Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

21/2/24

END SEMESTER/~~RE~~ EXAMINATION DECEMBER/ JANUARY 2024-25

Program: Third year B. Tech. Mechanical Sem V

Duration: 03 Hrs.

Course Code: PC–BTM512

Maximum Points: 100

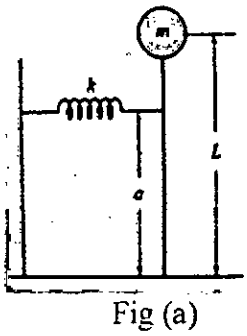
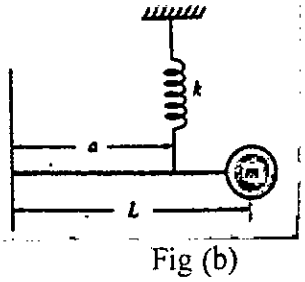
Course Name: Dynamics of Machinery

Semester: V

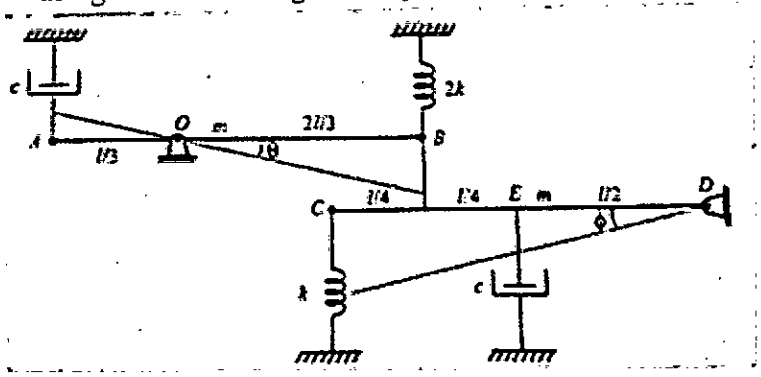
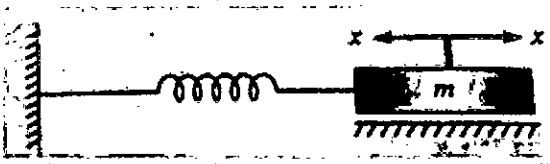
Notes: 1. Attempt any 5 questions
2. Each questions carry equal marks
3. Assume suitable data wherever necessary and justify the same

Q.No.	Questions	Points	CO	BL	Module No.
1	a) Explain Belt transmission dynamometer. b) What is the difference between absorption and transmission dynamometers? c) A shaft fitted with a flywheel rotates at 250 r.p.m. and drives a machine. The torque of machine varies in a cyclic manner over a period of 3 revolutions. The torque rises from 750 N-m to 3000 N-m uniformly during 1/2 revolution and remains constant for the following revolution. It then falls uniformly to 750 N-m during the next 1/2 revolution and remains constant for one revolution, the cycle being repeated thereafter. Determine the power required to drive the machine and percentage fluctuation in speed, if the driving torque applied to the shaft is constant and the mass of the flywheel is 500 kg with radius of gyration of 600 mm.	05 05 10	1	3	1
2	a) Discuss the effect of the gyroscopic couple on a two wheeled vehicle when taking a turn. b) A four-wheeled trolley car of total mass 2000 kg running on rails of 1.6 m gauge, rounds a curve of 30 m radius at 54 km/h. The track is lifted at 8°. The wheels have an external diameter of 0.7 m and each pair with axle has a mass of 200 kg. The radius of gyration for each pair is 0.3 m. The height of centre of gravity of the car above the wheel base is 1 m. Determine, allowing for centrifugal force and gyroscopic couple actions, the pressure on each rail.	10 10	1	1,2	2
3	a) 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 each ball is attached = 100 mm ; mass of each ball = 6 kg and	12	1	3	3

END SEMESTER/ RE EXAMINATION DECEMBER/ JANUARY 2024-25

	mass of the central load = 150 kg. If the radius of rotation of the balls is 180 mm when the arms are inclined at an angle of 40° to the axis of rotation, find the equilibrium speed for the above configuration. b) Derive the expression for effort and power of the governor.	08			
4	a) In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are TC= 28; TD= 26; TE= TF= 18. 1. Sketch the arrangement ; 2. Find the number of teeth on A and B ; 3. If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed of B ; and 4. If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise; find the speed of wheel B. b) Explain briefly the differences between simple. compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains ?	12 08	1	3	4
5	a) Explain: i. Damped and Undamped Vibrations ii. Deterministics and Random Vibrations b) Find the time period of small oscillations of an inverted pendulum and spring system as shown in figure a given that the pendulum is vertical in the equilibrium position. Is there any limitation on the value of k? Discuss. Compare the time period at vibration of this system with that one in figure b.  Fig (a)  Fig (b)	10 10	3	2,3	5

END SEMESTER/ RE EXAMINATION DECEMBER/ JANUARY 2024-25

6	a) Find the equivalent rotary system i.e. I_{eq}, k_{eq}, and c_{eq} using Θ as small angular displacement.  b) Find the natural frequency of damped free vibrations in case of coulomb damping.  	10 10	4	2,3	6
7	a) A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has a mass of 56 kg and its centre of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance, determine : 1. relative angular positions of the pulleys, and 2. dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m. b) Explain Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine.	12 08	2	3	7

B

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End Sem/ ~~Re-Exam~~ - DEC 2024/Jan 2025 4/12/24

T. Y. B. Tech (Mech) Sem V

Program: Mechanical **Duration:** 3 Hrs

Course Code: PC-BTM503 **Maximum Points:** 100

Course Name: Mechatronics **Semester:** V

Notes: Question **No.1 is compulsory**

Solve any **Four** questions out of **SIX**

Q.No.	Questions	Points	CO	BL	PI
1	**a) Discus** various applications of Mechatronics **b) Discuss** the Index addressing mode with suitable example **c) Explain** different types of control valves **d) Discuss** the concept of Stability	20	1to4	I,III,V	1.5.1
2a	**Explain** the different types of Pumps	10	2	I	1.6.1
2b	**Draw** and **Explain** the memory organization of 8051 and **explain** the control signals	10	2	VI	5.4.1
3a	**Draw** and **explain** i) Sequencing Circuit, and ii) Clamping circuit with accumulator	10	I	III	1.6.1
3b	**Discuss** the effect of change in G(s)H(s) on steady state error with different type of system.	10	2	V	5.4.1
4a	**Develop** a schematic and functional block diagram of Ship stabilization. In this system a roll sensor is used as a feedback element. The desired roll position is selected as Theta r , while actual roll position is theta c, which is compared with theta r to generate control signal. This activates the fin actuator in proper way to stabilize the ship.	10	3	VI	1.6.1

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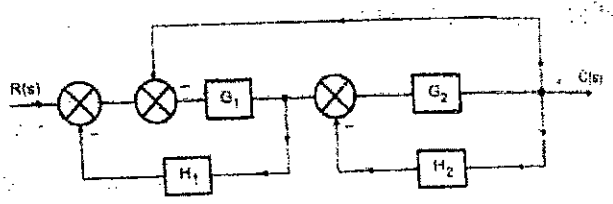
End Sem / ~~Re-Exam~~ - DEC 2024/Jan 2025

4b	**Reduce** the Block diagram and **obtain** the transfer function 	10	3	III	5.4.1
5a	**Discus** the effect of input R(s) on Steady state error with different state inputs	10	3	II	1.6.1
5b	**Draw** and **explain** construction of 4/2 poppet valve.	10	3	VI	1.6.1
6a	**Explain** the Routh-Herwitz and Routh stability criteria with suitable example.	10	3	IV	5.4.1
6b	For unity feedback system having open loop transfer function. $G(s) = \frac{K(s+2)}{s(s^3+7s^3+12s)}$ find i) Type of system, ii)Error coefficients, iii) steady state error when input to the system is $\frac{R}{2}t^2$.	10	3	III	5.4.1
7a	**Discuss** the Routh's Stability Criteria special cases. Obtain $S^5 + 2S^4 + 3S^3 + 6S^2 + 2S + 1 = 0$ Routh's Stability. Comment on stability.	10	4	III	5.1.2
7b	**Discus** the effect of ξ on second order system performance subjected to unit step.	10	4	III	5.1.2

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7/1/25

END SEM/~~RE-EXAM~~ EXAMINATION DEC/~~JAN~~ 2024-25

T.Y. B.Tech Sem V

Program: B.Tech Mechanical

Course Code: PC-BTM515

Course Name: Computer Aided Machine Drawing

Duration: 3 hrs.

Maximum Points: 100.

Semester: V

Important Notes:

1. Question 1 is compulsory.
2. Attempt any four out of remaining six questions.
3. Create a new folder and rename it to <Reg. No._CAMD_ENDSEM>
4. Create separate **.dwg file (AutoCAD)** and **PDF** for each question and save in the above created folder only. File name should be < Reg. No._Question number_2D/3D>; eg <M240005_4A_2D> OR <M240005_4A_3D>
5. Answers to free hand sketches should be drawn on given A4 answer sheet and submit is back. Theoretical answer must be written on answer book provided.
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.
10. If the File is **not Found** in the folder, student **themself** is responsible.

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END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

Q. No.		Points	MO/ CO	BL
Q.1	A) Explain, Unilateral Tolerance and Bilateral Tolerance.	05	02/01	02
	B) Calculate the dimensions of the hole and shaft for a given clearance fit using a hole basis system. Basic size of the shaft: 50 mm, Minimum clearance: 0.100 mm, Tolerance of the hole: 0.045 mm. Tolerance of the shaft: 0.070mm. Determine: The dimensions of the hole and shaft. The maximum clearance possible.	05	02/01	01
	C) Explain the steps involved in exporting a CAD model for 3D printing. Highlight the importance of selecting the correct file format.	05	07/01	02
	D) Draw Free Hand Sketches of the following: 1. Round Key. 2. Rectangular Sunk Key.	2.5 2.5	03/01	01
Q.2	A) A cone of base diameter 70 mm and axis height 110 mm is resting on its base on the HP. It is completely penetrated by a cylinder of base diameter 50 mm. The axis of the solids intersects each other at right angles, 25 mm above the base of the cone. Complete the following tasks:- 1. Create a 3D modelling of the given intersection. 2. Project the 3D modelling on the layout sheet. (F.V, S.V & T.V. and Isometric view) 3. Draw the 2D projection (F.V, S.V & T.V.) showing all the necessary details.	05 02 08	01/-- 03 01 03	03
	B) Draw Free Hand Sketches of the following: 1. Unified Thread. 2. Hexagonal Nut.	2.5 2.5	02/ 02	01

END SEM/~~RE-EXAM~~ EXAMINATION DEC/~~JAN~~ 2024-25

Q.3	Given in the figure, is the Details of Standard Universal Coupling. Complete the following tasks.		04/--	03
	a) Draw the 2D drawing of different parts as shown in the figure and plot them on pdf.	05	01	
	b) Create the 3D Model of each part and show them separately on one single pdf.	07	03	
	c) Create the assembly drawing of the universal coupling and show the (F.V, S.V & T.V. and Isometric view) on one single PDF. Also, show the B.O.M Table.	08	04	
Q.4	Given in the figure, is the details of Sleeve and Cotter Joint. Assume suitable material and d=30mm. Complete the following tasks:		03/--	03
	a) Draw the 2D drawing of different parts as shown in the figure and plot them on pdf.	05	01	
	b) Create the 3D Model of each part and show them separately on one single pdf.	07	03	
	c) Assemble the parts at their functional positions and show the (F.V, S.V & T.V. and Isometric view) on one single PDF. Also, show the B.O.M Table.	08	04	
Q.5	Given in the figure, is the details of Socket and Spigot Cotter Joint. Complete the following tasks:		06/--	03
	a) Draw the 2D drawing of different parts as shown in the figure and plot them on pdf.	05	01	
	b) Create the 3D Model of each part and show them separately on one single pdf.	07	03	
	c) Assemble the parts at their functional positions and show the (F.V, S.V & T.V. and Isometric view) on one single PDF. Also, show the B.O.M Table.	08	04	

END SEM/RE-EXAM EXAMINATION DEC/JAN 2024-25

Q.6	A) A square prism 30 mm base sides and 70mm axis is completely penetrated by another square prism of 25 mm sides and 70 mm axis, horizontally. Both axes Intersects & bisect each other. All faces of prisms are equally inclined to vertical Plane (VP). Draw the projections showing curves of intersections. Create 3D models of the prism-prism assembly and plot the projections of the prisms in (F.V, S.V & T.V. and Isometric view) on one single PDF.	10	01/03	03
	B) Explain the following terms in the context of limits, fits, and tolerances: Basic Size, Allowance, Tolerance with neat diagram.	05	02/02	01
	C) Draw Free Hand Sketches of the following: 1. Counter Sunk Headed Bolt. 2. Collar Neck Stud.	2.5 2.5	02/ 02	01
Q.7	A) Given in the figure is the Details of V-Belt Pulley, Create a 3D model for a given parts.	10	05,07/03	03
	B) Given in the figure is the Drill Jig Assembly, Create a 3D model for a given parts.	10		

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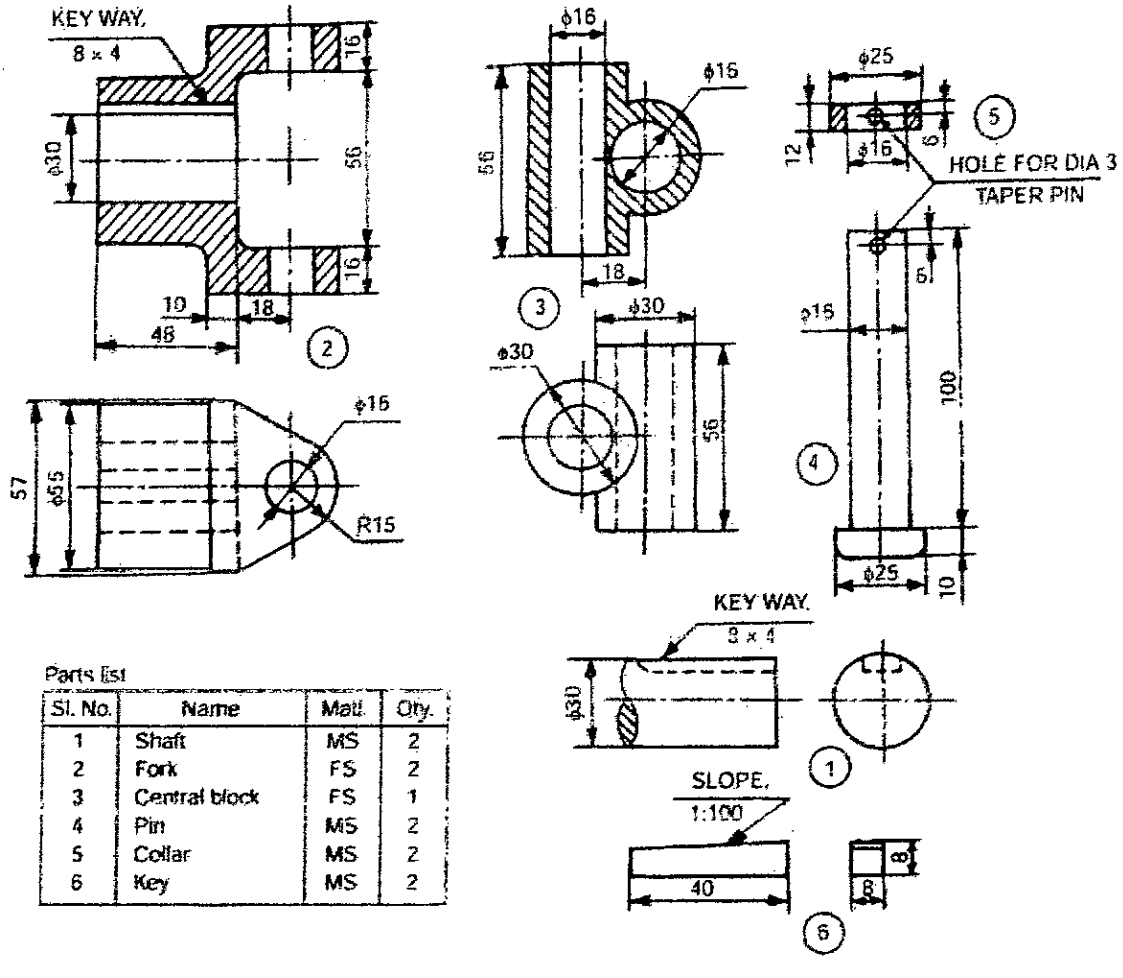
END SEM/~~RE-EXAM~~ EXAMINATION DEC/~~JAN~~ 2024-25

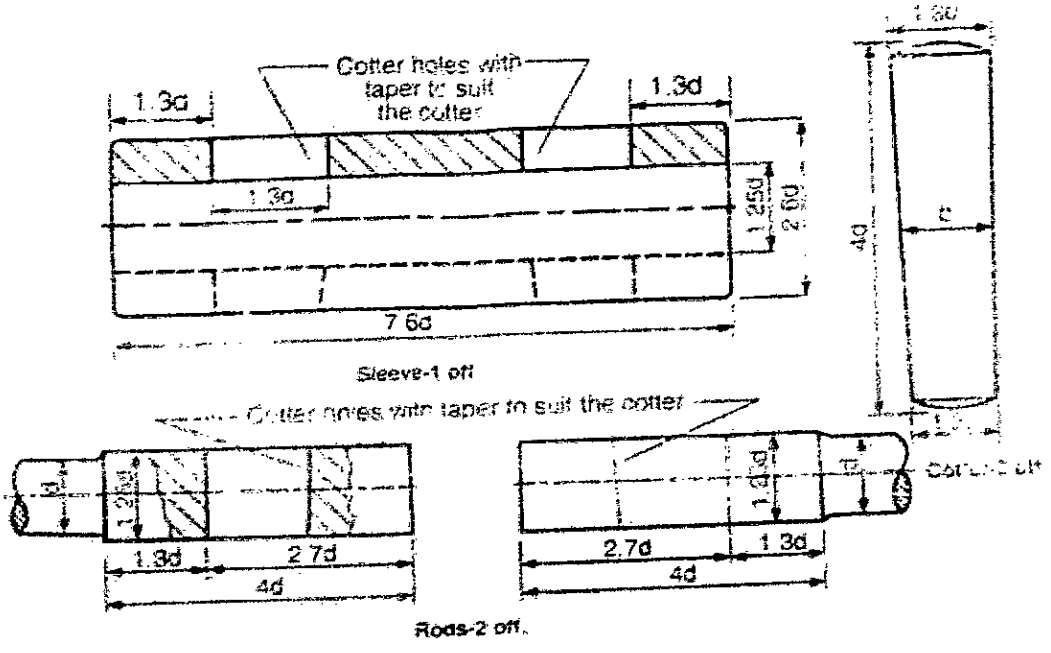


Parts list

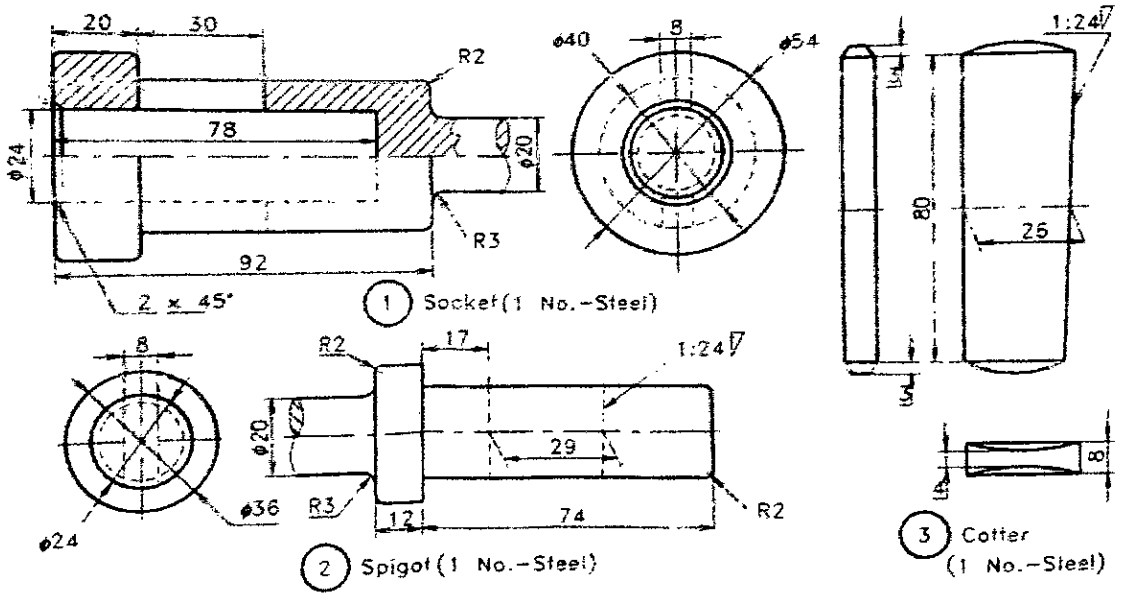
Sl. No.	Name	Matl.	Qty.
1	Shaft	MS	2
2	Fork	FS	2
3	Central block	FS	1
4	Pin	MS	2
5	Collar	MS	2
6	Key	MS	2

Q3). Universal Coupling.

END SEM/RE-~~EXAM~~ EXAMINATION DEC/~~JAN~~ 2024-25

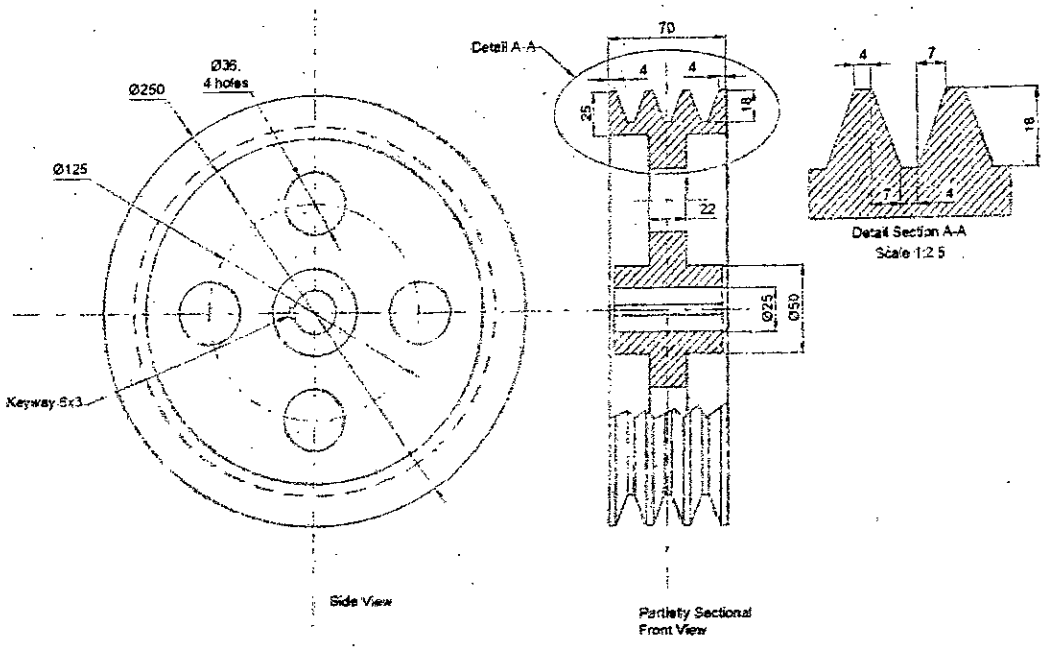


Q4). Sleeve and Cotter Joint.



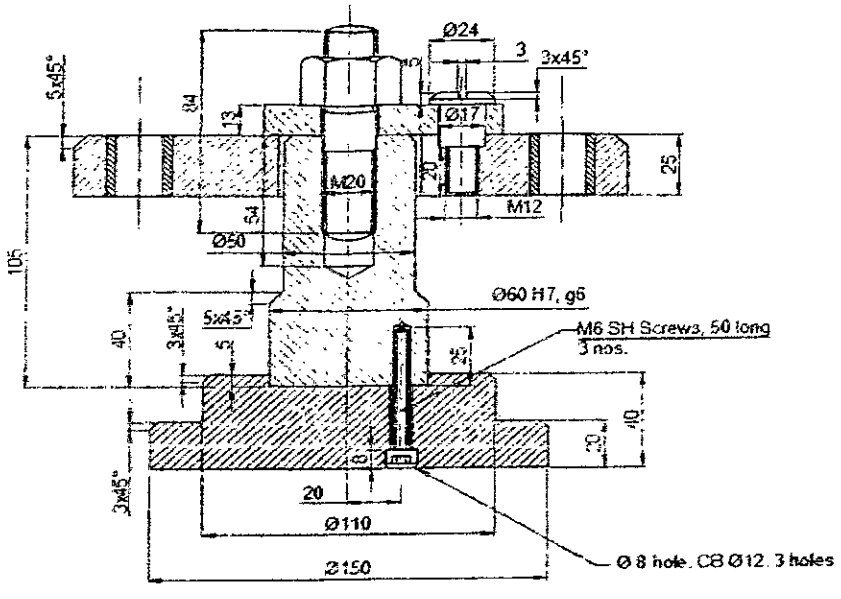
Q.5) Socket and Spigot Cotter Joint.

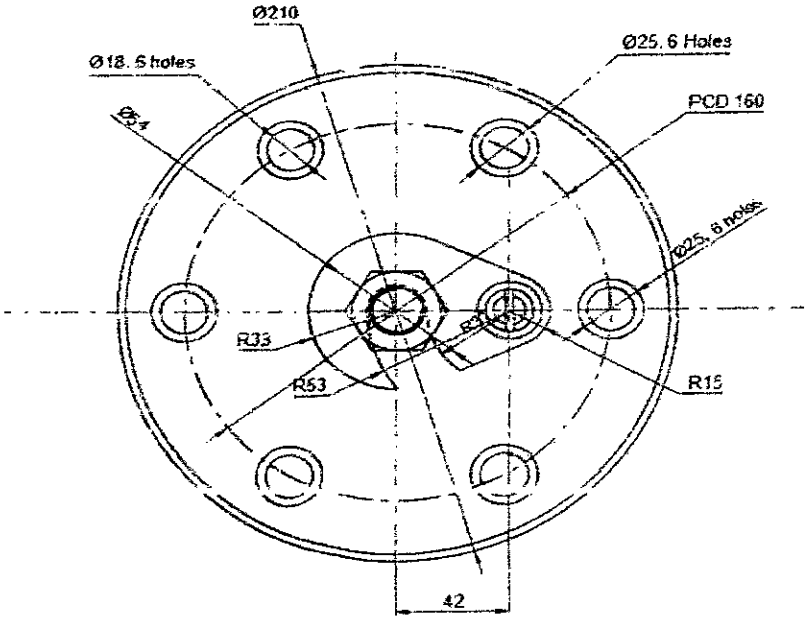
END SEM/~~RE-EXAM~~ EXAMINATION DEC/JAN-2024-25



Q.7.A.) V-Belt Pulley

END SEM/~~RE-EXAM~~ EXAMINATION DEC/~~JAN~~ 2024-25





Q.7.B.) Drill Jig Assembly

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9/12/24

END SEMESTER/~~RE~~-EXAMINATION DEC-~~JAN~~ 2024~~-25~~

T.Y. B.Tech Sem V

Program: B.Tech. Mechanical | **Duration: 3 Hour**

Course Code: PCC-BTM 514 | **Maximum Points: 100**

Course Name: Thermal and Fluid Machines | **Semester: V**

Notes:

1) **Solve: Any FIVE Questions.**
2) Answers must be **SPECIFIC** and in **LEGIBLE** handwriting.
3) Draw **neat system diagram/s and process diagrams** wherever necessary.
4) Use **Steam tables and Mollier Chart provided by Examination section,** if required.
5) Illustrate your answers with suitable examples as and where necessary.
6) **Assume suitable data wherever necessary and state the same.**

Q. No.	Question	Points	CO	BL	Module
1.	a) **Explain** how the centrifugal compressor and axial flow compressor work. **Draw** a neat sketch of each.	10	1, 2	II	1
	b) A two-stage double-acting air compressor delivers air at a rate of 1.35 kg/sec. The suction pressure is 1 bar and interstate pressure is 7 bar and delivery pressure 42 bar. Air enters the low-pressure cylinder at 17°C and is cooled in the intercooler to 32°C. The clearances in L.P. and H.P. cylinders are 6% and 8% of respective strokes. The law of compression and re-expansion is $pv^{1.2} = C$ in both cylinders. The speed of the compressor is 500 RPM. **Evaluate:** (i) The amount of cooling water required per minute in the intercooler, if the rise in temperature of water is limited to 20°C, Take c_{pw} = 4.18 kJ/kg K (for water) and c_{pa} = 1.005 kJ/Kg K (for air). (ii) Power required in kW (iii) Diameter and Stroke of L.P. cylinder if L=D.	10	3, 4	III, IV	1
2.	(a) **Draw** neat sketch of Babcock and Wilcox boiler and explain its working in detail.	10	1, 2	II, III	5
	(b) **Draw** neat sketch of Economiser and Air-preheater and explain its working.	10	1, 2	II, III	5
3.	(a) Dry saturated steam at a pressure of 8 bars absolute enters a convergent divergent nozzle and leaves at 1.5 bar absolute. If the flow is isentropic and corresponding expansion index is 1.135, find the ratio of cross-sectional area at exit and throat for maximum discharge.	10	3, 4	III, IV	5
	(b) **Draw** neat sketch of Pelton turbine and explain its working in detail.	10	1, 2	I,II	7
4.	(a) **Draw** neat sketch of schematic and T-s diagram for following method of improvement of efficiency of open cycle gas turbine and explain how efficiency increases.	10	1, 2	II, III	6

	(i) Regeneration (ii) Reheating				
	(b) The pressure ratio of an open cycle constant pressure gas turbine plant is 5. The temperature range of the plant is 15°C and 900°C. Using the following data: C_{pa} = 1 kJ/kg-K C_{pg} = 1.075 kJ/kg-K and γ = 1.4 for air and gases C.V. of fuel = 43000 kJ/kg η_c = 0.90, η_t = 0.95, η_{com} (Combustion) = 0.95. **Estimate:** (a) The thermal efficiency of the plant (b) I.P. of the plant if the circulation of air is 5 kg/sec (c) A:F ratio, and (d) Specific fuel consumption. Neglect the losses in the system.	**10**	3, 4	III, IV	6
5.	**a) Explain:** Phenomenon of combustion in S.I. Engines with various stages of combustion. **Draw:** Neat p-θ diagram.	**10**	1, 2	II, III	3
	b) Explain: Detonation in S.I. Engines. Discuss: i) Factors affecting detonation in S.I. Engines and ii) Measures to control the same. **Draw:** Neat sketches wherever necessary.	**10**	1, 2	II, III	3
6.	**a) Explain:** Phenomenon of combustion in C.I. Engines with various stages of the same. **Draw:** Neat p-θ diagram.	**10**	1, 2	II, III	4
	b) State: Various fuel injection systems for C.I. Engines. **Describe:** Features and working of any one of them. **Draw:** Neat schematic diagram.	**10**	1	I, II, III	4
7.	**a) Describe:** Working and Construction of a single stage centrifugal pump with its main parts. **Draw:** Neat sketch.	**08**	1	II, III	2
	b) Define and Explain: Various efficiencies of a centrifugal pump.	**06**	1	I,II	2
	c) A six-cylinder four-stroke petrol engine has diameter of each cylinder = 80 mm and stroke = 100 mm, engine speed = 4000 rpm, fuel consumption = 20 kg/hr, braking torque = 150m.N, calorific value of petrol = 43000 kJ/kg, **Calculate:** i) Brake power ii) Brake thermal efficiency and iii) bsfc of the engine.	**06**	4	V	3

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End Semester Examination December 2024

11/12/24

Program: **T.Y .Mechanical Engineering** T.Y. B.Tech 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 remaining six 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	Pt	CO	BL	M
Q1 A	Give definition of occupational health and safety? Explain its three components? Give any 5 principles of occupational health and safety?	10	2	1,2	1
B	Draw neat sketch Top-Down approach applied to a system using failure mode and effect analysis (FMEA) technique? Draw sketch of methodology and documentation table of FMEA?	10	1	1	3
Q2 A	With the help of sketch justify using 2-3 points, how entropy risk model helpful for OHS management? Explain entropy risk model and residual risk model in details with the help of neat schematic sketch?	10	1	2	2
B	What is INS concept for fault tree construction? Basic Events G1, G2 & G3 (refers to failure of respective generator) will lead to system top level event 'TE' (partial loss of power). Draw fault tree diagram for above case, then convert it into an equivalent AND & OR gate. Also calculate probability of occurrence of top level event if each basic event's probability of occurrence is equal to 0.33.	10	2	1,3	4
Q3 A	Give methodology of PHL hazard analysis process? Using table give difference between PHA and PHL hazard analysis process?	10	1	2	3
B	List down benefits and commitment to be followed by the participating parties in RAMSAR convention for wetland conservation?	10	3	1	5
Q4 A	List down Air quality concern in context of metro cities, critically polluted areas and rural areas?	10	4	1	7
B	A technician working at a height, and fitting a heavy hazardous chemical tank at that location, draw safety domain ontology for this case? Enlist hazardous elements, initiating mechanism and threat elements as in general case?	10	1	3	2
Q5 A	Draw neat schematic sketch which enlist's elements, which are important for safety engineers knowledge base as Primary elements and as Secondary elements? Explain all primary element in details?	10	2	1	1
B	Give classification of wetlands using codes? Write short note on Convention on Biological Diversity (CBD)?	10	3	2	5

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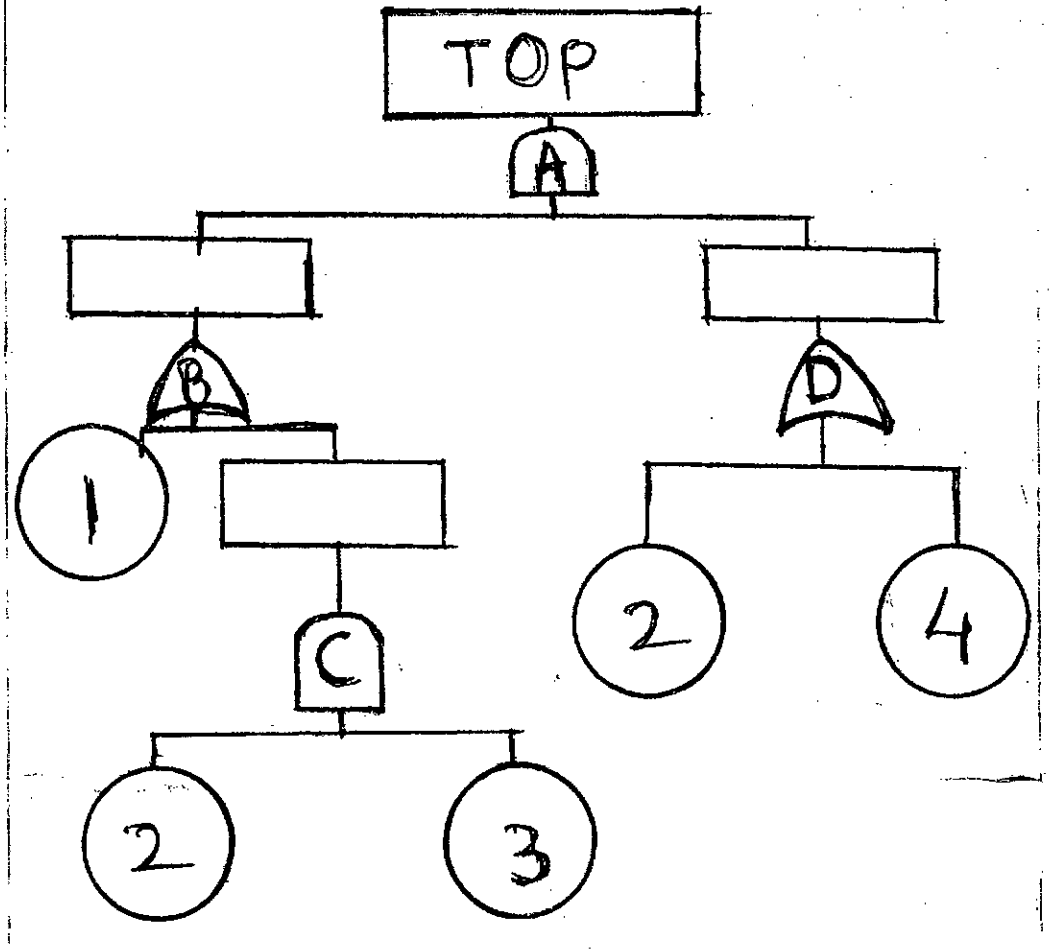
End Semester Examination December 2024

Q6 A	Give classification of waste according to different criteria's? According to environmental protection act, list down all types of solid wastes?	10	4	2	6
B	Write short note on following Dissolved oxygen and Biochemical oxygen demand? Explain their relations using systematic sketch?	10	4	1	7
Q7 A	Give definition of waste and disposal according to UN statistics division? List down all stages and explain how waste generates in each of these stages?	10	4	1	6
B	Write a short note on cut set method? Using MOCUS (minimal cut set todown) algorithm find minimal cut-set for the following system? (Stepwise answer expected)	10	2	3	4



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END SEM/~~RE-EXAM~~/DEC2024/~~JAN2025~~

13/12/24

T. Y. B. Tech Sem V

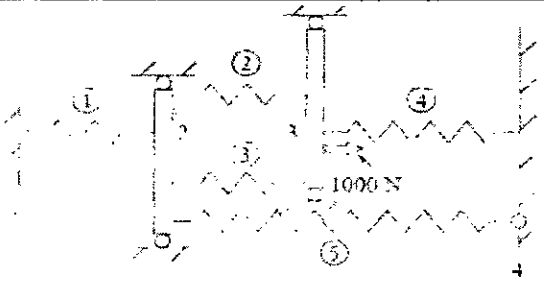
Program: **BTech Mechanical engg** **Duration: 3 hr**

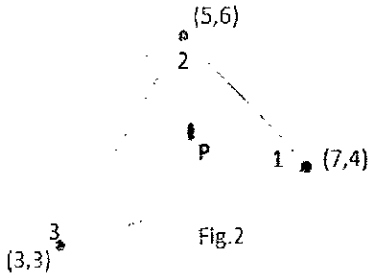
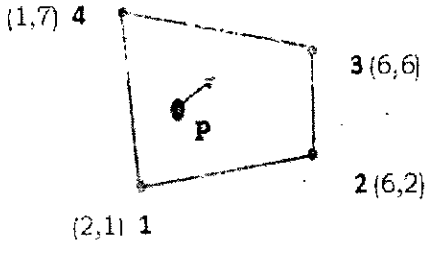
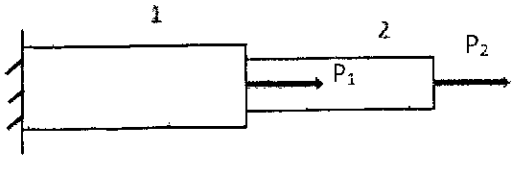
Course Code: PE-BTM511 **Maximum Points: 100**

Course Name: FEM for Mechanical Engineers. **Semester: V**

Notes:

1. All questions are compulsory.
2. Answers to each sub-questions are grouped together
3. Use of scientific calculator is allowed
4. Begin answer to each question on new page.
5. Keep some margin on left side of answer paper
6. **Candidates should write the answer legibly**

Q.No	Question Description	Pts	CO	BL
1	a) Natural co-ordinate system ensures displacement compatibility along the common edge in 2-D element. Explain. b) List and elaborate the steps involved FE analysis.	10 10	1,2	3,4
2	a) For the five-spring assemblage shown in figure, determine: i. The assembled stiffness matrix. ii. Nodal displacement  (Assume the rigid vertical bars at nodes 2 and 3 connecting the springs remain horizontal at all times but are free to slide or displace left or right. There is an applied force at node 3 of 1000 N to the right; and ($K_1 = K_4 = 750$ N/m $K_5 = 400$N/m $K_2 = K_3 = 500$ N/m). b) Explain Cholesky factorization method.	10 10	2,3	2,3
3	a) Using two parameter trial solution obtain the solution for following equation: $$\frac{dy}{dx} + y = 0;$$ $$0 \le x \le 1, \quad y(0) = 1$$ Use point collocation method (at x = 1/4 and x = 3/4: $R_d = 0$)	10	3	2,3

	b) Derive the expression of weak formulation for both end fixed supported beam element with udl.	10		
4	a) Obtain the shape functions for triangular element (fig.2) b) For the three-noded triangular element shown in fig.2, calculate temperature at point P(5,4). Given the nodal temperatures $T_1 = 70^0$ C, $T_2 = 100^0$ C, $T_3 = 90^0$ C. Obtain 80^0C isothermal line. c) For the three-noded triangular element shown in fig.2, calculate displacement at point P(5,5). Given $u_1=1$, $u_2=2$, $u_3=3$; $v_1=2$, $v_2=3$, $v_3=5$.  Fig.2	8 6 6	2,3	2,3
5	a) Find the Jacobian Matrix for the quadrilateral element shown in fig . b) Derive the shape function for quadratic bar element using Lagrangian method. (use Cartesian co-ordinate). 	10 10	2,3	2,3
6	The pin-fin used for heat dissipation, has 80 mm long and circular c/s area of 36π mm^2. At one end of fin temperature is 300^0C. (take k = 100 watt/cm ^{0}C. h = 10 watt/cm^2 ^{0}C, use 2 linear elements, (consider convection from free end also)Find: a) Conductive and convective matrix for each element b) Final assembled matrix c) Thermal load vector d) Temperature at the other end of pin.	 6 4 4 6	1,2,3	3,4
7	a) For the stepped bar shown in figure. obtain the following using FEM procedure: • Obtain element level and assembled stiffness matrix. • Calculate nodal displacement. • Stress in each element. Take $P_1 = 80$ kN, $P_2 = 50$ kN, $E_1 = 200$ GPa, $E_2 = 100$ GPa , $L_1 = 1.2$ m, $L_2 = 0.8$ m, $d_1 = 30$ mm, $d_2 = 18$ mm 	 8 6 6	1,2,3	3,4

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END SEM / ~~RE-EXAM~~ EXAMINATION DEC 2024

13/12/24

Total Points: 100 T.Y.B.Tech 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	Explain the Concept of Lean. State objectives of Lean manufacturing. Explain the roadmap for lean implementation in Indian Automotive industry and explain it. Draw the above roadmap.	10	4	1,2, 3,5	CO1
Q1B	Explore and explain critical success factors for Lean and Green Manufacturing.	10	5	1, 7	CO4
Q2A	What do you mean by VA, NVA. Draw the Value Stream Mapping of the Process used in service industry of your own choice. Show the process before and after improvement and calculate the cycle time before and after improvement.	10	4	2	CO3
Q2B	What are 3 M's as per Lean Manufacturing? Identify the wastes in the agriculture or healthcare sector. State the reasons of each waste. Develop the strategies to eliminate the wastes.	10	5	1	CO2
Q3A	What are the housekeeping principles? 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 in alignment with visual management in factory.	10	3	1,3	CO1, CO2
Q3B	State and explain the risks in JIT Implementation. Prepare the Fishbone Diagram to showcase Supply Risks in JIT implementation	10	3	3	CO1, CO2
Q4A	Explain why Green Supplier Development is necessary. Suggest the drivers and barriers. 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	4	7,5	CO4
Q4B	State the objectives Green Product Development. Explore and explain Barriers for Green Product Development. Develop the strategies for successful Green product development.	10	5	6	CO4
Q5A	How to ensure the sustainable lean implementation. Explain the Significance of Employee training and employee involvement.	10	5	1,5	CO1
Q5B	What are the objectives of Green Procurement? Explore the challenges in Green Procurement. Explain the role industry 4.0 technologies to address them.	10	5	7	CO4

Q6A	State the stakeholder of Manufacturing Industry. State the requirements of stakeholders of industry. Explore the Critical Success Factors of Stakeholder involvement in Greening drive of Organization.	10	5	7, 4 6	CO4
Q6B	Identify the lean and Green Metrics. Prepare and explain the Framework for Economic Assessment of Green initiatives.	10	5	4	CO4
Q7A	Prepare the Framework to successfully implement the Green in service industry like bank.	10	5	4	CO4
Q7B	What do you mean by error proofing. What are root causes of generation of error. Explain with neat sketches 20 Pokayoke examples.	10	4	3	CO3, CO4

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END SEMESTER EXAM/~~RE-EXAM~~ DECEMBER 2024/~~JANUARY 2025~~

Maximum Marks: 100 13/12/24 **Duration: 3 Hrs**

Class: **T.Y. B. Tech. (Mechanical)** Sem V Semester: **V**

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 1425 rpm gave the following results:- $Q\ (m^3/s)$: 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 A system is designed where the static head is 5 m and the operating point is Hm=17.7 m and Q= 0.018 m^3/s for the above pump. The system is redesigned, the static head being 5.5 m and the frictional and other losses increased by 20%. Find the new pump speed so that the flow rate of 0.018 m^3/s can be maintained.	15	2	7
(b)	Match the followings (Hydraulic Machineries with its working principle/characteristic feature) 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	5	1 to 3	2,3,4,5,6
2 (a)	Explain with neat sketches (i) Governing of Impulse Turbine (ii) Air vessels in Reciprocating Pumps	10	3	3
(b)	Write short note on (i) Draft tube in reaction turbines (ii) Selection of turbines	10	1,2,3	4,5
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	7
(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-	10	2,3,4	1 to 4

	(i) Francis turbine with Ns not greater than 230. (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)	Test on single stage centrifugal pump at 1450 rpm gave the following results:- $Q\ (m^3/s)$: 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.	**10**	**1,2**	**7**
(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	4
5 (a)	In a hydro-electric scheme a number of Pelton wheels are to be used under following conditions: Total output required 37 MW, gross head 245 m, speed 6.25 rps; 2 jets per wheel, Cv of nozzles 0.97; Speed ratio is 0.46, maximum overall efficiency (based on conditions immediately before the nozzles) 81.5%. "Dimensionless specific speed" not to exceed 0.022 rev (for one jet); head lost to friction in pipe line not to exceed 12 m. Calculate (i) The number of wheels required. (ii) The diameters of jet and wheels (iii) The hydraulic efficiency, if the blades deflects the water through 165^0 and reduce its relative velocity by 15% (iv) The percentage of input power that remains as kinetic energy of the water at discharge. Take the relation for dimensionless specific speed = $\frac{N\sqrt{P}}{\rho^{1/2}(gH)^{5/4}}$, where N is the speed in rps, P is the power in watts, H is the head in meters, and ρ is the density of the water in kg/m^3.	10	1 to 4	5
5 (b)	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**	**3**
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**	**2,4**	**7**
(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**	**3,4**	**4**
7 (a)	Test on single stage centrifugal pump at constant speed gave the following results:- Q (lit/s): 0, 12, 18, 24, 30, 36, 42	**10**	**3,4**	**7**

	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)	Manometric head discharge characteristics of a centrifugal pump is given by the equation: $Hm=20+15Q-600Q^2$ Where Hm is in m and Q is in m^3/s. System curve for a typical installation is estimated as $10+900Q^2$ (Q is in m^3/s), where 10 is static head in m. If the NPSHR characteristics of the pump is given by equation: $NPSHR=20Q+60Q^2$ where Q is in m3/s, evaluate how high the pump can be safely installed above the sump if suction pipe diameter is 15 cm, pipe length on suction side is 1.5 times static suction lift and 'f' for the pipe is 0.016. Evaluate the cavitation parameter 'σ' if pump runs at 1440 rpm and operates at duty point. Calculate the specific speed. Take atmospheric and vapour pressure being 10.3 and 2.5 mWc respectively.								**10**	**3**	**5,6**

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13/12/24

END SEMESTER/~~RE-EXAMINATION~~, DEC/~~JAN 2024-25~~ 24

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

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

Code: **PE BTM 554** Maximum Points:**100**

Course: **COMPRESSIBLE FLUID FLOW** Semester: V

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 the purpose of academic evaluation.

		Points	CO	BL
1	**(A)** Define Mach number and Mach angle. Derive an expression that represents sonic velocity in an arbitrary gaseous medium at a given temperature.	**[10]**	1	1
	(B) Differentiate between following. i) Compressible and Incompressible, ii) Subsonic and Supersonic, iii) Critical state and actual state of fluid flow. iv) Normal and Oblique shock wave	**[10]**	1,2	3
2.	**(A)** What do you understand by stagnation state of a flowing stream? Derive expression for stagnation properties- Pressure, Temperature and Density, in terms of stream Mach Number (M)	**[10]**	1	1,2
	(B) Air flows isentropically through the duct from 350 kPa (abs), 60°C, and 183 m/s at the inlet state to M=5 at the outlet, where local isentropic stagnation conditions are known to be 385 kPa (abs) and 350 K. Compute the local isentropic stagnation pressure and temperature at the inlet and the static pressure, temperature and density at the duct outlet. Locate the static state points of the inlet and outlet on a T-s diagram, and indicate the stagnation point also.	**[10]**	3,4	3
3.	**(A)** What are the basic governing equations for a compressible fluid flow analysis? Explain and write them in their mathematical form.	**[10]**	2,3	4
	(B) For flow through a variable area duct prove that $\frac{dV}{V} = -\frac{dA}{A}\frac{1}{\left[1-M^2\right]}$, Explain this expression with its physical meaning;	**[10]**	2,3	4,5
4.	**(A)** What is choked flow, and under what conditions does it occur? How does varying back pressure affect flow in a convergent-divergent (CD) nozzle? Illustrate the pressure ratio variation along the nozzle length and the mass flow rate as a function of the pressure ratio.	**[10]**	1,3	1,2
	(B) Air flows isentropically in a channel. At section 1 (Fig. 1), the Mach number is 0.3, the area is 0.001m^2, and the absolute pressure and the temperature are 650 kPa and 62°C, respectively. At section 2, the Mach number is 0.8. Sketch the channel shape, plot a Ts	**[10]**	3	4,5

diagram for the process, and evaluate properties in section 2.

If the Mach number at the inlet is 2, will the Mach number at the outlet increase or decrease? Analyze the flow conditions and provide a conclusion with justification.

5. **(A)** Consider a normal shock that exists in a one-dimensional gas flow. M_1 and M_2 are upstream and downstream Mach numbers of the flow across the normal shock. Derive the following expression, $M_2 = \dfrac{M_1^2 + \dfrac{2}{\gamma - 1}}{\dfrac{2\gamma}{\gamma - 1} M_1^2 - 1}$ **[10]** 3,4 1,2

(B) A normal shock stands in a duct. The fluid is air, which may be considered an ideal gas. Properties upstream from the shock are $T_1 = 5°C$, $p_1 = 65.0$ kPa (abs.). and $V = 668$ m/s. Determine properties downstream and $s_2 - s_1$. Sketch the process on a Ts diagram. **[10]** 4 3,4

(Use Gas Table)

6. **(A)** What is Fanno flow? Sketch the Fanno line on an appropriate property diagram and explain it. Discuss the effect of Fanno flow on the following properties: Pressure, temperature, density, enthalpy and velocity of flow. **[10]** 1,2 1,2

(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 of 310K and static pressure of 0.507 bar. Determine for a section at which the Mach number reaches 1.2, (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. **[10]** 3,4 3

(Use Gas Table)

7. **(A)** Discuss Rayleigh Flow. List down all governing equations required to characterise this flow. Represent it on a Ts diagram and explain its unique features. **[10]** 1,3 3,4

(B) What is a supersonic wind tunnel, and how does it differ from a subsonic wind tunnel? Explain the different flow development zones in a supersonic wind tunnel and describe the features that occur in each zone during operation. **[10]** 2,3 4,5

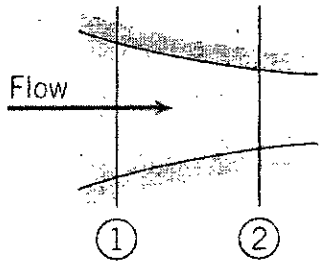

Fig. 1

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End Semester/Re~~-Exam~~ – December 2024 Examinations 13/12/24

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. Solve **any five** questions.
2. 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.
3. Assume suitable data and state the same if required.
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(a)	The insulation boards for air-conditioning purposes are made of three layers, middle being of packed grass 10 cm thick (k = 0.02 W/m°C) and the sides are made of plywood each of 2 cm thickness (k = 0.12 W/m°C). They are glued with each other. **Evaluate:** (i) The heat flow per m^2 area if one surface is at 35°C and other surface is at 20°C. Neglect the resistance of glue. (ii) Instead of glue, if these three pieces are bolted by four steel bolts of 1 cm diameter at the corner (k = 40 W/m°C) per m^2 area of the board then find the heat flow per m^2 area of the combined board.	10	1,2	3,4	2
1(b)	**Define** the thermal conductivity of a material. Also, discuss the factors it depends on with some examples of materials.	05	1	1	1
1(c)	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**:	05	1	1	1

End Semester/Re-~~Exam~~ – December 2024 Examinations

	(i) The rate of heat transfer (ii) The value of thermal resistance, and (iii) The equivalent convection coefficient.				
2(a)	**Calculate** the rate of heat flow per m^2 through a furnace wall containing of 200 mm thick inner layer of chrome brick, a center layer of kaolin brick 100 mm thick and an outer layer of masonry brick 100 mm thick. The unit surface conductance at the inner surface is 74 $W/m^2°C$ and the outer surface temperature is 70°C. The temperature of the gases inside the furnace is 1670°C. What temperatures prevail at the inner and outer surfaces of the center layer? Take thermal conductivity of chrome brick, karolin brick and masonary brick as 1.25 W/m°C , 0.074 W/m°C and 0.555 W/m°C respectively.	**10**	4	3,4	2
2(b)	Hot air at a temperature of 65°C if flowing through a steel pipe of 120 mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60 mm and 40 mm, and their corresponding thermal conductivities are 0.24 and 0.4 W/m°C. The inside and outside heat transfer coefficients are 60 $W/m^2°C$ and 12 $W/m^2°C$ respectively. The atmosphere is at 20°C. **Find** the rate of heat loss from 60 m length of pipe.	**10**	4	3,4	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**	1,2	3,4	3
3(b)	Derive an expression for LMTD of parallel flow heat exchanger.	**10**	2	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 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. Determine the heat transfer area required and the effectiveness remains constant at 2270 W/m^2 K. **Determine** the heat transfer area required and the	**10**	4	3,4	6

	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	3,4	6
5(a)	**Define** following terms and also write their significance. (i) Reynolds number (ii) Prandtl number (iii) Nusselt number (iv) Stanton number (v) Grashoff number	**10**	1	1,2	4
5(b)	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: $Nu_x=0.332\ (Re)^{1/2} \times (Pr)^{1/3}$ for laminar flow $\overline{Nu}=0.332\ (Re)^{1/2} \times (Pr)^{1/3}$ for laminar flow $Nu_x=0.036\ [(Re_x)^{0.8} - 850] * (Pr)^{1/3}$ – Turbulent Flow	**10**	4	3,4	4
6(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

End Semester/~~Re-Exam~~ – December 2024 Examinations

6(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 length. 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 0.9.	**10**	3	3,4	5
7	**Explain** the followings:				
	(i) State the examples of mass transfer in day-to-day life and industrial applications. What are the various mechanisms of mass transfer?	**05**	4	1,2	7
	(ii) State Fick's law of diffusion. Define the various symbols used and give their units.	**05**	4	1,2	7
	(iii) **Define** the terms absorptivity, reflectivity and transmissivity of radiation with neat sketch.	**05**	3	1,2	5
	(iv) What is 'black body'? How does it differ from a grey body?	**05**	3	1,2	5

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End Semester/Re-Exam – December 2024 Examinations

The properties of air are given below.

Table A 4.2 *Properties of dry air at atmospheric pressure*

T °C	ρ kg/m^3	C_p kJ/kg-K	$\mu \times 10^6$ N-s/m^2	k W/m-K	Pr	$\nu \times 10^6$ m^2/s
0	1.293	1.005	17.2	0.0244	0.707	13.28
10	1.247	1.005	17.7	0.0251	0.705	14.16
20	1.205	1.005	18.1	0.0259	0.703	15.06
30	1.165	1.005	18.6	0.0267	0.701	16.00
40	1.128	1.005	19.1	0.0276	0.699	16.96
50	1.093	1.005	19.6	0.0283	0.698	17.95
60	1.060	1.005	20.1	0.0290	0.696	18.97
70	1.029	1.009	20.6	0.0297	0.694	20.02
80	1.000	1.009	21.1	0.0305	0.692	21.09
90	0.972	1.009	21.5	0.0313	0.690	22.10
100	0.946	1.009	21.9	0.0321	0.688	23.13
120	0.898	1.009	22.9	0.0334	0.686	25.45
140	0.854	1.013	23.7	0.0349	0.684	27.80
160	0.815	1.017	24.5	0.0364	0.682	30.09
180	0.779	1.022	25.3	0.0378	0.681	32.49
200	0.746	1.026	26.0	0.0393	0.680	34.85
250	0.674	1.038	27.4	0.0427	0.677	40.61
300	0.615	1.047	29.7	0.0461	0.674	48.33
350	0.566	1.059	31.4	0.0491	0.676	55.46
400	0.524	1.068	33.0	0.0521	0.678	63.09
500	0.456	1.093	36.2	0.0575	0.687	79.38
600	0.404	1.114	39.1	0.0622	0.699	96.89
700	0.362	1.135	41.8	0.0671	0.706	115.4
800	0.329	1.156	44.3	0.0718	0.713	134.8
900	0.301	1.172	46.7	0.0763	0.717	155.1
1000	0.277	1.185	49.0	0.0807	0.719	177.1