Total No. of Questions : **08** Roll No. : 0701.....

B.Tech FOURTH SEMESTER EXAMINATION JUNE-2025

(Branch : Mechanical Engineering)

ME-4401 / ME-4301 APPLIED THERMAL ENGINEERING

Time : Three Hours ***Maximum Marks : 70***
Min. Pass Marks : 22

Note : Attempt any five questions. Use of Steam Tables/Mollier diagram is permitted. Assume suitable data if required.

1(a) What is a Steam Generator as per A.S.M.E definition? Discuss its classification in brief with suitable examples. ***08***

(b) Draw the neat flow diagram of La Mont Boiler and describe it's working. ***06***

2(a) Discuss the following terms in reference to Steam Generators : ***08***

(i) Evaporation rate (ii) Factor of Evaporation
(iii) Boiler efficiency and (iv) Boiler Trial.

(b) The following readings were obtained during a boiler trial of 6 hours duration : ***06***

Mean steam pressure = 13 bar Mass of steam generated = 41,000 kg
Mean dryness fraction of steam = 0.90 Mean feed water temperature = 32°C
Coal used = 4,200 kg Calorific value of coal = 33,500 kJ/kg

Calculate : (i) Factor of evaporation (ii) Equivalent evaporation and
(iii) Efficiency of the boiler.

3(a) Draw the various components utilized in a simple steam thermal power plant. Discuss the processes applied on each component in a Rankine vapour power cycle on a temperature-entropy diagram ***08***

(b) In a Rankine cycle, the steam at inlet to turbine is dry saturated at a pressure of 35 bar and the exhaust pressure is 0.10 bar. ***06***

Determine : (i) Heat supplied (ii) Turbine work
(iii) Cycle efficiency and (iv) pump work.

4(a) Apply the concept of Rankine cycle by modifying it for Practical Regenerative 1-feed water heater arrangements with the help of neat flow, T-s diagram and h-s diagram. ***08***

(b) A reheat Rankine cycle operates between the pressure limits of 26 bar and 0.04 bar. The steam entering the HP turbine and LP turbine has a temperature of 400°C. The steam leaves the HP turbine as dry saturated. Find out the cycle efficiency. Neglect the feed-pump work. ***06***

5(a) Derive the work transfer in a reciprocating air compressor with clearance volume with the help of neat diagram and define volumetric efficiency and clearance ratio. ***08***

(b) A single-stage double acting air compressor has a free air delivery (F.A.D) of 14 m^3/ min measured at 1.013 bar and 15°C. The pressure and temperature in the cylinder during induction are 0.95 bar and 32°C. The delivery pressure is 7 bar and index of compression and expansion, n = 1.30. The clearance volume is 5% of the swept volume. ***06***

Calculate : (i) Indicated power required and (ii) Volumetric efficiency.

P.T.O.

6(a) Explain the principle and working of any one type of Surface Condenser with the help of neat diagram. ***08***

(b) The absolute pressure in the condenser is 11.56 kPa when the barometer reads 1 bar. The condenser temperature is 40^{o}C. Calculate : ***06***

(i) the partial pressure of air
(ii) vacuum efficiency and
(iii) mass of air present in the condenser per kg of steam.

7(a) What is the function of nozzle? Derive its principle using steady flow energy equation. Show the effect of friction inside the nozzle with the help of enthalpy-entropy diagram. ***08***

(b) Define and discuss the following terms in reference to Gas Dynamics : ***06***

(i) Mach number (ii) Mach angle (iii) Mach cone
(iv) Mach line and (v) Zone of action and silence.

8 Write Short Notes on **any two** : ***2*7***

(i) Factors involved in the making of heat balance sheet
(ii) Deriving speed of sound applicable for any fluid
(iii) Supersaturated flow in nozzles.

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Total No. of Questions : **08** Roll No. : 0701.....

B.Tech FOURTH SEMESTER EXAMINATION JUNE-2025

(Branch : Mechanical Engineering)

ME-4402 / ME-4302 FLUID MECHANICS

Time : Three Hours ***Maximum Marks : 70***
Min. Pass Marks : 22

Note : Attempt any five questions.

1(a) A 20 mm wide gap between two vertical plane surfaces is filled with an oil of specific gravity 0.90 and dynamic viscosity 3 N-s/m^2. A metal plate 2m × 2m × 2mm thick and weighing 30 N is placed midway in the gap. Determine the force required to lift the plate with a constant velocity of 0.2 m/s. ***10***

(b) Prove that shear stress distribution in laminar flow through a pipe is linear. ***04***

2 Define metacentre and derive an expression for determination of theoretical metacentric height. Also discuss about stability of floating bodies. ***14***

3(a) Derive continuity equation for three dimensional flow field. ***10***

(b) A stream function in a two dimensional flow field is $\psi = 2xy$. Show that the flow is irrotational and determine the corresponding velocity potential function ϕ. ***04***

4(a) A fluid flow field is given by $V = x^2 y\,\hat{i} + y^2 z\,\hat{j} - \left(2xyz + yz^2\right)\hat{k}$ ***10***

Prove that it is a case of possible steady incompressible fluid flow. Also calculate the velocity and acceleration at the point (3, 2, 1).

(b) A pipe AB carries water and tapers uniformly from a diameter of 0.1 m at A to 0.2 m at B. If the point B is 5 m above point A and pressure head difference between at A and B is 0.3 m of water column, determine the flow through the pipe, neglecting all losses. ***04***

5(a) Derive Euler's equation of motion along a stream line and obtain Bernoulli's theorem from it. ***10***

(b) Write short note on pitot tube. ***04***

6(a) Derive an expression for theoretical discharge through venturimeter. Use this expression to calculate the discharge of water flowing through a pipe 35 cm diameter placed in an inclined position where a venturimeter is inserted having a throat diameter of 15 cm. The difference of piezometric head between the main and throat is measured by a U tube mercury manometer which gives a reading of 5 cm. The specific gravity of mercury used in manometer is 13.5. ***11***

(b) A pipe of cross sectional area 1 m^2 carries water at a velocity of 30 m/s. the pressures at the points A and B in this pipe line are 29.50 N/cm^2 and 23.50 N/cm^2 respectively, while the datum head at A and B are 26 m and 30 m. Find the loss of head between A&B and also the direction of flow. Take gravitational acceleration g = 10 m/s^2. ***03***

P.T.O.

7(a) Two reservoirs are connected by a pipe line which is 15 cm in diameter for first 10 m and 25 cm in diameter for remaining 20 m. The difference in water levels of two reservoirs is 8 m. Find the discharge through the arrangements assuming all minor and major losses. Take coefficient of friction as 0.01. ***10***

(b) Derive an expression for head loss due to sudden contraction by using the expression for the head loss due to sudden expansion in a pipe flow. ***04***

8(a) State the Buckingham's Pie theorem and explain how repeating variables are selected. ***04***

(b) The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness K. Discuss Buckingham's π theorem and obtain an expression for Δp using Buckingham's theorem. ***08***

(c) Define Eulers number and Reynolds number and explain their physical significance. ***02***

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B.Tech FOURTH SEMESTER EXAMINATION JUNE-2025

(Branch : Mechanical Engineering)

ME-4403 STRENGTH OF MATERIALS

Time : Three Hours ***Maximum Marks : 70***
Min. Pass Marks : 22

Note : Attempt any five questions. All questions carry equal marks. Assume missing/ misprint data suitably if required.

1(a) If a tension bar is found to taper uniformly from (D-a) cm diameter to (D+a) cm, prove that the error involved in using the mean diameter to calculate Young's modulus is $(10a/D)^2$. ***07***

(b) A load of 2 MN is applied on a short concrete column 500 mm × 500mm. The column is reinforced with four steel bars of 10 mm diameter, one in each corner. Find the stresses in the concrete and steel bars. ***07***

Take E for steel as 2.1×10^5 N/mm^2 and for concrete as 1.4×10^4 N/mm^2 percent.

2(a) Define the terms : Principal planes and principal stresses. ***04***

(b) At a point in a strained material, the principal stresses are 100 N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. What is the maximum intensity of shear stress in the material at the point? ***10***

3(a) Derive an expression for bending stress at a layer in a beam. ***07***

(b) A beam is simply supported and carries a UDL of 40 kN/m run over the whole span. The section of the beam is rectangular having depth as 500 mm. If the maximum stress in the material of the beam is 120 N/mm^2 and moment of inertia of the section is 7×10^8 mm^4. Find the span of the beam. ***07***

4(a) The shear stress is maximum at the N.A. for a circular section and is given by – ***07***

$$\tau_{max} = \frac{4}{3}\times \tau_{avg}$$

(b) A rectangular beam 200 mm deep and 300 mm wide is simply supported over a span of 8.0 m. What uniformly distributed load per metre the beam may carry, if the bending stress is not to exceed 120 N/mm^2. ***07***

5 A beam of length 6.0 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 1m and 3m respectively from the left support. Find : ***14***

(i) deflection under each load
(ii) maximum deflection
(iii) the point at which maximum deflection occurs.

Given E = 2×10^5 N/mm^2 and I = 85×10^6 mm^4

P.T.O.

6(a) A solid circular shaft transmits 75 kW power at 200 rpm, calculate the shaft diameter, if the twist in the shaft is not to exceed 1^o in 2.0 m length of shaft and shear stress is limited to 50 N/mm^2. Take C = 1×10^5 N/mm^2. ***07***

(b) A closely coiled helical spring of round steel wire 10 mm in diameter having 10 complete turns with a mean diameter of 12 cm is subjected to an axial load of 200 N. Determine : ***07***

(i) the deflection of the spring
(ii) maximum shear stress in the wire
(iii) stiffness of the spring

Take C = 8×10^4 N/mm^2.

7(a) Derive the relation between elastic constants Young's modulus, bulk modulus, Poisson's ratio and modulus of rigidity. ***07***

(b) Calculate the safe compressive load on a hollow cast iron column (one end rigidly fixed and other hinged) of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety of 5 and E = 95 kN/mm^2. ***07***

8 Write short notes on **any four** : ***14***

(i) thermal stress and thermal strain
(ii) volumetric strain and Poisson's ratio
(iii) moment area method
(iv) torsional rigidity
(v) equivalent length of column
(vi) difference between open coiled and closed coiled helical spring

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Total No. of Questions : **08** Roll No. : 0701.....

B.Tech FOURTH SEMESTER EXAMINATION JUNE-2025

(Branch : Mechanical Engineering)

ME-4404 / ME-4304 MANUFACTURING PROCESS

Time : Three Hours ***Maximum Marks : 70***
Min. Pass Marks : 22

Note : Attempt any five questions. Draw neat and clean diagrams in support of your answers.

1(a)	Explain wringing process used in slip gauges.	***07***
(b)	Explain basic principle of comparator and working of dial gauge.	***07***
2(a)	Explain different types of pattern.	***07***
(b)	Briefly explain the procedure to be followed for making a sand mould.	***07***
3(a)	Describe the operations of a cupola furnace for melting cast iron.	***07***
(b)	Explain different defects occur during casting.	***07***
4(a)	What are the advantages of hot working over cold working of metals?	***07***
(b)	How the grain structure of the metal is affected during rolling?	***07***
5(a)	List various operations generally performed in a sheet metal shop.	***07***
(b)	What is metal spinning?	***07***
6(a)	Explain different rolling mills.	***07***
(b)	Explain different extrusion operations.	***07***
7(a)	Describe in brief the equipment required for oxy-acetylene welding.	***07***
(b)	Explain gas cutting operations.	***07***
8(a)	Describe briefly the technique of welding in MIG process.	***07***
(b)	Explain atomic hydrogen welding process.	***07***

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B.Tech FOURTH SEMESTER EXAMINATION JUNE-2025

(Branch : Mechanical Engineering)

HS-4406 / HS-4306 INDUSTRIAL ENGINEERING

Time : Three Hours ***Maximum Marks : 70***
Min. Pass Marks : 22

Note : Attempt any five questions. Each question carries equal marks.

1(a) "Industrial engineering is an important tool for improving productivity". Justify or refute this statement. Give suitable examples to support your answer. ***07***

(b) What are the factors affecting productivity? Discuss the key parameters used for measuring productivity? ***07***

2(a) What is partial productivity? How many types of partial productivities are there? How will you calculate total productivity given numerous partial productivities? ***07***

(b) How application of work study leads to improved productivity? Explain work study in detail. ***07***

3(a) What are the important objectives of method study? Discuss method study with suitable example. ***07***

(b) Explain critical examination technique as a step of method study. ***07***

4(a) Explain the complete process of replacing punctured tyre of a car with the help of flow process chart. ***07***

(b) What is meant by work measurement? Write systematic procedure to carry out time study with details of time study tools and charts used in it. ***07***

5(a) What are the different allowances considered in time study? Discuss each one of them and quote suitable examples to support your answer ***07***

(b) Discuss work sampling as a method of work measurement. How will you determine the number of observations to be made to justify work sampling? ***07***

6(a) Discuss following wage plan : (i) Tailor's differential piece rate plan
(ii) Merrick's multiple piece rate plan ***07***

(b) What are the constituents of cost? How will you determine the cost of a product produced in a factory? ***07***

7(a) Mr. Alok Kumar, an author, is considering his own publishing company. He expects fixed cost of $ 2,50,000 and a variable cost per book to be $ 20. He assume selling price to be $ 30 per book. How many books must he sell to break-even? What is the break-even point in dollars? Additionally, if he wants to pay himself a salary of $75000 per annum, how Break-even point will change in units? How will it change in terms of dollars? ***07***

(b) Discuss in detail the sensory system of human body along with its relative capabilities. ***07***

8(a) What are the ergonomic considerations you will keep in mind for seat design of a car driver? How anthropometric data will help you in designing car seat for a typical Indian Driver? ***07***

(b) Write notes on ***any two*** : ***07***
(i) Difference between qualitative and quantitative displays
(ii) Estimation of Energy expenditure in physical activities
(iii) Micro-motion study
(iv) Travel chart

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