

B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025*(Branch : Mechanical Engineering)***ME-7301 HEAT AND MASS TRANSFER**

Time : Three Hours

Maximum Marks : 70

Min. Pass Marks : 22

Note : Attempt any five questions. All questions carry equal marks. Use of Heat and Mass Transfer Data Book is permitted. Assume suitable data if required.

- 1(a) How heat transfer initiates in Convection heat transfer? Describe its mechanism with the help of neat diagram and then derive the law which governs it. **08**
- (b) A wall is constructed of a section of stainless steel [$k=17 \text{ W/m K}$], 4.5 mm thick with identical layers of plastic on both sides of the steel. The overall heat-transfer coefficient, considering convection on both sides of the plastic, is $125 \text{ W/m}^2 \text{ K}$. If the overall temperature difference across the arrangement is 50°C , draw the layout of the walls and calculate the temperature difference across the stainless steel. **06**
- 2(a) How adding insulation thickness is different in pipes as compared to plane slab in terms of heat transfer? Derive an expression to determine the critical radius of insulation applicable in a spherical flow and show it on a heat transfer versus radius plot. **08**
- (b) A tube 2 cm outer diameter maintained at uniform temperature of T_1 is covered with insulation ($K = 0.20 \text{ W/m K}$) to reduce heat loss to the ambient air at T_∞ with heat transfer coefficient at ambient is $15 \text{ W/m}^2 \text{ K}$. Calculate :
- (i) the critical thickness of insulation and
- (ii) the ratio of heat loss from the tube with insulation to that without insulation.
- 3(a) What are extended surfaces and its applications? With the help of neat diagram discuss various types of extended surfaces. **08**
- (b) A rod of 10 mm square section and 160 mm length with thermal conductivity of 50 W/m-K protrudes from a furnace wall at 200°C , and is exposed to air at 30°C with convection coefficient $20 \text{ W/m}^2\text{-K}$. Calculate the temperature established at 80 mm and 158 mm lengths. Assume the fin to be infinitely long. **06**
- 4(a) Differentiate between steady state and unsteady state heat conduction and discuss the concept of Response of Thermocouple with the help of temperature-time plot. **08**
- (b) A fin made of chrome nickel (15% chromium, 10% Nickel) of 2 cm diameter and 10 cm height is attached to a wall at 300°C . The ambient temperature is 50°C and heat transfer coefficient is $10 \text{ W/m}^2 \text{ K}$. Neglecting the heat loss from the end surface of the fin, find :
- (i) rate of heat loss from the fin
- (ii) the temperature at the tip of the fin and
- (iii) effectiveness of the fin.
- 5(a) Establish the relationship between the non-dimensional numbers namely Nusselt number (Nu), Reynolds number (Re) and Prandtl number (Pr) using the concept of dimensionless analysis in a forced convection problem in the form $\text{Nu} = f(\text{Re}, \text{Pr})$. **08**
- (b) A steam pipe 50 mm diameter and 2.5 m long has been placed horizontally and exposed to still air at 25°C . If the pipe wall temperature is 295°C , determine the rate of heat loss. **06**

- 6(a) Discuss the graph obtained in a wavelength distribution of black body radiation given by Planck's law. **08**
- (b) Two very large parallel planes with emissivities 0.35 and 0.85 radiative energy. Determine the percentage reduction in radiative energy transfer when a polished aluminium radiation shield ($\varepsilon = 0.045$) is placed between them. **06**
- 7(a) Differentiate L.M.T.D and NTU methods in Heat exchangers? Derive an expression to calculate the L.M.T.D in parallel flow heat exchanger. **08**
- (b) Steam is being condensed on a series of tubes through which cold water is flowing. Each tube is 25 mm in diameter and overall heat transfer coefficient based on outside area is $200 \text{ W/m}^2 \text{ K}$. Water in each tube flows at a rate of 200 kg/hr and entering temperature of 15°C and leaving temperature of 80°C . If the steam is condensed at 100°C . Find the steam condensed on each tube per hour and the length of the tube. Use NTU method to solve the problem. **06**
- 8 Write short notes on **any two** : **7,7**
- (i) Classification of Heat Exchangers
 - (ii) Deriving concept of thermal diffusivity in 1-D conduction heat transfer
 - (iii) Derivation of Reciprocity theorem

B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025*(Branch : Mechanical Engineering)***ME-7341 (EL-IV) REFRIGERATION AND AIR CONDITIONING**

Time : Three Hours

Maximum Marks : 70

Min. Pass Marks : 22

Note : Attempt total five questions. All parts of a question should be attempted at one place. Use of property tables and psychrometric chart is permitted.

- 1(a) Derive the expression for COP of Bell Coleman cycle. 08
- (b) How many kg of ice at -4°C can be made by a refrigerating machine of one ton capacity? 06
The ice is made from water at 20°C and the time for refrigeration is one hour. Take the specific heat of ice = 2.1 kJ/kg-K , the latent heat of ice = 335 kJ/kg and the specific heat of water = 4.187 kJ/kg-K .
- 2 Write note on simple aircraft refrigeration system. 14
The speed of an aeroplane flying at an altitude of 8 km is 900 km/h. at this altitude the ambient air is at -15°C temperature and 0.35 bar pressure. The simple aircraft refrigeration system is used for aeroplane to take a load of 15 TR. The main compressor compresses the rammed air up to pressure of 3 bar. The cabin pressure is 1.01 bar and the temperature of air leaving the cabin should not exceed 25°C . The ramming efficiency is 90%, isentropic efficiency of the compressor is 85%, the effectiveness of air cooler is 0.65 and isentropic efficiency of the turbine is 88%. Find :
(i) stagnation pressure and temperature of air entering the compressor
(ii) mass flow rate of air circulated per minute.
- 3 Explain the working of simple saturated standard vapour compression refrigeration cycle. 14
A simple saturated vapour compression refrigeration cycle of 2 TR capacity uses ammonia. The condenser temperature and evaporator temperature are 45°C and -5°C respectively. Calculate the COP, mass flow rate of refrigerant and volume of suction vapour per hour.
The specific volumes of saturated vapour at evaporator temperature is equal to $0.3465 \text{ m}^3/\text{kg}$. Also use following data :
- | T ($^{\circ}\text{C}$) | p (bar) | h_f (kJ/kg) | h_g (kJ/kg) | s_f (kJ/kgK) | s_g (kJ/kgK) | c_p (kJ/kgK) |
|--------------------------|---------|---------------|---------------|----------------|----------------|----------------|
| -5 | 3.549 | 157.3 | 1437 | 0.6266 | 5.398 | 2.6 |
| 45 | 17.82 | 396.3 | 1471 | 1.435 | 4.814 | 3.6 |
- 4 Explain the working of simple $\text{NH}_3\text{-H}_2\text{O}$ vapour absorption refrigeration system. Also 14
derive the expression for its maximum COP.
- 5(a) Discuss the thermodynamic and thermophysical properties of refrigerants. 06
- (b) What do you understand by azeotropic and zeotropic mixtures? 04
- (c) How does the hermitical compressor differ from open type compressor? Discuss. 04

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- 6(a) A mixture of dry air and water vapour is at a temperature of 20°C under a total pressure of 735 mm of Hg . The dew point temperature is 15°C . Find: partial pressure of water vapour, specific volume (density) of air, specific volume (density) of water vapour, relative humidity, specific humidity, enthalpy of air per kg of dry air. **08**
- (b) Define specific humidity and derive its expression. **06**
- 7 An air conditioned room is maintained at 24°C DBT and 50% RH, while the outside conditions are 40°C DBT, 35% RH. The RSHF of air conditioned room is 0.7. The 50% of the return room air is recirculated and amount of fresh air for ventilation is $100\text{ m}^3/\text{min}$. By assuming the bypass factor of the cooling coil to be zero, determine :
- (i) ADP
 - (ii) Volume flow rate of the air entering the cooling coil
 - (iii) RSH and RLH
 - (iv) OASH and OALH
 - (v) GSHF, ESHF

Write the procedure and attach the psychrometric chart with answer book.

- 8(a) What do you understand by subcooling of liquid refrigerant? How the subcooling is carried out in the refrigeration cycle? Discuss the effect of subcooling. **07**
- (b) An air conditioned hall for 100 persons is maintained at 24°C DBT and 50% RH, while the outside conditions are 35°C DBT, 27°C WBT. **07**
- (i) If the ventilation requirement is $0.03\text{ m}^3/\text{persons}/\text{second}$, find sensible heat load and latent heat load due to ventilation air.
 - (ii) If the total internal volume of the hall is 800 m^3 and the infiltration of the air in the hall is equal to 1.5 ACH, find sensible heat load and latent heat load due to infiltration of air.

B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025*(Branch : Mechanical Engineering)***ME-7321 (OEL-II) SOLAR ENERGY UTILIZATION***Time : Three Hours***Maximum Marks : 70****Min. Pass Marks : 22****Note : Attempt any five questions. All parts of a question should be attempted at one place.**

- 1(a) Discuss following terms: solar constant, declination angle, hour angle, and tilt factor. **06**
- (b) Calculate the angle made by beam radiation with the normal to a flat-plate collector on March 11 at 1200 h (LAT). The collector is located in New Delhi (28°35'N, 77°12'E) and is tilted at an angle of 30° with the horizontal and is pointing due to south. **08**
- 2(a) Discuss hour angle corresponding to sunrise, hour angle corresponding to sunset, and day length. **06**
- (b) Discuss the ASHRAE clear sky model to estimate the hourly global and diffuse solar radiation falling on a horizontal surface. **08**
- 3 Describe a conventional liquid flat plate collector. Derive the relation for temperature variation across the plate in between the tubes of this conventional liquid flat plate collector. **14**
- 4(a) How are the bottom and side loss coefficients of a flat plate collector determined? **08**
- (b) How is the top loss coefficient of a flat plate collector determined? Discuss. **06**
- 5 Discuss the performance analysis of a solar air heater in which air flows in between the glass cover and absorber plate. Also write the energy balance equations for the absorber plate, glass cover and air stream. **14**
- 6(a) How the performance of solar air heater can be improved? Discuss some new designs. **10**
- (b) Discuss the advantage and disadvantages of concentrating collectors. **04**
- 7 Discuss the performance analysis of a cylindrical parabolic trough collector and derive relation for useful heat gain in following form : **14**
- $$q_u = F_R (W - D_o) L \left[S - \frac{U_l}{C} (T_{fi} - T_a) \right]$$
- 8(a) Explain the terms : time value of money and simple and discounted pay back periods. **06**
- (b) The replacement of the glass cover of a flat plate collector at the end of eighth year is likely to cost Rs. 4000. What amount should a user deposit every year to accumulate the required amount if he earns 6 per cent interest on his deposits? Derive and discuss the relation used. **08**

Total No. of Questions : **08**

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B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025

(Branch : *Mechanical Engineering*)

ME-7322 (OEL-II) SUPPLY CHAIN MANAGEMENT

Time : Three Hours

Maximum Marks : 70

Min. Pass Marks : 22

Note : Attempt any five questions. Each questions carry equal marks. Assume data if needed. Use of statistical table is permitted

- 1(a) What are the main objectives and functions of supply chain management? Quote suitable examples in support of your answer. **07**
- (b) What is the process view of supply chain? How is it different from cyclic view? **07**
- 2(a) Write major decisions that are taken by a manager in supply chain management? Quote suitable examples. **07**
- (b) Explain various competitive strategies available for managing supply chain. Take suitable examples to elaborate your answer. **07**
- 3(a) What is causal model of forecasting? Explain the complete procedure of causal model to forecast the future demand of car tyres in next year. **07**
- (b) Discuss the outcome of aggregate planning. How aggregate planning helps in operational planning? **07**
- 4(a) What is economic order quantity? Derive formula for EOQ, total cost of inventory and state the assumptions very clearly. **07**
- (b) What are the important tools available for vendor development? How vendor development cost is justified in supply chain? **07**
- 5(a) The daily demand of LED TV at a shop is normally distributed with an average of 50 and a standard deviation of 20 units. The lead time for receiving a shipment of new TVs is 10 days and is fairly constant. Determine the reorder point and safety stock for a 95 % service level. If the lead time is also normally distributed with mean lead time as 10 days and standard deviation of 3 days, how your answer will change? **07**
- (b) A car manufacturer produces subcomponent at a rate of 300 per day and it uses this subcomponent at a rate of 12500 per year (of 250 working days). Holding costs are \$ 2 per item per year and the set up costs are \$30 per setup. **07**
 - (i) What is the economic batch quantity?
 - (ii) How many production runs per year will be made?
 - (iii) What will be the maximum inventory level?
 - (iv) What percentage of time will the facility be producing items?
 - (v) What is the annual cost of inventory?

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- 6(a) Discuss various supply chain metrics you will consider for selection of supplier. What are the techniques available for supplier selection problem? **07**
- (b) What do you mean by multimodal transportation system? How containerization helps in achieving the intended benefits? **07**
- 7(a) Why third party logistics provider in a typical supply chain is important? Discuss the advantages and disadvantages of engaging 3 PL. **07**
- (b) Explain following supply chain practices with suitable examples to support your answer :- **07**
- (i) Vender managed inventory (VMI)
 - (ii) Cross docking
- 8(a) Discuss balanced scorecard model of supply chain performance measurement with suitable example. **07**
- (b) Write short notes on **any two** : **07**
- (i) Bench marking
 - (ii) Risk management in supply chain
 - (iii) Kraljik's model of inventory classification
 - (iv) Bullwhip effect

B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025*(Branch : Mechanical Engineering)***ME-7331 (OEL-III) VIBRATION AND NOISE CONTROL**

Time : Three Hours

Maximum Marks : 70

Min. Pass Marks : 22

Note : Attempt any five questions. Assume suitable data wherever necessary.

- 1(a) Explain in brief, any one method for determination of natural frequency of vibration. **07**
- (b) Determine the expression of natural frequency of free vibration of a spring mass system taking into account the mass of the spring. **07**
- 2(a) Find the expression of equivalent spring stiffness when two spring of different stiffness are connected : (i) in series and (ii) in parallel. **05**
- (b) A disc of mass moment of inertia 0.08 kg-m^2 is attached to the end of shaft whose diameter is 120 mm and length is 600 mm long. When it vibrates it is observed that the amplitude on the same side of the rest position for successive cycles are 9° , 6° and 4° . Determine : **09**
- (i) The logarithmic decrement (ii) The damping torque at unit velocity
(iii) The periodic time of observation.
- What would be the frequency, if the disc is removed from the viscous fluid? Assume modulus of rigidity of shaft material as $4.5 \times 10^{10} \text{ N/m}^2$.
- 3(a) A single cylinder vertical petrol engine of total mass 320 kg is mounted upon a steel chassis and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine have a mass of 24 kg and move through a vertical stroke of 150 mm with SHM. A dashpot attached to the system offers a resistance of 490 N at a velocity of 0.3 m/s. Determine : **07**
- (i) The speed of the driving shaft at resonance
(ii) The amplitude of the steady state vibration when the driving shaft rotates at 480 rpm.
- (b) What is Whirling Speed? Prove that Whirling speed is equal to the natural frequency of transverse vibration. **07**
- 4(a) Define : (i) Magnification Factor (ii) Phase angle (iii) Transmissibility Ratio. **06**
- (b) Discuss how natural frequency of a two rotor system can be obtained? Also draw mode shape. **08**
- 5 An automobile weighs 2000 N and has a wheel base of 3.0 m. Its CG is located 1.4 m behind the front wheel axis and has a radius of gyration about its CG as 1.1 m. The front springs have a combined stiffness of $6 \times 10^6 \text{ N/m}$ and rear springs have a combined stiffness of $6.5 \times 10^6 \text{ N/m}$. Find the principle modes of vibration of the automobile and locate the node points for each mode. **14**
- 6(a) Discuss the principle of dynamic vibration absorber. **04**
- (b) Explain in brief, various methods of industrial noise control **10**
- 7(a) Show that when the distance from point of source doubles, the sound intensity level decreases by 6 dB. **06**
- (b) Explain the principle & working of Sound Level Meter. **08**
- 8 Write short notes on : **14**
- (i) Weighted Networks (ii) Octave band analysis (iii) Seismic Instrument.

Total No. of Questions : **08**

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B.Tech SEVENTH SEMESTER EXAMINATION JUNE-2025

(Branch : *Mechanical Engineering*)

ME-7332 (OEL-III) AUTOMOBILE ENGINEERING

Time : Three Hours

Maximum Marks : 70

Min. Pass Marks : 22

Note : Attempt any five questions. Each question carries equal marks. Draw neat and clean diagrams in support of your answer.

- 1(a) What are the functions of frame? **07**
- (b) Draw schematic diagram showing the layout of the transmission system of a rear wheel driven car. **07**
- 2(a) What are the essential properties required of a clutch facing material? Explain how these are met with in common materials? **07**
- (b) Discuss in detail the constructional features of a clutch plate. Explain clearly the function of the clutch plate. **07**
- 3(a) What is a CVT? Describe its principle of working in detail with the help of simple diagrams. **07**
- (b) Explain clearly the necessity of a transmission in a vehicle. **07**
- 4(a) Explain with the help of a neat sketch the construction of a propeller shaft. **07**
- (b) Explain the necessity of a differential in an automobile. **07**
- 5(a) Give the description of a telescopic damper, with neat sketches. **07**
- (b) Compare independent suspension over rigid axle type suspension. **07**
- 6(a) Discuss a steering linkage for a vehicle with independent suspension. **07**
- (b) Explain the necessity of power steering in an automobile. **07**
- 7(a) What are different types of starting motor drive in current practice? **07**
- (b) What is sealed headlamp system? **07**
- 8(a) Explain uses and working of catalytic converter. **07**
- (b) Compare BS IV with BS VI emission standard. **07**
