + 0 to 5)

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i

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ENDSEM EXAMINATION DECEMBER 2023

SET – A

Program: B.Tech Mechanical T.Y. B.Tech (Mech) **Duration: 3 hrs.**

Course Code: PC-BTM515 **Maximum Points: 100.**

Course Name: Computer Aided Machine Drawing **Semester: V**

Important Notes:

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2. Attempt any three out of remaining five questions.
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9. **Save your Work** in AutoCad Regularly.

ENDSEM EXAMINATION DECEMBER 2023

Set A

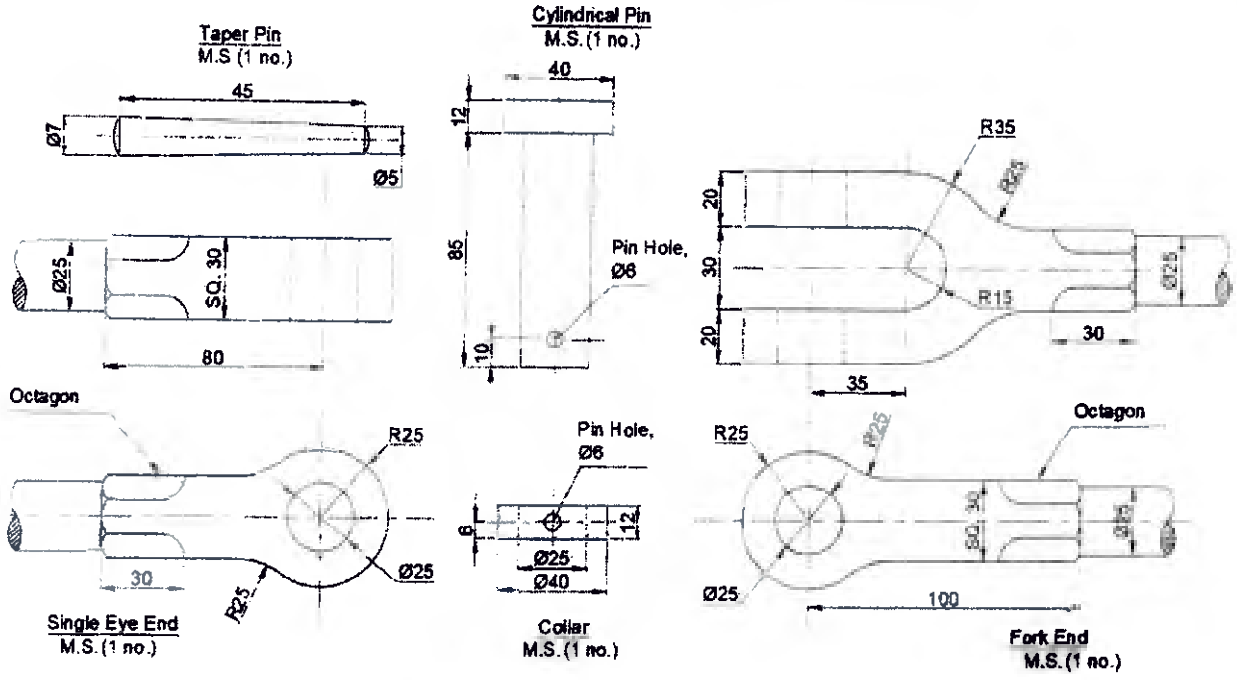
Q. No.		Points	MO/ CO	BL	PI
Q.1	Given in the figure is the details of Knuckle Joint. Complete the following tasks:		03/--	03	5.1.2
	a) Draw detail drawing of each part in **2d**.	06	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Sectional Front View** of Assembly in **2d.**	07	03		
	c) Create a Bill of Material and plot a pdf file of the assembly with given template layout.	04	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	i. BA Thread.	04	02		
	ii. Buttress Thread	04			
Q.2	A vertical square pyramid, base 60 mm side and axis 100 mm is resting on its base on the H.P. with all sides of base equally inclined to V.P. A horizontal cylinder, diameter 30 mm, having its axis parallel to both the V.P. and H.P. penetrates the pyramid. The axis of the solids intersects each other at right angle and cylinder axis is 30 mm above the pyramid base.		01/--	03	5.1.2
	a) Create 3d models of the pyramid and cylinder.	06	01		
	b) Create a copy of 3d models of the pyramid- cylinder and assemble them as given in problem.	04	03		
	c) plot the projections of the assembly in F.V., T.V., and S.V. showing curves of intersections in the given layout template.	07	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	1. Dome Nut.	04	02		
	2. Square Headed-Bolt	04			

ENDSEM EXAMINATION DECEMBER 2023

Q.3	Given in the figure is the Details of Standard Flange Coupling. Complete the following tasks.		04/--	03	5.1.2
	a) Create the Part drawing in **2d** space.	07	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Sectional Front View and Side View** of Assembly in **2d.**	08	03		
	c) Create a Bill of Material and plot a pdf file of the assembly with given template layout.	05	04		
	d) Draw Free Hand Sketches of the following: 1. Wood-ruff Key	05	04/ 02	01	1.4.1
Q.4	Given in the figure is the Details of V-Belt Pulley. Complete the following tasks.		05/--	03	5.1.2
	a) Create the part model of all parts in **3d** space.	10	01		
	b) Make one copy of each part and assemble the parts at their functional positions. Plot **Sectional Front View and Side View** of Assembly in **2d** layout with template.	5	03		
	c) Create a Bill of Material and plot a pdf file of the assembly.	5	04		
	d) Calculate the limits for Ø25 H7, f7	5	02/ 02	01	1.4.1
Q.5	Given in the figure is the Expansion Valve Assembly.		06/--	03	5.1.2
	a) Plot the **2d** detail drawing for: **Gland:** i) Sectional Front View	5	01		
	ii) Side View	7	01		
	b) Create the **3d** part model of **Neck Bush.**	8	03		
	c) Plot the **Sectional Front View** of **3d** model of **Neck Bush** in 2d layout.	5	04		

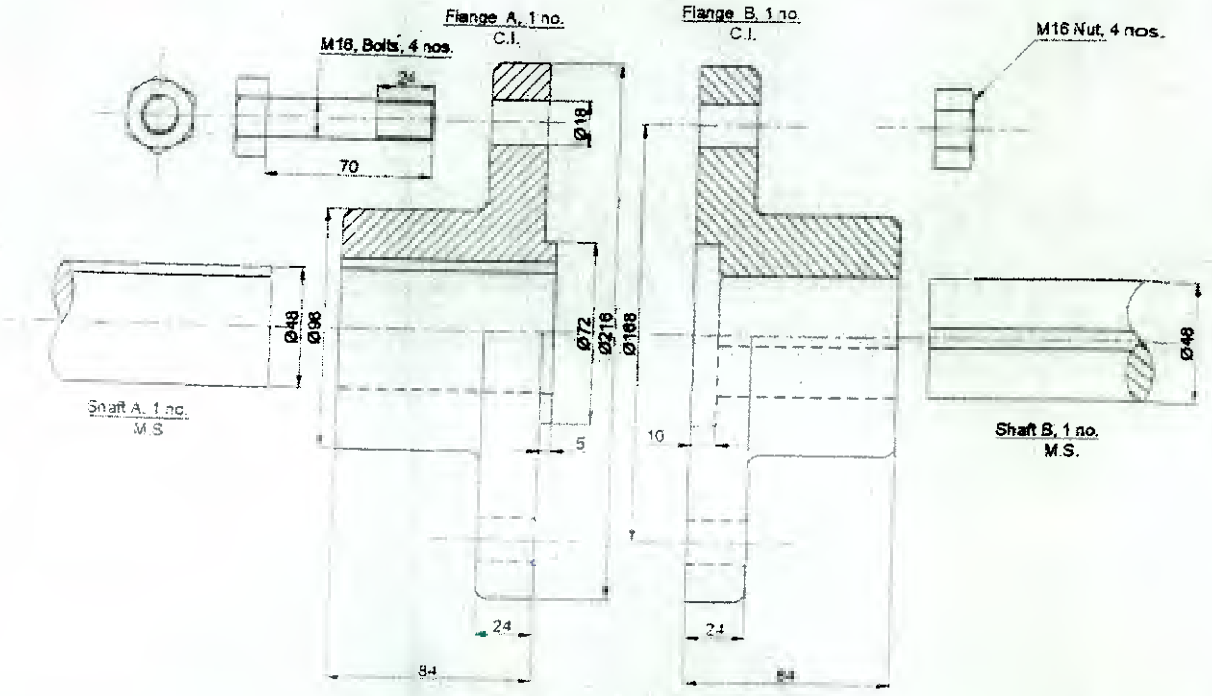
ENDSEM EXAMINATION DECEMBER 2023

Q.6	Given in the figure is the Drill Jig Assembly. a) Create 3d part model of Jig Plate b) Plot the **Sectional Front View and Top View of 3d model** in **2d layout** with given template. c) Create a **3d** model for Base Plate.	 08 10 07	07/-- 03 04 03	03	5.1.2

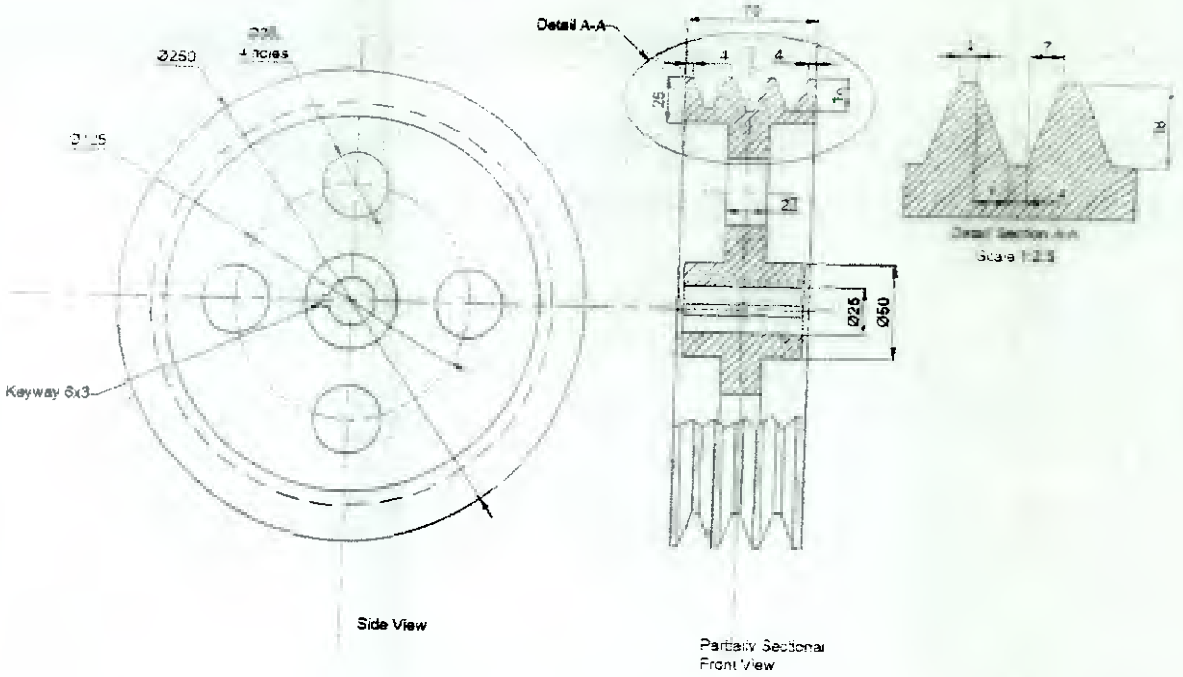


Q.1. Knuckle Joint

ENDSEM EXAMINATION DECEMBER 2023



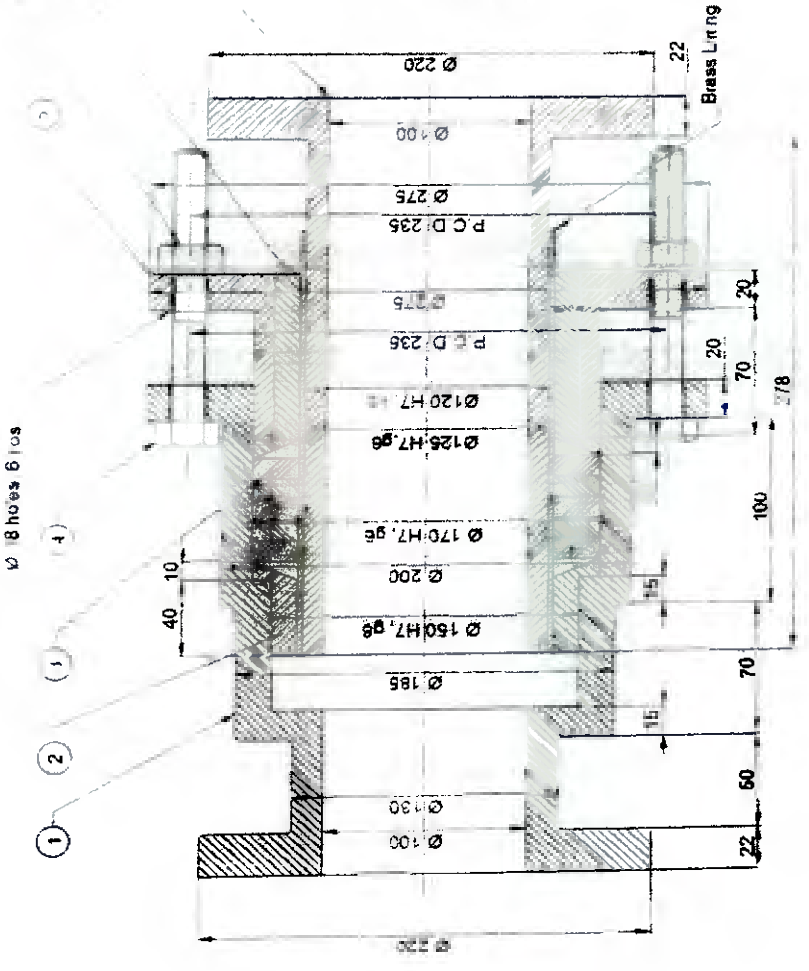
Q.3. Standard Flange Coupling



Q.4. V-Belt Pulley

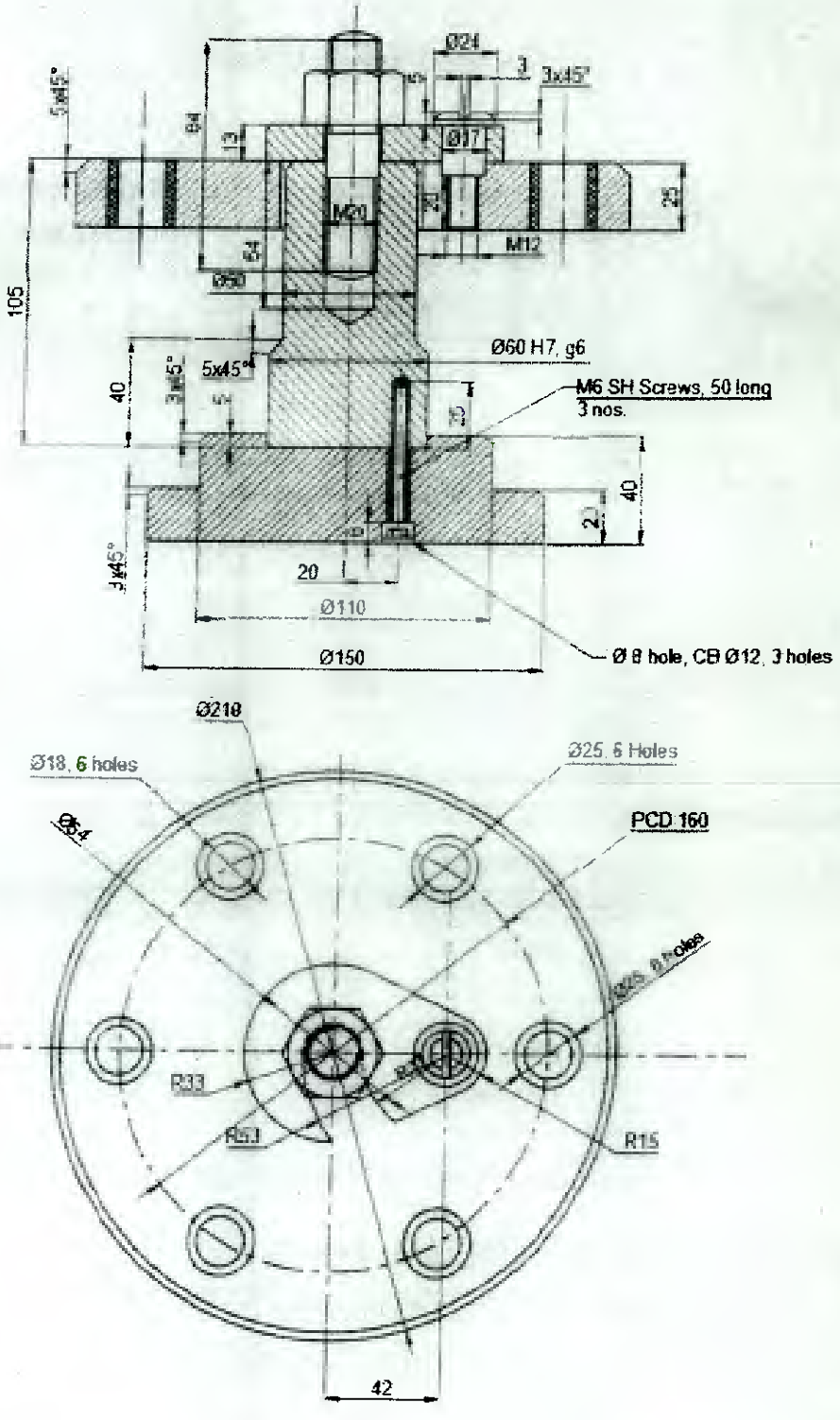
ENDSEM EXAMINATION DECEMBER 2023

Bill of Material			
Part No	Part Name	Material	Qty.
1	Body	C.I.	1 no.
2	Neck Bush	Brass	1 no.
3	Gasket 11 thick	Rubber	5 nos
4	Hex. Headed Bolt, M16 145 long	M.S	8 nos
5	Gland	Brass	1 no.
6	Hex. Nut, M16	M.S.	8 nos.
7	Gland Bush	Brass	1 no.
8	Pipe	C.I	1 no



Q.5. Exapnsion Joint

ENDSEM EXAMINATION DECEMBER 2023



Q.7. Drill Jig Assembly

ENDSEM EXAMINATION DECEMBER 2023

Limits, Tolerance Tables

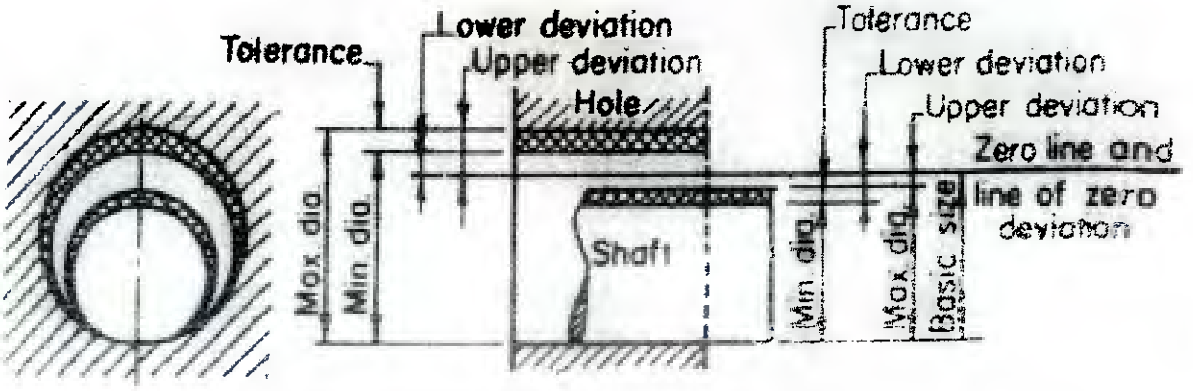


Table 1 Recommended diameter steps upto 500 mm (13 steps)

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Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia. in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm (IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	+ (IT7 – IT6)
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	+ (IT7 + 0 to 5)

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i

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ENDSEM EXAMINATION DECEMBER 2023

SET – B

T.Y. B Tech (M) Sem V

Program: B.Tech Mechanical **Duration: 3 hrs.**

Course Code: PC-BTM515 **Maximum Points: 100.**

Course Name: Computer Aided Machine Drawing **Semester: V**

Important Notes:

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4. Create separate .dwg file for each question and save in the above created folder only. File name should be <Q1_Reg. no._Endsem>.
5. Answers to free hand sketches should be drawn on given A4 answer sheet and submit is back.
6. Students to carry only Admit Card, Pen, Pencil, eraser and sharpener in Exam Hall. Use of scale and any geometric instrument is prohibited in Exam Hall.
7. At the end of exam, your folder with autocad and pdf files will be uploaded by the authorized person. Before leaving the exam seat, student have to confirm that his/her folder is uploaded by the authorized person.
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ENDSEM EXAMINATION DECEMBER 2023

Set B

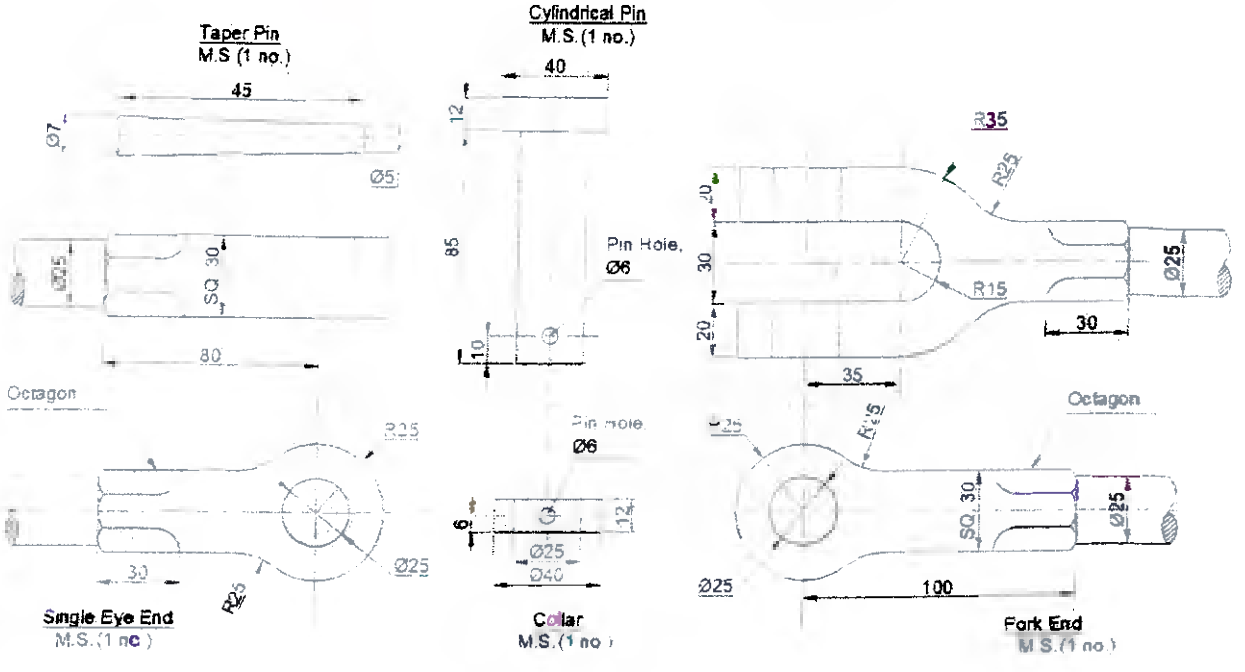
Q. No.		Points	CO/ MO	BL	PI
Q.1	Given in the figure 1 is the details of Knuckle Joint. Complete the following tasks:		03/--	03	5.1.2
	a) Draw detail drawing of each part in **2d**.	06	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Top View** of Assembly in **2d.**	07	03		
	c) Create a Bill of Material and plot a pdf file of the assembly with given template layout.	04	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	i Unified Thread.	04	02		
	ii. Square Thread	04			
Q.2	A vertical square pyramid, base 80 mm side and axis 120 mm is resting on its base on the H.P. with all sides of base equally inclined to V.P. A horizontal prism, side 40 mm, with all sides of base equally inclined to V.P. and having its axis parallel to both the V P. and H.P. penetrates the pyramid. The axis of the solids intersects each other at right angle and prism axis is 40 mm above the pyramid base.		01/--	03	5.1.2
	a) Create 3d models of the pyramid and prism.	04	01		
	b) Create a copy of 3d models of the pyramid- prism and assemble them as given in problem.	04	03		
	c) plot the projections of the assembly in F.V., T.V., and S.V showing lines of intersections in the given layout template.	09	04		
	d) Draw Free Hand Sketches of the following:		02/	01	1.4.1
	1. Wing Nut.	04	02		
	2. T-Bolt	04			

ENDSEM EXAMINATION DECEMBER 2023

Q.3	Given in the figure is the Details of Protected Flange Coupling. Complete the following tasks.		04/--	03	5.1.2
	a) Create the Part drawing in **2d** space.	07	01		
	b) Make one copy of each part and assemble the parts at their functional positions where u can see **Sectional Front View and Side View** of Assembly in **2d.**	08	03		
	c) Create a Bill of Material and plot a pdf file of the assembly with given template layout.	05	04		
	d) Draw Free Hand Sketches of the following: 1 Gib Headed Key	05	04/ 02	01	1.4.1
Q.4	Given in the figure is the Details of V-Belt Pulley. Complete the following tasks.		05/--	03	5.1.2
	a) Create the part model of all parts in **3d** space.	10	01		
	b) Make one copy of each part and assemble the parts at their functional positions. Plot **Sectional Front View and Side View** of Assembly in **2d** layout with template.	5	03		
	c) Create a Bill of Material and plot a pdf file of the assembly.	5	04		
	d) Calculate the limits for Ø35 H7,f7	5	02/ 02	01	1.4.1
	1.				
Q.5	Given in the figure is the Expansion Valve Assembly.		06/--	03	5.1.2
	a) Plot the **2d** detail drawing for:				
	Gland: i) Front View	5	01		
	ii) Side View	7	01		
	b) Create the **3d** part model of **Gland Bush.**	8	03		
	2. Plot the **Sectional Front View** of **3d** model of **Gland Bush** in 2d layout.	5	04		

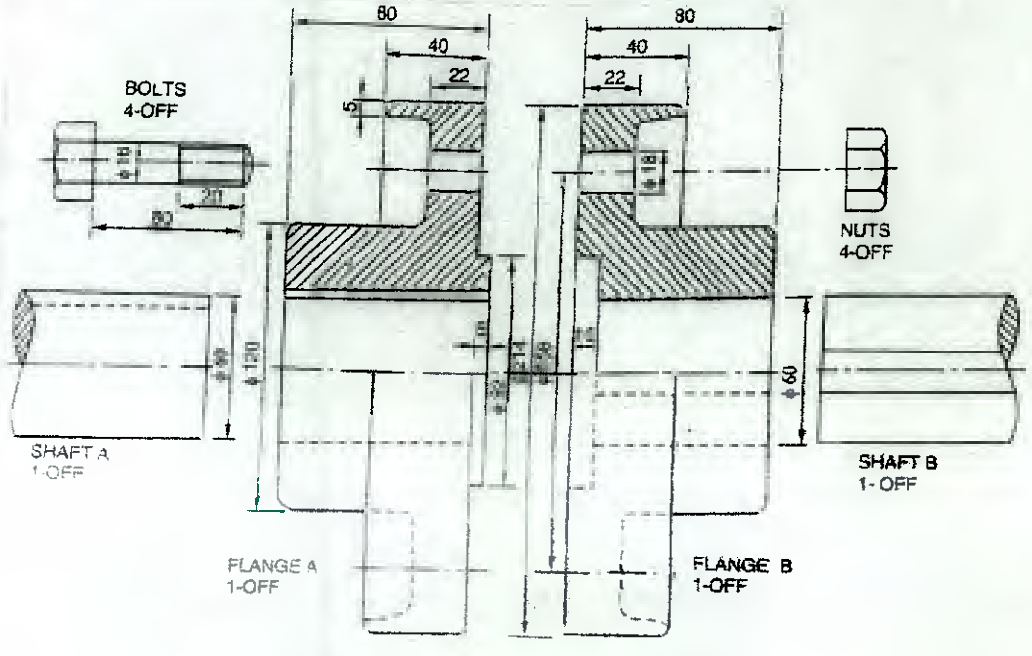
ENDSEM EXAMINATION DECEMBER 2023

Q.6	Given in the figure is the Drill Jig Assembly.		07/--	O3	5.1.2
	a) Create 3d part model of Latch washer	08	03		
	b) Plot the **Front View and Top View of 3d model** in **2d layout** with given template.	10	04		
	c) Create a **3d** model for Stem.	07	03		

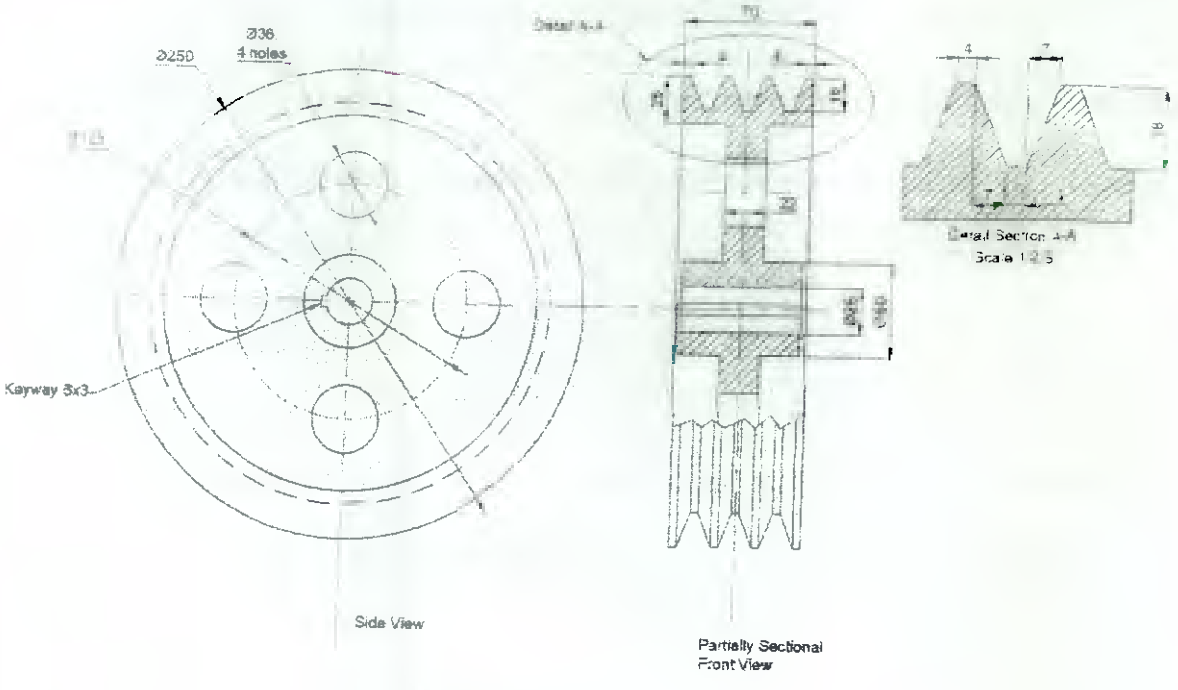


Q.1. Knuckle Joint

ENDSEM EXAMINATION DECEMBER 2023



Q.3. Protected Type Flange Coupling

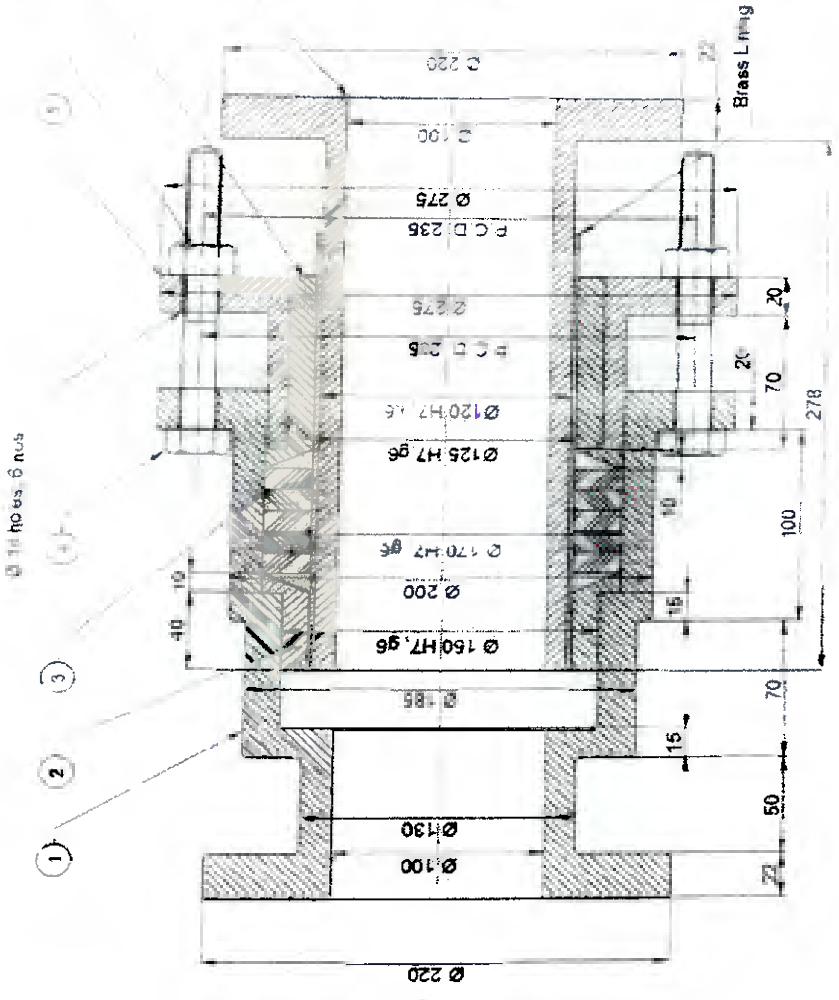


Q.4. V-Belt Pulley

ENDSEM EXAMINATION DECEMBER 2023

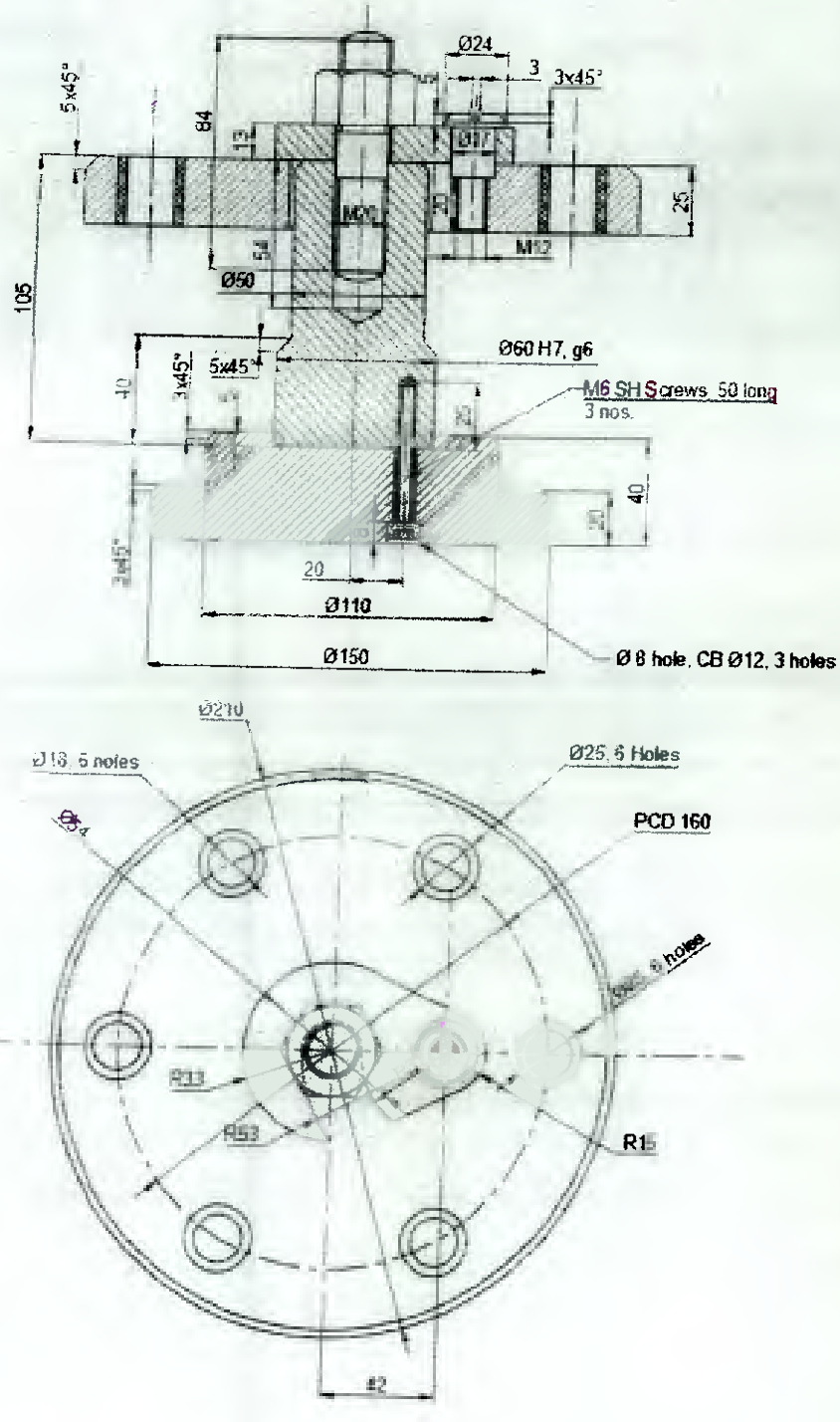
Bill of Material

Part No	Part Name	Material	Qty
1	Body	C.I	1 no.
2	Neck Bush	Brass	1 no.
3	Gasket 11 thick	Rubber	5 nos.
4	Hex. Headed Bolt, M16, 145 long	M S	6 nos
5	Gland	Brass	1 no
6	Hex. Nut, M16	M S	6 nos.
7	Gland Bush	Brass	1 no
8	Pipe	C.I	1 no



Q.5. Exapnsion Joint

ENDSEM EXAMINATION DECEMBER 2023



Q.7. Drill Jig Assembly

ENDSEM EXAMINATION DECEMBER 2023

Limits, Tolerance Tables

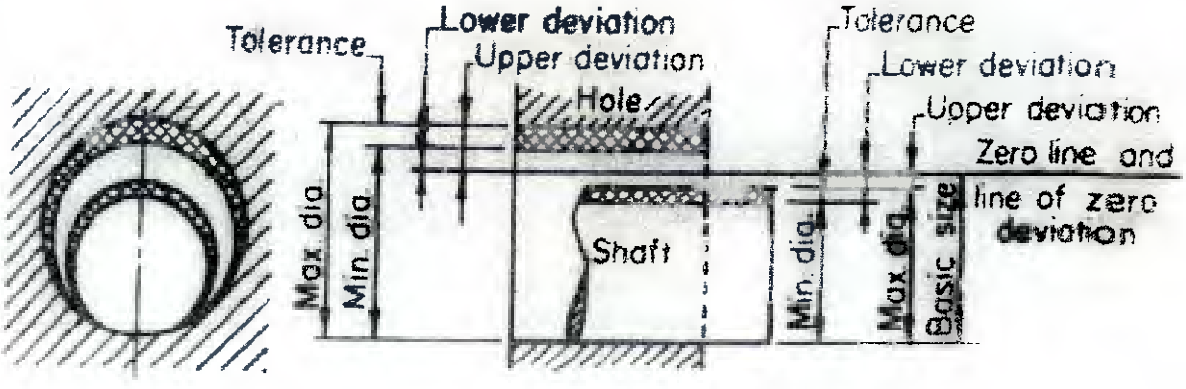


Table 1 Recommended diameter steps upto 500 mm (13 steps)

Over		3	6	10	18	30	50	80	120	180	250	315	400
Upto	3	6	10	18	30	50	80	120	180	250	315	400	500

Table 2 Equations to calculate fundamental deviation of shaft size up to 500 mm (D = Geometrical mean dia in mm)

Symbol	Fundamental deviation in microns	Symbol	Fundamental deviation in microns
d	$-16D^{0.44}$	js	$\pm(IT/2)$
e	$-11D^{0.41}$	k4 to k7	$+0.63D^{1/2}$
f	$-5.5D^{0.41}$	m	+ (IT7 – IT6)
g	$-2.5D^{0.34}$	n	$+5D^{0.34}$
h	0	p	+ (IT7 + 0 to 5)

Table 3 Fundamental Tolerance for IT grades in terms of i.

IT Grade	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16
Tolerance in Microns	7i	10i	16i	25i	40i	64i	100i	160i	250i	400i	640i	1000i

Exam

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SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

PREVIOUS SEMESTER EXAMINATION FEBRUARY 2024

Program: Third year B. Tech. Mechanical Sem V

Duration: 03 Hrs.

Course Code: PC–BTM512

Maximum Points: 100

Course Name: Dynamics of Machinery

Semester: V

Notes: 1. Attempt any 5 questions
2. Each questions carry equal marks
3. Assume suitable data wherever necessary and justify the same

Q.No.	Questions	Points	CO	BL	Module No.
1	a) Explain Prony brake dynamometer b) The turning moment diagram of a four stroke engine may be assumed for the sake of simplicity to be represented by four triangles in each stroke. The areas of these triangles are as follows: Suction stroke = 5×10^{-5} m^2; Compression stroke = 21×10^{-5} m^2; Expansion stroke = 85×10^{-5} m^2; Exhaust stroke = 8×10^{-5} m^2. All the areas excepting expression stroke are negative. Each m^2 of area represents 14 MN-m of work. Assuming the resisting torque to be constant, determine the moment of inertia of the flywheel to keep the speed between 98 r.p.m. and 102 r.p.m. Also find the size of a rim-type flywheel based on the minimum material criterion, given that density of flywheel material is 8150 kg/m^3; the allowable tensile stress of the flywheel material is 7.5 MPa. The rim cross-section is rectangular, one side being four times the length of the other.	05 15	1	3	1
2	a) Derive the expression for effect of gyroscopic couple on stability of an four wheeler vehicle. b) The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: 1. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 2. when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.	12 08	1	1,2	2

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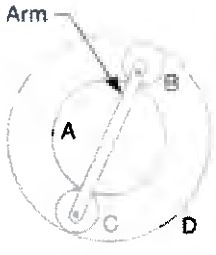
3	a) Define the following terms: i. Sensitiveness ii. Stability iii. Isochronous iv. Hunting b) The following particulars refer to a Proell governor with open arms : Length of all arms = 200 mm, distance of pivot of arms from the axis of rotation = 40 mm, length of extension of lower arms to which the ball is attached = 100 mm, mass of each ball = 6 kg and mass of the central load = 150 kg. If the radius of rotation of the balls is 180 mm when the arms are inclined at 40° to the axis of rotation, find : 1. the equilibrium speed for the above configuration, 2. the coefficient of insensitiveness if the friction of the governor mechanism is equivalent to a force of 20 N at the sleeve, and 3. the range of speed between which the governor is inoperative.	08 12	1	3	3
4	a) An epicyclic train of gears is arranged as shown in Figure. How many revolutions does the arm, to which the pinions B and C are attached, make: 1. when A makes one revolution clockwise and D makes half a revolution anticlockwise, and 2. when A makes one revolution clockwise and D is stationary ? The number of teeth on the gears A and D are 40 and 90 respectively.  b) Explain with a neat sketch the sun and planet wheel.	15 05	1	3	4
5	a) Define the following: (i) Damped Vibrations (ii) Forced Vibrations (iii) Resonance (iv) Transverse Vibrations b) Derive the expression for free longitudinal vibrations by equilibrium method.	08 12	3	2,3	5
6	a) Explain following systems: i. Underdamped ii. Critically damped	12	4	2,3	6

PREVIOUS SEMESTER EXAMINATION FEBRUARY 2024

	iii. Overdamped b) Determine the equivalent spring stiffness and the natural frequency of the following vibrating system when the i. mass is suspended to a spring ii. mass is suspended at the bottom of two springs in series	08			
7	a) A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centres are 30 mm, 38 mm, 40 mm and 35 mm respectively from the axis of rotation. The masses A, C and D are 7.5 kg, 5 kg and 4 kg respectively. The axial distances between the planes of rotation of A and B is 400 mm and between B and C is 500 mm. The masses A and C are at right angles to each other. Find for a complete balance, 1. the angles between the masses B and D from mass A, 2. the axial distance between the planes of rotation of C and D, 3. the magnitude of mass B. b) Explain balancing of four cylinder four stroke in line engine.	12 08	2	3	7

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END SEMESTER EXAMINATION DECEMBER 2023

Program: Third year B. Tech. Mechanical Sem V

Duration: 03 Hrs.

Course Code: PC–BTM512

Maximum Points: 100

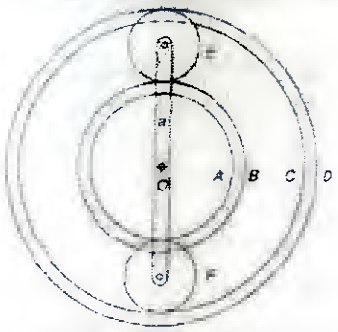
Course Name: Dynamics of Machinery

Semester: V

Notes: 1. Attempt any 5 questions
2. Each questions carry equal marks
3. Assume suitable data wherever necessary and justify the same

Q.No.	Questions	Points	CO	BL	Module No.
1	a) Explain Epicyclic Train Dynamometer. b) In a belt transmission dynamometer, the driving pulley rotates at 300 rpm. The distance between the centre of the driving pulley and the dead mass is 800 mm. The diameter of each of the driving as well as the intermediate pulley is equal to 360 mm. Find the value of the dead mass required to maintain the lever in a horizontal position when the power transmitted is 2 KW. Also, find its value when the belt just begins to slip on the driving pulley. μ being 0.25 and the maximum tension in the belt is 1200 N. c) A flywheel with a mass of 3 KN has a radius of gyration of 1.6 m. Find the energy stored in the flywheel when its speed increases from 315 rpm to 340 rpm.	05 10 05	1	3	1
2	a) The turbine rotor of a ship has a mass of 2.2 tonnes and rotates at 1800 rom clockwise when viewed from the aft. The radius of gyration of the rotor is 320 mm. Determine the gyroscopic couple and its effect when the (i) Ship turns right at a radius of 250 m with a speed of 25 km/h (ii) Ship pitches with the bow rising at an angular velocity of 0.8 rad/s (iii) Ship rolls at an angular velocity of 0.1 rad/s. b) Explain gyroscopic effect on aeroplanes while taking left and right turn.	12 08	1	1,2	2
3	a) Explain Controlling force diagram. b) Each ball of a porter governor has a mass of 3 kg and the mass of the sleeve is 15 kg. The governor has equal arms each of 200 mm	06	1	3	3

END SEMESTER EXAMINATION DECEMBER 2023

	length and pivoted on the axis of rotation. When the radius of rotation of the balls is 120 mm. The sleeve begins to rise up 160 mm at the maximum speed. Determine the (i) Range of speed (ii) Lift of the sleeve (iii) Effort of the governor (iv) Power of the governor What will be the effect of friction at the sleeve if it is equivalent to 8 N?	14			
4	a) Define the following terms: I. Pressure Line II. Path of Contact III. Arc of Recess b) An epicyclic gear as shown in figure, the compound wheels A and B as well as internal wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to the arm A. All the wheels are of the same module. The number of teeth on the wheels are $T_A = 52$, $T_B = 56$, $T_E = T_F = 36$ Determine the speed of C if (i) The wheel D fixed and arm a rotates at 200 rpm clockwise (ii) The wheel D rotates at 200 rpm counterclockwise and the arm A rotates at 20 rpm counter clockwise. 	06 14	1	3	4
5	a) Define the following: (i) Damped Vibrations (ii) Forced Vibrations (iii) Resonance (iv) Transverse Vibrations b) Derive the expression for free longitudinal vibrations by equilibrium method.	08 12	3	2,3	5

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6	a) Differentiate between Viscous and Coulomb damping. b) A vibratory system consist of a mass of 50 kg, a spring with a stiffness of 30 kN/m and a damper. The damping provided is only 20% of the critical value. Determine the (i) Damping factor (ii) critical damping coefficient (iii) natural frequency of damped vibrations (iv) Logarithmic decrement (v) Ratio of two consecutive amplitudes.	05 15	4	2,3	6
7	a) Four masses A, B, C and D are completely balanced. Masses C and D make angles of 90^0 and 195^0 respectively with that of mass B in the counterclockwise direction. The rotating masses have the following properties: mb = 25 kg ra = 150 mm mc = 40 kg rb = 200 mm md = 35 kg rc = 100 mm rd = 180 mm Planes B and C are 250 apart. Determine the (i) Mass A and its angular position with that of mass B (ii) Positions of all the planes relative to plane of mass A b) Explain balancing of four cylinder four stroke in line engine.	12 08	2	3	7

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11/12/24

Program: B.Tech T.Y. B.Tech (M) Sem V
Course Code: PC-BTM514
Course Name: Thermal Systems

Duration: 3 Hours
Maximum Points: 100
Semester: V

Notes:

1. Question number ONE is compulsory and solve any FOUR questions out of remaining SIX.
2. Steam table and Mollier diagram is allowed to use.
3. All sub questions to be grouped together.
4. Assume suitable data wherever necessary and justify the same.

Q. No.	Questions	Points	CO	BL	Module No
1(a)	Explain effect of pressure ratio on volumetric efficiency of reciprocating compressor.	5	1	1	1
1(b)	Draw neat sketch of the elements of condensing plant and explain function of each element.	5	3	1	3
1(c)	Differentiate between impulse and reaction turbine	5	3	1	5
1(d)	Draw neat sketch of centrifugal compressor and explain its working.	5	3	1	2
2(a)	Derive the condition of intermediate pressure for minimum work required per kg of air delivered by two stage compressor with perfect intercooling is given by. $P_2 = \sqrt{P_1 P_3}$	8	1	2	1
(b)	A single acting two stage compressor with perfect intercooling delivers 5 kg/min of air at 15 bar pressure. The entry condition of air at 1 bar pressure and 15^0 C. The compression and expansion follows the law $Pv^{1.3} = C$. Estimate the power required to run the compressor and isothermal efficiency when speed of the compressor is 420 rpm. Assume the clearance of L.P. and H.P to 5% and 6% of the respective cylinder swept volume. Also estimate the clearance volume in cm^2 for each cylinder.	12	2	3	1
3(a)	Explain with neat sketch working of root blower and vane-type blower.	10	1	1	2
(b)	A convergent nozzle is supplied with steam at 10 bar and 270°C. The diverging portion of the nozzle is 3.2cm long and throat diameter is 6 mm. Find the semi-cone angle of the divergent section so that the steam leaves the nozzle at 1.2 bar. The loss in the nozzle due to friction is 15% of the total enthalpy drop. Assume that the loss takes place only in the divergent part of the nozzle.	10	4	3	5

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End Semester Examinations - December 2023

4(a)	Draw neat sketch of evaporative condenser and explain its working.	**10**	3	1	4
(b)	The following data refer to a single stage impulse turbine: Isentropic nozzle enthalpy drop = 210 kJ/kg, Nozzle efficiency = 90% Nozzle angle = 25°C Ratio of blade speed to whirl component of steam = 0.5 Blade velocity coefficient = 0.9 The velocity of steam entering the nozzle = 30 m/s Estimate the followings: (i) The blade angles at inlet and outlet if the steam enters the blades without shock and leaves the blades in an axial direction. (ii) Blade efficiency (iii) Power developed (iv) Axial thrust if the steam flow rate is 10 kg/sec.	**10**	4	3	5
5(a)	Draw neat sketch of Cochran boiler and explain its working in detail.	**10**	3	2	3
(b)	Derive an equation for maximum efficiency of impulse turbine assuming that blades are symmetrical i.e.($\beta_1=\beta_2$) and no friction in the fluid passage, which is given by: $(\eta_b)_{max} = Cos^2\alpha_1$	**10**	3	2	5
6(a)	Draw neat sketch of the fusible plug and economizer used in the steam generator and explain its function.	**10**	3	1	3
(b)	Draw schematic diagram and T-s diagram for methods which are used to improve the thermal efficiency of open cycle gas turbine given below. Also write equation of work input to compressor, work output by turbine, work available and thermal efficiency for each method. (i) Regeneration (ii) Intercooling and (iii) Reheating	**10**	3	1,2	6
7(a)	Explain the working of Pelton wheel turbine with neat sketch	**10**	3	1,2	7
(b)	In an open constant pressure gas turbine, air enters the compressor at 1.02 bar and 27°C. The pressure of air after the compression is 4.08 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The A:F ratio used is 80:1. Find the I.P. and thermal efficiency of the cycle if the flow rate of air is 2.5 kg/sec. Take C_p = 1 kJ/kg. K and γ=1.4 for air and gases. Take calorific value of fuel used = 41720 kJ/kg.	**10**	4	1	6

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Re-Examination – February 2024

Program: T Y. B. Tech Mechanical Engineering **Duration: 3 hours**
Course Code: PC-BTM501 **Maximum Points:100**
Course Name: Heat and Mass Transfer **Semester: V**

1. **Q.1 is COMPULSORY.** Solve **any Four questions out of remaining Six.**
2. Use of **heat exchanger data and charts** duly approved by the examiner is permitted.
3. Use of **Reference Data** for **Properties of fluids, Convective heat transfer correlations and Heisler Charts** duly approved by examiner is permitted.
4. Draw **neat sketches** wherever required.
5. Answers to theory questions should be **specific** and in **legible handwriting.**

Q.No.	Questions	Points	CO	BL	Module
1	Solve any four (a) What is lumped capacity? What is meant by transient heat conduction? (b) Define the terms; Total emissive power, Monochromatic emissive power, Emissivity, Black body and Grey body (c) A surface of area 3m2 and at 200°C exchanges heat with another surface at 30°C by radiation. If value of factor due to the geometric location and emissivity is 0.60, determine :(i)The rate of heat transfer (ii)The value of thermal resistance, and (iii)The equivalent convection coefficient. (d) Define the Coefficient of convective heat transfer with clearly stated formulae and it's nomenclature. (e) Define the terms mass density and mass fraction.	**20**	1,2	1,2	3,5,1,4,7
2(a)	A 240 mm steam main pipe which is 240 meters long, covered with 50 mm of high temperature insulation (k = 0.092 W/m°C) and 40 mm of low temperature insulation (k = 0.062 W/m°C). The inner and outer surface temperatures as measured are 390°C and 40°C respectively. **Evaluate:** (i) The total heat loss per hour (ii) The heat loss per m^2 of pipe surface (iii)The total heat loss per m^2 of outer surface, and (iv)The temperature between two layers of insulation.	**10**	1,2	3,4	2

	Neglect heat conduction through pipe material				
2(b)	A cold storage room has walls made of 220 mm of brick on the outside, 90 mm of plastic foam, and finally 16 mm of wood on the inside. The outside and inside air temperatures are 25°C and -10°C respectively. If the inside and outside heat transfer coefficients are respectively 30 and 11 W/m^2°C, and the thermal conductivities of brick, foam and wood are 0.99, 0.022 and 0.17 W/m°C respectively. **Estimate:** (i) The rate of heat removal by refrigeration if the total wall area is 85 m^2. (ii) The temperature of the inside surface of the brick.	**10**	1,2	3,4	2
3(a)	A 120 mm thick large steel plate (k = 42.6 W/m °C, α = 0.043 m^2/h), initially at 440°C is suddenly exposed on both sides to an environment with convective heat transfer coefficient 235 W/m^2 °C and temperature 50°C. Determine the center line temperature, and temperature inside the plate 15 mm from the midplane after 4.3 minutes.	**10**	4	1,3	6
3(b)	Derive an expression for LMTD of counter flow heat exchanger with neat sketch of flow arrangement and temperature distribution along the length of heat exchanger.	**10**	2	1,2,3	6
4(a)	The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s respectively. The inlet temperature on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both side are 500 W/m^2°C. Calculate the area of the heat exchanger.	**10**	4	3,5	7
4(b)	A counter-flow heat exchanger is employed to cool 0.55 kg/s (c_p = 2.45 kJ/kg °C) of oil from 115°C to 40°C by the use of water. The inlet and outlet temperatures of cooling water are 15°C and 75°C, respectively. The overall heat transfer coefficient is expected to be 1450 W/m^2 °C. Using NTU method, estimate the followings: (i) The mass flow rate of water, (ii) The effectiveness of the heat exchanger, (iii) The surface area required.	**10**	4	3,5	7

Re-Examination – February 2024

5(a)	State: The following laws of radiation and Express: Mathematical equation/s for each of them. i) Stefan-Boltzmann Law ii) Kirchoff's Law iii) Wien's Displacement Law iv) Lambert's Cosine Law	**10**	3	1,2	5
5(b)	For an industrial furnace in the form of a black body emitting radiations at 2500°C, Evaluate: i) Monochromatic emissive power at 1.2 μm. ii) Wavelength at which emission is maximum iii) Maximum emissive power iv) Total emissive power v) Total emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.8	**10**	3	5	5
6(a)	Give formulation of Stanton Number and give nomenclature of each property in it.	**04**	01	01	04
6(b)	A hot plate height 1m and wide 0.5 m at 90°C is kept vertically in still air at 30°C. Find: (i) Heat transfer coefficient. (ii) Rate of cooling for one side of the plate. Select the thermal properties from the given property table. $Nu_L = 0.59(Gr \cdot Pr)^{1/4}$ for $10^4 < Gr \cdot Pr < 10^9$. $Nu_L = 0.10(Gr \cdot Pr)^{1/3}$ for $10^9 < Gr \cdot Pr < 10^{12}$	**10**	04	03	04
6(c)	Show and explain the hydrodynamic and thermal boundary layer formation over a flat plate.	**06**	04	03	04
7(a)	Air at 25°C is flowing over a flat plate at a velocity of 5 m/s. if the plate is 300 mm wide and at 65°C, Calculate the following: (i) Bulk Mean Temperature (T_f), (ii) Boundary layer thickness (δ) (iii) Thickness of thermal boundary layer (δ_{th}) (iv) Local convective heat transfer coefficient at x = 150 mm, (h_x) (v) Rate of Convective heat transfer by plate, Q_{conv} Select appropriate correlation: $Nu_x = 0.332 (Re)^{1/2} * (Pr)^{1/3}$ for laminar flow $\overline{Nu} = 0.332 (Re)^{1/2} * (Pr)^{1/3}$ for laminar flow $Nu_x = 0.036 [(Re_x)^{0.8} - 850] * (Pr)^{1/3}$ – Turbulent Flow	**10**	04	4	04

7(b)	Hydrogen gas is maintained at pressures of 2.4 bar and 1 bar on opposite sides of a plastic membrane 0.3 mm thick. The binary diffusion coefficient of hydrogen in the plastic is 8.6×10^{-8} m^2/s and solubility of hydrogen in the membrane is 0.00145 kg-mole/m^3-bar. Calculate under uniform temperature conditions of 24°C, the following: Molar Concentrations of hydrogen at opposite faces of membrane, Mass diffusion flux of hydrogen through the membrane. Mass fraction of each species. Molar fraction of each species.	**10**	04	03	07

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End Semester Exam – December 2023 Examinations

Program: T Y. B. Tech Mechanical Engineering Sem V **Duration: 3 hours**

Course Code: PC-BTM501 **Maximum Points:100**

Course Name: Heat and Mass Transfer **Semester: V**

Important Instructions:

1. Q.1 is compulsory.
2. Solve **any four** questions **out of remaining six.**
3. Use of **Reference Data** for **Properties of fluids, Convective heat transfer correlations Heisler Charts and heat exchanger data** charts duly approved by examiner is permitted.
4. Draw **neat sketches** wherever necessary.
5. Answers to theory questions should be **specific** and in legible **handwriting.**

Q.No.	Questions	Points	CO	BL	Module No.
1	Solve **any four** of the followings: **(5 marks each)**	**20**			
	(a) What is LMTD correction factor? Why is a counter flow heat exchanger more effective than a parallel flow heat exchanger? How does fouling factor affect the performance of a heat exchanger?		1	2	6
	(b) A surface of area $3m^2$ and at 200°C exchanges heat with another surface at 30°C by radiation. If value of factor due to the geometric location and emissivity is 0.60, determine (i) The rate of heat transfer (ii) The value of thermal resistance, and (iii) The equivalent convection coefficient.		3	3	5
	(c) What is a black body? How does it differ from a gray body?		1	1	5
	(d) Differentiate between Forced and Natural Convection?		1	2	4
	(e) Define the terms mass concentration and mass fraction.		1	1	7

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2(a)	The interior of a refrigerator having inside dimensions of 0.5m x 0.5m base area and 1m height is to be maintained at 6°C. The walls of the refrigerator are constructed of two mild steel sheets 3mm thick ($k = 46.5\ W/m°C$) with 50 mm of glass wool insulation ($k=0.046\ W/m°C$) between them. If the average heat transfer coefficients at the outer and inner surfaces are 11.6 $W/m^2°C$ and 14.5 $W/m^2°C$ respectively. Estimate the followings: The rate at which heat must be removed from the interior to maintain the specific temperature in the kitchen at 25°C, and The temperature on the outer surface of the metal sheet.	**10**	4	1,2,3	2
2(b)	A 240 mm steam main pipe which is 210 meters long, covered with 50 mm of high temperature insulation (k = 0.092 W/m°C) and 40 mm of low temperature insulation (k = 0.062 W/m°C). The inner and outer surface temperatures as measured are 390°C and 40°C respectively. **Evaluate:** (i) The total heat loss per hour (ii) The heat loss per m^2 of pipe surface (iii)The total heat loss per m^2 of outer surface, and (iv)The temperature between two layers of insulation. Neglect heat conduction through pipe material.	**10**	4	1,2,3	2
3(a)	A 60 mm thick large steel plate (k = 42.6 W/m °C, α = 0.043 m^2/h), initially at 440°C is suddenly exposed on both sides to an environment with convective heat transfer coefficient 235 W/m^2 °C and temperature 50°C. Determine the center line temperature, and temperature inside the plate 15 mm from the midplane after 4.3 minutes.	**10**	4	1,2,3	3
3(b)	Derive an expression for LMTD of parallel flow heat exchanger.	**10**	4	1,2,3	6
4(a)	In a certain double pipe heat exchanger hot water flows at a rate of 5000 kg/h and gets cooled from 95°C to 65°C. At the same time 50000 kg/h of cooling water is at 30°C enters the heat exchanger. The flow conditions are such that overall heat transfer coefficient remains constant at 2270 W/m^2 K.	**10**	4	1,2,3	6

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	Estimate: (ii) the heat transfer area required (iii) the effectiveness, assuming two streams are in parallel flow. Assume for both the streams C_p = 4.2 kJ/kg K.				
4(b)	Steam at atmospheric pressure enters the shell of a surface condenser in which the water flows through a bundle of tubes of diameter 25 mm at the rate of 0.05 kg/s. The inlet and outlet temperatures of water are15°C and 70°, respectively. The condensation of steam takes place on the outside surface of the tube. If the overall heat transfer coefficient is 230 W/m^2°C. Estimate the followings using NTU method. Take the latent heat of vaporization at 100°C = 2257 kJ/kg. (i) The effectiveness of the heat exchanger, (ii) The length of the tube (iii) The rate of steam condensation.	**10**	4	1,2,3	6
5(a)	State: The following laws of radiation and Express: Mathematical equation/s for each of them. i) Stefan-Boltzmann Law ii) Kirchoff's Law iii) Wien's Displacement Law iv) Lambert's Cosine Law	**10**	3	1,2	5
5(b)	For an industrial furnace in the form of a black body emitting radiations at 3000°C, Evaluate: i) Monochromatic emissive power at 1.2 μm, ii) Wavelength at which emission is maximum, iii) Maximum emissive power, iv) Total emissive power, v) Intensity of normal radiation,	**10**	3	5	5
6(a)	Give formulation of Grashoff Number and give nomenclature of each property in it.	**04**	01	01	04
6(b)	A hot plate height 1m and wide 0.5 m at 130°C is kept vertically in still air at 20°C. Find: (i) Heat transfer coefficient. (ii) Rate of cooling if both sides of plate are considered. Select the thermal properties from the given property table. $Nu_L = 0.59(Gr \cdot Pr)^{1/4}$ for $10^4 < Gr \cdot Pr < 10^9$. $Nu_L = 0.10(Gr \cdot Pr)^{1/3}$ for $10^9 < Gr \cdot Pr < 10^{12}$.	**10**	04	03	04

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6(c)	Show and explain the effects of Pr number on relation of hydrodynamic and thermal boundary layer.	**06**	04	03	04
7(a)	Air at 1 bar pressure and 20°C is flowing over a flat plate at a velocity of 3 m/s. if the plate is 280 mm wide and at 60°C, Calculate the following: (i) Bulk Mean Temperature (T_f), (ii) Boundary layer thickness (δ) (iii) Thickness of thermal boundary layer (δ_{th}) (iv) Local convective heat transfer coefficient at x – 200 mm, (h_x) (v) Rate of Convective heat transfer by plate, Q_{conv} Select appropriate correlation: $Nu_x = 0.332\ (Re)^{1/2} * (Pr)^{1/3}$ for laminar flow $\overline{Nu} = 0.332\ (Re)^{1/2} * (Pr)^{1/3}$ for laminar flow $Nu_x = 0.036\ [(Re_x)^{0.8} - 850] * (Pr)^{1/3}$ – Turbulent Flow	**10**	04	4	04
7(b)	Hydrogen gas is maintained at pressures of 2.4 bar and 1 bar on opposite sides of a plastic membrane 0.3 mm thick. The binary diffusion coefficient of hydrogen in the plastic is 8.6×10^{-8} m^2/s and solubility of hydrogen in the membrane is 0.00145 kg-mole/m^3-bar. Calculate under uniform temperature conditions of 24°C, the following: (i) Molar Concentrations of hydrogen at opposite faces of membrane, (ii) Mass diffusion flux of hydrogen through the membrane.	**10**	04	03	07

TABLE A–9

Properties of air at 1 atm pressure

Temp. T, °C	Density ρ, kg/m³	Specific Heat c_p J/kg·K	Thermal Conductivity k, W/m·K	Thermal Diffusivity α, m²/s	Dynamic Viscosity μ, kg/m·s	Kinematic Viscosity ν, m²/s	Prandtl Number Pr
−150	2.866	983	0.01171	4.158×10^{-6}	8.636×10^{-6}	3.013×10^{-6}	0.7246
−100	2.038	966	0.01582	8.036×10^{-6}	1.189×10^{-5}	5.837×10^{-6}	0.7263
−5	1.582	999	0.01979	1.252×10^{-5}	1.474×10^{-5}	9.319×10^{-6}	0.7440
−40	1.514	1002	0.02057	1.356×10^{-5}	1.527×10^{-5}	1.008×10^{-5}	0.7436
−30	1.451	1004	0.02134	1.465×10^{-5}	1.579×10^{-5}	1.087×10^{-5}	0.7425
−20	1.394	1005	0.02211	1.578×10^{-5}	1.630×10^{-5}	1.169×10^{-5}	0.7408
−10	1.341	1006	0.02288	1.696×10^{-5}	1.680×10^{-5}	1.252×10^{-5}	0.7387
0	1.292	1006	0.02364	1.818×10^{-5}	1.729×10^{-5}	1.338×10^{-5}	0.7362
5	1.269	1006	0.02401	1.880×10^{-5}	1.754×10^{-5}	1.382×10^{-5}	0.7350
10	1.246	1006	0.02439	1.944×10^{-5}	1.778×10^{-5}	1.426×10^{-5}	0.7336
15	1.225	1007	0.02476	2.009×10^{-5}	1.802×10^{-5}	1.470×10^{-5}	0.7323
20	1.204	1007	0.02514	2.074×10^{-5}	1.825×10^{-5}	1.516×10^{-5}	0.7309
25	1.184	1007	0.02551	2.141×10^{-5}	1.849×10^{-5}	1.562×10^{-5}	0.7296
30	1.164	1007	0.02588	2.208×10^{-5}	1.872×10^{-5}	1.608×10^{-5}	0.7282
35	1.145	1007	0.02625	2.277×10^{-5}	1.895×10^{-5}	1.655×10^{-5}	0.7268
40	1.127	1007	0.02662	2.346×10^{-5}	1.918×10^{-5}	1.702×10^{-5}	0.7255
45	1.109	1007	0.02699	2.416×10^{-5}	1.941×10^{-5}	1.750×10^{-5}	0.7241
50	1.092	1007	0.02735	2.487×10^{-5}	1.963×10^{-5}	1.798×10^{-5}	0.7228
60	1.059	1007	0.02808	2.632×10^{-5}	2.008×10^{-5}	1.896×10^{-5}	0.7202
70	1.028	1007	0.02881	2.780×10^{-5}	2.052×10^{-5}	1.995×10^{-5}	0.7177
80	0.9994	1008	0.02953	2.931×10^{-5}	2.096×10^{-5}	2.097×10^{-5}	0.7154
90	0.9718	1008	0.03024	3.086×10^{-5}	2.139×10^{-5}	2.201×10^{-5}	0.7132
100	0.9458	1009	0.03095	3.243×10^{-5}	2.181×10^{-5}	2.306×10^{-5}	0.7111
120	0.8977	1011	0.03235	3.565×10^{-5}	2.264×10^{-5}	2.522×10^{-5}	0.7073
140	0.8542	1013	0.03374	3.898×10^{-5}	2.345×10^{-5}	2.745×10^{-5}	0.7041
160	0.8148	1016	0.03511	4.241×10^{-5}	2.420×10^{-5}	2.975×10^{-5}	0.7014
180	0.7788	1019	0.03646	4.593×10^{-5}	2.504×10^{-5}	3.212×10^{-5}	0.6992
200	0.7459	1023	0.03779	4.954×10^{-5}	2.577×10^{-5}	3.455×10^{-5}	0.6974
250	0.6746	1033	0.04104	5.890×10^{-5}	2.760×10^{-5}	4.091×10^{-5}	0.6946
300	0.6158	1044	0.04418	6.871×10^{-5}	2.934×10^{-5}	4.765×10^{-5}	0.6935
350	0.5664	1056	0.04721	7.892×10^{-5}	3.101×10^{-5}	5.475×10^{-5}	0.6937
400	0.5243	1069	0.05015	8.951×10^{-5}	3.261×10^{-5}	6.219×10^{-5}	0.6948
450	0.4880	1081	0.05298	1.004×10^{-4}	3.415×10^{-5}	6.997×10^{-5}	0.6965
500	0.4565	1093	0.05572	1.117×10^{-4}	3.563×10^{-5}	7.806×10^{-5}	0.6986
600	0.4042	1115	0.06093	1.352×10^{-4}	3.846×10^{-5}	9.515×10^{-5}	0.7037
700	0.3627	1135	0.06581	1.598×10^{-4}	4.111×10^{-5}	1.133×10^{-4}	0.7092
800	0.3289	1153	0.07037	1.855×10^{-4}	4.362×10^{-5}	1.326×10^{-4}	0.7149
900	0.3008	1169	0.07465	2.122×10^{-4}	4.600×10^{-5}	1.529×10^{-4}	0.7206
1000	0.2772	1184	0.07868	2.398×10^{-4}	4.826×10^{-5}	1.741×10^{-4}	0.7260
1500	0.1990	1234	0.09599	3.908×10^{-4}	5.817×10^{-5}	2.922×10^{-4}	0.7478
2000	0.1553	1264	0.11113	5.664×10^{-4}	6.630×10^{-5}	4.270×10^{-4}	0.7539

Note: For ideal gases, the properties c_p, k, μ, and Pr are independent of pressure. The properties ρ, ν, and α at a pressure P (in atm) other than 1 atm are determined by multiplying the values of ρ at the given temperature by P and by dividing ν and α by P.

Source: Data generated from the EES software developed by S. A. Klein and F. L. Alvarado. Original sources: Keenan, Chao, Keyes, Gas Tables, Wiley, 198; and Thermophysical Properties of Matter, Vol. 3: Thermal Conductivity, Y. S. Touloukian, P. E. Liley S C. Saxena, Vol. 11: Viscosity, Y. S. Touloukian, S. C. Saxena, and P. Hestermans, IFI/Plenun, NY, 1970, ISBN 0-306067020-8.

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SARDAR PATEL COLLEGE OF ENGINEERING

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Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination December 2023

Program: T.Y .Mechanical Engineering Sem V

Duration: 3 Hour

Course Code: **MC- BT003**

Maximum Points: 100

Course Name: **Health Safety and Environment**

Semester: V

Notes: 1. Solve any Five main questions out of Seven main questions.
2. Draw neat schematic diagrams wherever is necessary, highlight important points.
3. Assume suitable data if necessary and mention it.

Q.No.	Questions	Points	CO	BL	Module No.
Q1 A	What are the industry and vehicle specific air pollution control strategies that can be adopted and implemented in metro city like Delhi and Mumbai?	10	4	3	5
Q1 B	What are main sources of air pollution and type of pollutants observed in Metro cities, Rural areas and critically polluted areas?	10	4	1	5
Q2 A	Classification of wastes according to their origin and type?	10	3	2	7
Q2 B	What is BASEL convention? Give its importance? List down impacts of waste if not managed properly? Explain each impact using 2 important points?	10	3	2	7
Q3 A	Give important elements involved in "Framework for implementation of Ramsar Convention". Explain pointwise how conservation of wetland can be done to implement this convention?	10	3,4	1	6
Q3 B	Explain the following pointwise about wetlands a)Values, b) Functions?	10	3,4	1	6
Q4 A	With the help of neat sketch, Explain "Cycle of neglect" in developing countries. Discuss pointwise about Limitations of existing statutes related to occupational health and safety (OHS)?	10	2	2	1
Q4 B	A gas oven system consist of Gas cylinder which is regulated by manual valve C, Rubber pipe and gas oven system with burner A and B which controlled by manual valve A and B. In the initial event of leakage of gas, there are 3 possible accident scenarios are fire, small release and safe release. i) Construct fault tree	10	1	2	4

End Semester Examination December 2023

	ii) Obtain formulae for probability of accident scenarios				
Q5 A	Give fundamental objectives of occupational health and safety?	10	1	1	1
Q5 B	What is integrity of system in OHS scenario? What is "Heinrich triangle"? Using neat block diagram show steps involved in safety function deployment?	10	1	2	2
Q6 A	Write short note on Fault tree analysis using following points; a) Event symbols, b) Gate symbols, c) different principal concepts to construct fault tree?	10	1	1	4
Q6 B	Explain using definition and with an example, what is hazard, accident and risk? Draw neat sketch of Peterson model of Accident Causation or any other model?	10	1	2	2
Q7 A	What is Pareto chart and explain its significance in relation to failure mode and effect analysis (FMEA)? Draw recommended worksheet for the Preliminary hazard analysis and FMEA?	10	1,2	1	3
Q7 B	Explain stepwise process or algorithm used for process related hazard analysis technique. If an fertilizer manufacturing unit uses two chemical's like ammonia and phosphoric acid, then apply hazard analysis at any one node using all possible guide words?	10	1	1	3

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Re Sem Examination Feb 2024

Program: Mechanical Engineering T.Y. B.Tech (my term V) **Duration: 3 Hrs**

Course Code: PE BTM 532 **Maximum Points: 100**

Course Name: Mechatronics **Semester: V**

Notes:

1. **Q.1** is compulsory
2. Solve any Four out of **Q.2** to **Q.7**
3. **Assume suitable data wherever necessary**

Q.No.	Questions	Points	CO	BL	Mod. No.
1 a	Enlist the different applications of Mechatronics in day to day life	05	I	3	I
1b	Explain Meter in and Meter out circuit and differentiate the same	05	I	4	III
1c	Draw and explain bottle filling plat with functional block diagram	05	IV	5	V
1 d	Discuss the Flag register of 8085 with suitable example	05	II	3	II
2a	Explain the term Clock signal, Interrupt signals, Control signals, Address and data bus in 8085	10	II	5	II
2 b	Discuss in detail the PSW and Internal RAM of 8051	10	II	3	II
3 a	Discuss the different applications of hydraulic and pneumatic and different components of hydraulic components	10	III	4	III
3 b	Explain term Transfer function and differentiate open loop and closed loop system	10	IV	5	III
4a	Develop and explain the working principle of Robotic Manipulator and sequencing circuit.	10	III	3	IV

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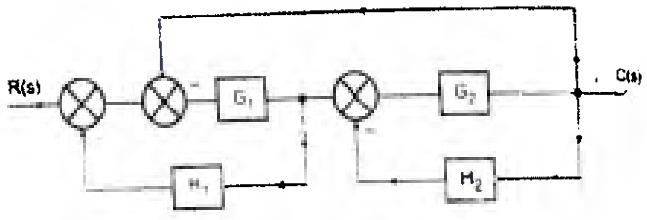
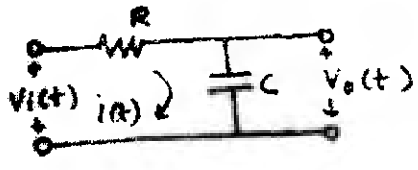
Re Sem Examination Feb 2024

4b	Explain the block diagram reduction rule and reduce the block diagram to simple form and obtain transfer function of following diagram 	10	IV	4	IV
5a	Solve the Routh-Herwith criteria $s^3 + s^2 + s^3 + s^1 + 4 = 0$ and Routh criteria $s^5 + 2s^4 + 3s^3 + 6s^2 + 2s + 1=0$	10	IV	3	VII
5b	A unity feedback system has $G(s) = \frac{K(s+2)}{s(s^3+7s^3+12s)}$, Determine i) Type of system, ii) all error coefficients and iii) Error for input $\frac{R}{2}t^2$	10	IV	4	VII
6a	Explain the term Time response analysis with suitable example and develop the derivation of steady state error.	10	IV	5	IV
6b	Find the transfer function of the given network 	10	III	5	IV
7a	Develop a ticket vending m/c for western railway using the mechatronics concept with suitable sketches.	10	II	5	VI
7b	Derive the steady state error and effect of change in input R(s) and change in G(s) H(S) on steady state error.	10	III	5	VI

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8/11/24

END SEMESTER EXAMINATION, DECEMBER 2023

T. Y. (M)

B.Tech. (Mechanical Engineering) Semester –V Duration: **Three Hour**

Course: **COMPRESSIBLE FLUID FLOW (PE BTM 554)** Maximum Points :**100**

Notes

- Answer any FIVE from seven questions,
- Answers to all sub questions should be grouped together for evaluation,
- Make suitable assumption if needed with proper reasoning,
- Data shown under column CO and BL are only for academic evaluation (CO: Course Outcome, BL: Blooms Taxonomy,)

		Points	CO	BL
1.	Explain you understanding about the following terms of a compressible flow. a) Mach number and classification of flow regimes based on it, b) Bulk modulus, coefficient of volumetric expansion and compressibility, c) Stagnation state and critical state, d) Concept of maximum speed in compressible flow.	[20]	1	4
2.	(A) Examine the characteristic features of compressible low and identify its basic equations? Write them in their mathematical form.	[10]	4	4,5
	(B) Derive following expressions $\frac{T_0}{T} = 1 + \left(\frac{\gamma - 1}{2}\right) M^2$ What do you understand by this expression? Conclude an appropriate expression for pressure and density also.	[10]	3	3,4
3.	(A) Differentiate between following. i) Compressible and Incompressible, ii) Subsonic and Supersonic, iii) Critical state and stagnation state of fluid flow, iv) Normal and oblique shock wave	[10]	1,2	4
	(B) Derive following expression and explain the effect of flow area variation on velocity and pressure of the flow for the sub sonic and supersonic flow. $\frac{dV}{V} = -\frac{dA}{A}\frac{1}{\left[1 - M^2\right]}$,	[10]	3	3
4.	(A) Derive an expression for maximum flow rate through a varying area duct. Analyze and discuss the expression.	[10]	3,4	2,3
	(B) Consider steady adiabatic flow of air through a long straight pipe with $A=0.05m^2$. At inlet section the air is at 200kPa(abs), 60°C and 146 m/s. At a downstream location the air is 95.6 kPa(abs), and 280 m/s. Determine p_{01}, p_{02}, T_{01}, T_{02} and entropy change for the flow. (Using Gas table not permitted here)	[10]	2,3	3,4

5.	(A) Draw a schematic diagram of a supersonic wind tunnel. Discuss the different components involved here. Analyse the problems associated to its design and fabrication.	[10]	1,2	1,2
	(B) A normal shock wave exists in a 500 m/s stream of Nitrogen with a static temperature of -40 ℃ and static pressure of 70kPa. Calculate the Mach number, pressure and temperature downstream of the wave and entropy increase across the wave. For nitrogen, γ=1.4, R=297 J/kg.K. (Use Gas Table)	[10]	2,3	3,4
6.	(A) Discuss Rayleigh Flow. List down all governing equation required to characterize this flow. Represent it on a Ts diagram and explain its unique feature.	[10]	1,3	2,4
	(B) A long pipe of 25.4 mm diameter has a mean coefficient of friction of 0.003. Air enters the pipe at a Mach number of 2.5, stagnation temperature 310K and static pressure 0.507 bar. Determine for a section at which the Mach number reaches 1.2 **(Use Gas Table),** (a) static pressure and temperature (b) stagnation pressure and temperature (c) velocity of air (d) distance of section from the inlet, and (e) mass flow rate of the air		3,4	3,4
7.	(A) What is Fanno flow? Sketch Fanno line on an appropriate property diagram and explain it. Discuss the effect of Fanno flow on following properties: Pressure, temperature, density, enthalpy and velocity of flow.	[10]	1,2	1,2
	B) A combustion chamber in a gas turbine plant receives air at 350K, 0.55 bar and 75m/s. The air/fuel ratio is 29 and the calorific value of the fuel is 41.87 MJ/kg. Taking γ = 1.4, and R = 0.287kJ/kg-K for the gas determine: (a) the initial and final Mach numbers (b) final pressure, temperature and velocity of the gas, (c) % stagnation pressure loss in the combustion chamber, and (d) the maximum stagnation temperature attainable. **(Use Gas Table),**	**[10]**	3,4	3,4

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RE-EXAMINATION, FEBRUARY 2024

T.Y. (Mech) Sem V

B.Tech. (Mechanical Engineering) Semester –V Duration: **Three Hour**

Course: **COMPRESSIBLE FLUID FLOW (PE BTM 554)** Maximum Points :**100**

Notes

- Answer any FIVE from seven questions,
- Answers to all sub questions should be grouped together for evaluation,
- Make suitable assumption if needed with proper reasoning,
- Data shown under column CO and BL are only for academic evaluation (CO: Course Outcome, BL: Blooms Taxonomy,)

		Points	CO	BL
1.	Distinguish between the following terms. a) Incompressible and Compressible flow, b) Subsonic, sonic and supersonic flow conditions, c) Stagnation state and critical state, d) Chocked flow and non-chocked flow.	[20]	1	4
2.	(A) Derive an expression for the velocity of sound. Write the mathematical form of all basic governing equations of a compressible flow.	[10]	4	4,5
	(B) Derive an expression for maximum flow rate through a varying area duct. Analyze and discuss the expression.	[10]	3	3,4
3.	(A) Derive following expression for a variable area flow. $$\frac{A}{A^*} = \frac{1}{M}\left[\frac{1+\frac{k-1}{2}M^2}{\frac{k+1}{2}}\right]^{(k+1)/2(k-1)}$$	[10]	1,2	4
	(B) Consider steady, adiabatic flow of air through a long straight pipe with A = 0.05 m^2. At the inlet (section 1) the air is at 200 kPa (abs), 60C, and 146 m/s. Downstream at section 2 , the air is at 95.6 kPa (abs) and 280 m/s. Determine p_{01}, p_{02}, T_{01}, T_{02}, and the entropy change for the flow.	[10]	3	3
4.	(A) What do you understand by the following expression? Derive it. $$\frac{T_0}{T} = 1+\left(\frac{\gamma-1}{2}\right)M^2$$ Conclude an appropriate expression for pressure and density also.	[10]	3,4	2,3
	(B) A supersonic diffuser decelerates air isentropically from a Mach number of 3 to a Mach number of 1.4. If static pressure at diffuser inlet is 30kPa(abs), calculate static pressure rise in the diffuser and the ratio of inlet to outlet area of the diffuser. (Using Gas table not permitted here)	[10]	2,3	3,4
5.	(A) What are the important characteristics of a supersonic wind tunnel? What are its different arrangements that commonly used? Draw a schematic diagram of all.	[10]	1,2	1,2

	(B) A normal shock occurs in the divergent section of a CD nozzle. The upstream mach number is 1.8, pressure is 0.5 bar and area ratio(A_e/A^*) of divergent section is 3. Calculate the mach number, static and stagnation pressure at the exit of the nozzle assuming isentropic flow after the shock. (Use Gas Table)	[10]	2,3	3,4
6.	(A) What do you understand by a Fanno flow? Sketch Fanno line on an appropriate property diagram and explain it.	[10]	1,3	2,4
	(B) Consider a pipe of diameter 50 mm with wall friction factor 0.008. Air at stagnation pressure and temperature 10 bar and 400K respectively is supplied to the pipe at Mach number 3. Exit Mach number is 1. Determine the mass flow are and the length of the pipe. (Use Gas Table),		3,4	3,4
7.	(A) Discuss Rayleigh Flow. List down all governing equation required to characterize this flow. Represent it on a Ts diagram and explain its unique feature.	[10]	1,2	1,2
	B) The Mach number at the exit of a combustion chamber is 0.9. the ratio of stagnation temperature at the exit and entry is 3.74. The pressure and temperature of the gas of exit are 2.5 bar and 1000°C respectively, determine (a) M, P, T of the gas at the entry, (b) heat supplied per kg of the gas and (c) the maximum heat that can be supplied. (Use Gas Table),	[10]	3,4	3,4

Bharatiya Vidya Bhavan's

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Re-EXAMINATIONS Feb 2024

T.Y. Sem V

Program :**BTech Mechanical engg** **Duration** :**3 hr**

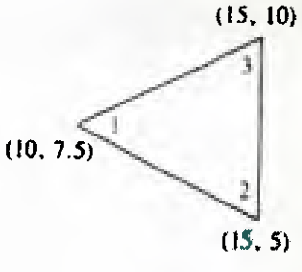
Course Code :**PE-BTM511** **Maximum Points** :**100**

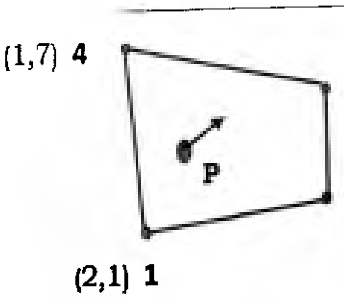
Course Name :**Finite Element Methods for Mechanical Engineers.**

Semester :**V**

Instruction : Refer below

1. Question No. 1 is compulsory
2. Solve any four out of remaining six.
3. Answers to each sub-questions must be grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. Keep some margin on left side of answer paper
7. **Candidates should write the answer legibly**

Q. no.	Description	Points	CO	BL
1	Answer the following: a) List six steps involved in FEM procedure. Explain any two in detail. b) Explain with suitable example, how the use of natural coordinates assures displacement compatibility in FEA? c) Explain how natural B.C.'s are explicitly taken care in weak formulation and only geometric B.C.'s are to be satisfied by governing equation. d) What are the mesh revision methods? Discuss.	5x4	1,2 ,3	2,3
2	a) Evaluate the shape function, B matrix and stiffness matrix for the elements shown in Figure. The coordinates are given in units of millimeters. Assume plane stress conditions. Let E= 210 GPa, v =0.25, and t = 10 mm. 	20	1,2	3,4
3	a) Obtain the consistance nodal load vector for a fixed beam with the point load 'P' is at 2/3 of its span 'L' from the left support. b) Obtain the Jacobian value for quadratic bar element, if mid-side node is located at L/4 from the first node. (Where L is length of element.) c) Explain Gauss quadrature numerical integration method	7 7 6	1,2	1,2

4	For the quadrilateral element shown in Figure, determine: a) Equivalent nodal forces, if the load of 10 kN in the directions of 45 degrees with horizontal is applied at P (3, 4).  	20	2,3	2,3
5	i. The pin-fin used for heat dissipation, has 50 mm long and circular c/s area of 100π mm^2. At one end of fin temperature is 300^{0}C. (take k = 100 watt/cm ^{0}C, h = 10 watt/cm^2 ^{0}C, surrounding temperature 30^{0}C, use 2 linear elements, don't neglect convection from free end). Find: a) Conductive and convective matrix for each element b) Final assembled matrix c) Thermal load vector d) Temperature at various nodes. ii. Obtain Jacobian matrix for element shown in Question number 4	3 3 3 3 8	1,2 ,3	3,4
6	a) Evaluate $\iint(3y^2+2x)dxdy$ using 2X2 gauss quadrature, take limits of integration as 0 to 2 for both x and y. b) A taper bar having 50 mm^2 and 20 mm^2 as cross-sectional area at fixed end and free end respectively, is subjected to point load of 10 kN at a distance of 1/3 of total length from fixed end and 5 kN at free end. Take total length of taper bar as 1.5 m and E = 200 GPa. Find the displacement at the point of application of loads and stress in each element.(discretize bar in 3 1D element)	8 12	2,3	3,4
7	a) Derive expression of stiffness matrix for arbitrary oriented bar element. (truss element) b) Derive the expression of shape functions for nine-noded quadrilateral element.	8 12	1,2	3,4

$$N_1 = \frac{1}{L^3}(2x^3 - 3x^2L + L^3) \qquad N_2 = \frac{1}{L^3}(x^3L - 2x^2L^2 + xL^3)$$

$$N_3 = \frac{1}{L^3}(-2x^3 + 3x^2L) \qquad N_4 = \frac{1}{L^3}(x^3L - x^2L^2)$$

$$\frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

$$N_1 = 1 - \frac{3x}{\ell} + \frac{2x^2}{\ell^2}, \qquad N_2 = \frac{-x}{\ell} + \frac{2x^2}{\ell^2}, \qquad N_3 = \frac{4x}{\ell} - \frac{4x^2}{\ell^2}$$

$$[D] = \frac{E}{1-\nu^2}\begin{bmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{bmatrix}$$

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SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

END-SEM-EXAMINATIONS December 2023

8/11/24

Program :BTech Mechanical engg **Duration** :3 hr

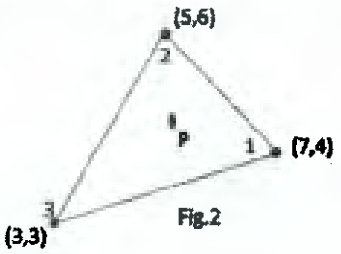
Course Code :PE-BTM511 **Maximum Points** :100

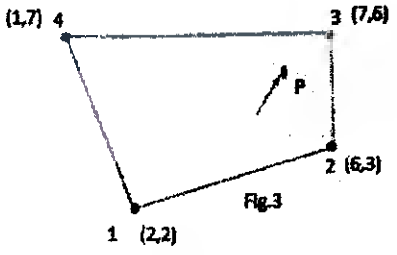
Course Name :Finite Element Methods for Mechanical Engineers.

Semester :V T.Y. B.Tech (M) Sem V

Instruction : Refer below

1. Question No. 1 is compulsory
2. Solve any four out of remaining six.
3. Answers to each sub-questions must be grouped together
4. Use of scientific calculator is allowed
5. Begin answer to each question on new page.
6. Keep some margin on left side of answer paper
7. **Candidates should write the answer legibly**

Q. no.	Description	Points	CO	BL
1	Answer the following: a) Explain with suitable example, how the use of natural coordinates assures displacement compatibility in FEA? b) Develop the weak formulation for simply supported beam with udl. c) What are the mesh revision methods? Discuss. d) Explain Gauss quadrature numerical integration method.	5x4	1,2 ,3	2,3
2	a) Obtain the equation of temperature distribution for 2D-triangular element shown in fig.2. Also find the temp. gradient in x and y direction, Given the nodal temperatures $T_1 = 55^0$ C, $T_2 = 40^0$ C, $T_3 = 30^0$ C. b) Assuming fig.2 as plane-stress element having thickness 1 mm, obtain the stiffness matrix. (Take poisons ratio v =0.25, E = 200 GPa, nodal co-ordinates in centimeters.)  Fig.2	08 12	1,2	3,4
3	a) Obtain the consistance nodal load vector for a fixed beam with the point load 'P' is at 1/3 of its span 'L' from the left support. b) Obtain the Jacobian value for quadratic bar element, if mid-side node is located at 3L/4 from the first node. (Where L is length of element.) c) Explain Cholesky factorization method	6 6 8	1,2	1,2

4	For the quadrilateral element shown in Figure-3, determine: a) Jacobian matrix b) Equivalent nodal forces, if the load of 12 kN in the directions of 60 degrees with horizontal is applied at P (5, 4).  Fig.3	10 10	2,3	2,3
5	The pin-fin used for heat dissipation, has 60 mm long and circular c/s area of 100π mm^2. At one end of fin temperature is 250^{0}C. (take k = 100 watt/cm ^{0}C, h = 10 watt/cm^2 ^{0}C, surrounding temperature 30^{0}C, use 3 linear elements, don't neglect convection from free end). Find: a) Conductive and convective matrix for each element b) Final assembled matrix c) Thermal load vector d) Temperature at various nodes.	5 3 6 6	1,2 ,3	3,4
6	a) Evaluate $\iint(3y^2+2x)dxdy$ using 2X2 gauss quadrature, take limits of integration as 0 to 2 for hoth x and y. b) A taper bar having 45mm^2 and 25mm^2 as cross-sectional area at fixed end and free end respectively, is subjected to point load of 1.8 kN at a distance of 1/3 of total length from fixed end and 1.2 kN at free end. Take total length of taper bar as 1.2 m and E = 210 GPa. Find the displacement at the point of application of loads and stress in each element.(discretize bar in 3 1D element)	8 12	2,3	3,4
7	a) Derive expression of stiffness matrix for arbitrary oriented bar element. (truss element) b) Derive the expression of shape functions for nine-noded quadrilateral element.	8 12	1,2	3,4

$$N_1=\frac{1}{L^3}(2x^3-3x^2L+L^3) \qquad N_2=\frac{1}{L^3}(x^3L-2x^2L^2+xL^3)$$

$$N_3=\frac{1}{L^3}(-2x^3+3x^2L) \qquad N_4=\frac{1}{L^3}(x^3L-x^2L^2)$$

$$\frac{EI}{L^3}\begin{bmatrix} 12 & 6L & -12 & 6L \\ 6L & 4L^2 & -6L & 2L^2 \\ -12 & -6L & 12 & -6L \\ 6L & 2L^2 & -6L & 4L^2 \end{bmatrix}$$

$$N_1=1-\frac{3x}{l}+\frac{2x^2}{l^2}, \qquad N_2=\frac{-x}{l}+\frac{2x^2}{l^2}, \qquad N_3=\frac{4x}{l}-\frac{4x^2}{l^2}$$

$$[D]=\frac{E}{1-\nu^2}\begin{bmatrix} 1 & \nu & 0 \\ \nu & 1 & 0 \\ 0 & 0 & \frac{1-\nu}{2} \end{bmatrix}$$

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SARDAR PATEL COLLEGE OF ENGINEERING

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END SEM EXAMINATION JAN 2024

Total Points: 100 Duration : 3 Hour

CLASS/SEM: Third Year Mech. Engg, SemV Subject: LGM, Course Code PE-BTM534

Lean & Green manufacturing

Que1 is compulsory.
Solve any 4 questions from remaining.
Figures to the right indicate full marks.
Assume any suitable data if necessary.

SN	Que statement	Points	BTLevel	Module	CO
Q1A	Draw the roadmap for lean implementation in Indian Automotive industry and explain it.	10	4	1,2, 3,5	CO1
Q1B	Identify and explain Practice Bundles for Lean and Green Manufacturing	10	5	1,6, 7	CO4
Q2A	Draw the Value Stream Mapping of the Training Feedback Process. Consider feedback process in a traditional way initially.	10	4	2	CO3
Q2B	Identify the wastes in the manufacturing system. State the reasons of each waste. Develop the strategies to eliminate the wastes.	10	5	1	CO2
Q3A	What do you mean by 5S ? What is the purpose of each S ? Why is it necessary to implement 5S in organisation? Draw the necessary sketches to showcase principle of set in order.	10	4	1,3	CO1, CO2
Q3B	Prepare the Cause and effect Diagram to showcase Supply Risks in JIT implementation	10	3	3	CO1, CO2
Q4A	Prepare and explain the KPIV KPOV based Process Model for Green Supplier development. Prepare and explain the Green Supplier Development Model based on stage gate approach.	10	5	7,5	CO4
Q4B	Explore and explain Barriers for Green Product Development.	10	5	6	CO4
Q5A	Draw the Framework for Lean implementation and explain it in detail.	10	5	1,5	CO1
Q5B	Explore the challenges in Green Procurement and explain the role Blockchain IOT technologies to address them.	10	5	7	CO4
Q6A	Explore the Critical Success Factors of Stakeholder involvement in Greening drive of Organization. Consider Stakeholders as Customer, Management, Employee, Supplier.	10	5	7, 4 6	CO4
Q6B	Prepare and explain the Framework for economic Assessment of Green initiatives.	10	5	4	CO4
Q7A	Prepare the Framework to successfully implement the Green.	10	5	4	CO4
Q7B	Explain with neat sketches 20 Pokayoke examples.	10	5	3	CO3, CO4

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SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

END SEMESTER DECEMBER 2023 EXAMINATION

Maximum Marks: 100 **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical)** Sem V Semester: **V** 8/11/24

Program: **B. Tech. (Mechanical Engineering)**

Name of the Course: **Hydraulic Machinery** Course Code: **PE-BTM552**

Instructions:

1. **Question number 1 is compulsory.**
2. **Solve any 4 questions from remaining questions (Question number 2 to 7)**
2. **Draw neat diagrams wherever necessary.**
3. **Assume suitable data if necessary.**

Q. No.		Points	CO No.	M No.
1 (a)	Test on single stage centrifugal pump at 1450 rpm gave the following results:-	15	2	7

Q (m^3/s)	0	0.006	0.012	0.018	0.024	0.030	0.036
Hm (m)	22.6	21.9	20.3	17.7	14.2	9 7	3.9

When two such identical pumps are connected in parallel, the flow rate through the system is the same as when they are connected in series. Determine the flow rate that the individual pump would deliver if connected to the same system. Assume that the system characteristic is purely resistive with no static lift.

(b)	Match the followings (Hydraulic Machineries with its working principle/characteristic feature)		5	1 to 3	2 4

Centrifugal Pump	Impulse turbine
Gear Pump	Axial flow reaction turbine
Pelton Turbine	Medium specific speed reaction turbine
Francis Turbine	Positive displacement Pump
Kaplan Turbine	Rotodynamic Pump

2 (a)	Calculate the diameter and speed of the runner of a Kaplan turbine developing 6000 KW under an effective head of 5 m. Overall efficiency of the turbine is 90%. The diameter of the boss is 0.4 times the external diameter of the runner. The turbine speed ratio is 2 and flow ratio is 0.6. What is the specific speed of the turbine?	10	3	
(b)	Write short note on (i) Draft tube in reaction turbines (ii) Selection of turbines	10	4	4
3 (a)	Find the height from the water surface at which a centrifugal pump may be installed in the following case to avoid cavitation: Atmosphere pressure =1.01 bar (abs); vapour pressure =0.022 bar (abs); inlet and other losses in suction pipe 1.42 m, effective head of pump=49 m; and cavitation parameter=0.115.	10	3	
(b)	In water power site, the available discharge is 340 m^3/s under a net head of 30 m. Assuming a turbine efficiency of 88% and rotational speed of 166.7 rpm, determine the least number of machines, all of the same size, that may be installed if the selection rests with- (i) Francis turbine with Ns not greater than 230.	10	2,3, 4	1 1 4

	(ii) Kaplan turbine with Ns not greater than 685, What will be the output of each unit? Which of the two installations will be more economical? (Reference Ns given is considering speed in rpm, power in KW, and head in meters).		
4 (a)	A model of Francis turbine one-fifth of full size, develops 3 KW at 306 rpm under a head of 1.77 m. Find the speed and power of full size turbine operating under a head of 5.7 m, if (a) the efficiency of the model and the full size turbine are same. (b) the efficiency of the model turbine is 76% and the scale effect is considered.	10	1,2, 4
(b)	A single-acting reciprocating pump has a stroke length of 160 mm, suction pipe is 7 m long and the ratio of suction pipe diameter to the piston diameter is 0.75. The water level in the sump is 3 m below the axis of the pump cylinder and the pipe connecting the sump and pump cylinder is 75 mm in diameter. If the crank is running at 75 rpm, determine the pressure head on the piston at the beginning, middle and end of the suction stroke. Take friction factor, f=0.04 (Take $h_f=flv^2/2gd$).	10	3,4
5	Only draw neat labeled sketches of (i) Pelton wheel Bucket (Front and sectional top views) (ii) Various types of Draft tube (iii) Separate indicator diagram considering alone acceleration and frictional effects for reciprocating pump. (iv) Various types of Impellers of Centrifugal Pumps.	20	1 to 4
6 (a)	A three-stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is 45^0 and the area occupied by the vane thickness may be assumed 8% of the total area. If the pump delivers 3.6 m^3/min of water when running at 920 rpm, determine (i) Power of the pump (ii) Manometric head and (iii) specific speed. Assume mechanical efficiency as 88% and manometric efficiency as 77%.	**10**	4
(b)	A hydraulic turbine is to develop 1015 KW when running at 120 rpm under a net head of 12 m. Work out the maximum flow rate and specific speed for the turbine if the overall efficiency at the best operating point is 92%. In order to predict its performance, a 1:10 scale model is tested under a head of 7.2 m. What would be the speed, power output and water consumption of the model if it runs under the conditions similar to the prototype?	**10**	**3**
7 (a)	Test on single stage centrifugal pump at constant speed gave the following results:-	**10**	**3**

Q (lit/s)	0	12	18	24	30	36	42
H (m)	22.6	21.3	19.4	16.2	11.6	6.5	0.6
η (%)	0	74	86	85	70	46	8

The pump is used to lift water over a vertical distance of 6.5 m by means of 10 cm diameter pipe, 65 m long, for which the friction factor is 0.02.

(i) Determine the rate of flow and power supplied to the pump

(ii) If it is required to increase the rate of flow by addition of a second identical pump (running at the same speed) which is connected in parallel with the original pump. Determine the rate of flow from both the pumps and the power supplied to both the pumps

(b)	The three jet Pelton turbine is required to generate 10000 KW under a net head of 400 m. The blade angle at outlet is 15^0 and the reduction in the relative velocity while passing over the blade is 5%. If the overall efficiency of the wheel is 80%, Cv=0.98 and speed ratio=0.46, then find: (i) the diameter of the jet (ii) total flow in m^3/s and (iii) the force exerted by a jet on the buckets. If the jet ratio is not to be less than 10, find the speed of the wheel for a frequency of 50 Hz and the corresponding wheel diameter.	**10**	**3**