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Second Semester M.Tech. Degree Examination, June/July 2025 Design of Heat Transfer Equipments

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Define Heat exchanger, classify heat exchangers in detail.	10	L1	CO1
	b.	In counter flow double pipe heat exchanger, water is heated from 25°C to 65°C by an oil with a specific heat of 1.45 kJ/Kg K and mass flow rate of 0.9 Kg/sec, the oil is cooled from 250°C to 160°C, If the overall heat transfer coefficient is 420 W/m ² °C. calculate : i) The rate of heat transfer ii) Mass flow rate of water iii) The surface area of heat exchanger	10	L3	CO1
OR					
Q.2	a.	Derive an expression for LMTD for a counter flow heat exchangers.	10	L3	CO1
	b.	It is required to design a shell and tube heat exchanger for heating 2.4 Kg/sec of water from 20°C to 90 °C by hot engine oil (C _p = 2.4 kT/Kg K) flowing through the shell of the heat exchanger. The oil makes a single pass entering at 145 °C and leaving at 90 °C with an average heat transfer coefficient of 380 W/m ² K, the water flows through '12' thin walled tubes of 25 mm diameter with each tube making 8-passes through the shell the heat transfer coefficient on the water side is 2900 W/m ² K. calculate the length of the tube required for the heat exchanger to accomplish the required water heating.	10	L4	CO1
Module – 2					
Q.3		It is desired to heat 9820 lb/hr of cold benzene from 80 to 120°F using hot toluene which is cooled from 160 to 100 °F, the specific gravities at 68 °F are 0.88 and 0.87 respectively. The other properties will be found in the data hand book. A fouling factor of 0.001 should be provided for each stream and allowable pressure drop on each stream is 10 Psi. A number of 20 ft hair pins of 2 inches by 1 ¹ / ₄ inches IPS pipes available. Calculate overall coefficient U _c and U _a .	20	L3,4	CO2

OR			
Q.4	<p>A 43800 lb/hr of a 42 ° API kerosene leaves the bottom of a distilling column at 390 °F and will be cooled to 200 °F by 149000 lb/hr 34 ° API Midcontinent crude coming from storage at 100 °F and heated to 170 °F. A 10 Psi pressure drops is permissible on both streams, and in accordance with table 12, a combined dist factor of 0.003 should be provided. Available for this service is a $21\frac{1}{4}$ inch. ID exchanger having 1581 inch, OD, 13 BWG tubes 16'0" long and laid out on $1\frac{1}{4}$ inches. Square pitch the bundle is arranged for 4 passes and buffers are spaced 5 inches apart. Will the exchanger be suitable ie what is the dirt factor?</p>	20	L3,4 CO2
Module - 3			
Q.5	<p>Design of horizontal 1-2 condenser is required for the condensation of 60,000 lb/hr of pure n-propanol (propyl alcohol) coming from the top of distilling column operating at 15 Psig, at which pressure it boils at 244°F. Water at 85 °F will be used as the cooling medium. A dirt factor of 0.003 is required with allowable pressure drops of 2.0 Psi for the vapour and 10.0 Psi for the water. Because of the location of the condenser, assume that 8'0" tube are used. Tubes are to be $\frac{3}{4}$ inch, OD, 16 BWG on $\frac{15}{16}$ in (inch), Triangular pitch.</p>	20	L3 CO3
OR			
Q.6	<p>Design a butane DC super heater condenser 27958 lb/hr of isobutene with small amount of n-butane issues from a gas reactor at 200 °F and 85 Psig. The gas becomes saturated at 130 °F and its completely condensed at 125 °F cooling is by well water from 65 to 100 °F. A minimum combined dirt factor of 0.003 is required along with allowable pressure drops of 2.0 Psi for the butane and 10.0 Psi for the water. Available for the service is a $23\frac{1}{4}$ inches. ID horizontal 1-2 gas exchangers with $352\frac{3}{4}$ inches OD, 16 BWG tubes 16'0" long laid out on 1-inch triangular pitch for four (4) passes. The baffles are spaced 12 inches apart.</p>	20	L4 CO3
Module - 4			
Q.7	<p>a. With a neat sketch, explain the following :</p> <ul style="list-style-type: none"> i) Forced circulation vaporizer ii) Natural circulation vaporizer 	10	L1,2 CO4
	<p>b. Classify vaporizing exchanger.</p>	10	L2 CO4

OR				
Q.8	<p>A 45500 lb/hr of bottoms of 65° API gravity and small boiling range at 400°F enters a Kettle reboiler from which 28,100 lb/hr of vapor is formed at an operating pressure of 200 Psig. Heat is supplied by 28 ° API gas oil in the range from 575 to 475 °F and 120 Psig, operating pressure. A pressure drop of 10 Psi is permissible. Available for the service is a 25 inch ID kettle reboiler containing six pass $15\frac{1}{4}$ inches circular bundle.</p> <p>The bundle contains 68.1 inch OD, 14 BWG tubes 12'0" long on $1\frac{1}{4}$ inch square pitch. The bundle is baffled only by quarter circular support plates.</p> <p>i) Will reboilers is satisfactory? ii) What are the dirt factor and pressure drops?</p>	20	L1,2	CO5
Module – 5				
Q.9	<p>Explain the influence of following process and conditions upon design of cooling tower, with H-T diagram.</p> <p>i) Number of Diffussion unit ii) Changing the L/G ratio iii) Elevation iv) Close approach v) Dehumidification</p>	20	L1,2	CO5
OR				
Q.10	<p>a. A 50,000 lb/hr of the gas (dew point is 120 °F) is to be cooled from an initial temperature of 500° to 200 °F. How many diffusion units of any type of tower are required?</p>	20	L4	CO5

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22UTP/MTP14

First Semester M.Tech. Degree Examination, June/July 2025 Advanced Thermodynamics and Combustion

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Briefly explain the concept of entropy through a Clausius Theorem.	10	L2	CO1
	b.	A room is maintained at 27°C while the surroundings are at 2°C. The temperature of the inner and outer surface of the wall ($K = 0.71 \text{ W/mk}$) are measured to be 21°C and 6°C respectively. Heat flows steadily through the wall 5 m × 7 m in cross section and 0.32 m in thickness. Determine : i) The rate of heat transfer through the wall ii) The rate of entropy generation in the wall and iii) The rate of total entropy generation with this heat transfer process.	10	L3	CO1
OR					
Q.2	a.	Obtain the energy balance equation for a closed system.	10	L2	CO1
	b.	An ideal gas is flowing through an insulated pipe at the rate of 3 kg/s. There is a 10% pressure drop from inlet to exit of the pipe. What is the rate of energy loss because of the pressure drop due to friction? Take $R = 0.287 \text{ kJ/kg K}$ and $T_0 = 300 \text{ K}$.	10	L3	CO1
Module – 2					
Q.3	a.	Write the first and second Tds equations, and derive the expression for the differences in heat capacities, C_p and C_v .	10	L2	CO2
	b.	Explain Joule-Kelvin effect. What is inversion temperature?	10	L2	CO2
OR					
Q.4	a.	Derive entropy change of an ideal gas.	10	L2	CO4
	b.	An air water vapour mixture enters an adiabatic saturator at 30°C and leaves at 20°C, which is the adiabatic saturation temperature. The pressure remains constant at 100 kPa. Determine the relative humidity and the humidity ratio of the inlet mixture.	10	L2	CO4
Module – 3					
Q.5	a.	Explain the following : i) Enthalpy of formation ii) Enthalpy of combustion iii) Adiabatic flame temperature iv) Combustion Efficiency	10	L2	CO4
	b.	Find the stoichiometric air for the combustion of gaseous propane (C_3H_8) On mass basis and molar basis	10	L3	CO4
OR					
Q.6	a.	Explain the First law analysis of reacting systems.	10	L2	CO4
	b.	Explain the entropy change of reacting systems.	10	L2	CO4

Module – 4

Q.7	a.	Obtain Gibb free energy equation for chemical equilibrium.	10	L2	CO4
	b.	A mixture of 2 K mol of CO and 3 K mol of O ₂ is heated to 2600 K at a pressure of 304 kPa. Determine the equilibrium composition, assuming the mixture consist of CO ₂ CO and O ₂ . Assume K _p = 16.461 at 2600 K.	10	L3	CO4
OR					
Q.8	a.	Explain the simplified combustion of Kinetics.	10	L2	CO4
	b.	Explain the fundamental laws of transport phenomena.	10	L2	CO5
Module – 5					
Q.9	a.	With a neat sketch, explain the Laminar Premixed flame structure.	10	L2	CO3
	b.	List the methods of measuring burning velocity. Explain any one.	10	L2	CO3
OR					
Q.10	a.	With a neat sketch, explain the diffusion flame structure.	10	L2	CO3
	b.	What are the methods of flame stabilization? Explain swirl or jet induced re-circulating flow method.	10	L2	CO3

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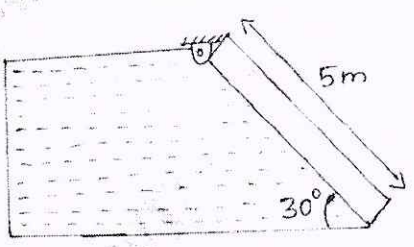
MME114B

First Semester M.Tech. Degree Examination, June/July 2025 Advanced Fluid Mechanics

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	A hinged gate of length 5 m inclined at 30° with the horizontal and with water mass on its Left is shown in the figure below. Density of water is 1000 kg/m ³ . The minimum mass of the gate in kg per unit width (perpendicular to plane of the paper) required to keep it closed is _____.	10	L2	CO1
		 <p style="text-align: center;">Fig. Q1 (a)</p>			
	b.	Derive an expression for circulation of Forced Vortex motion in Rigid Body Rotation.	10	L2	CO1
OR					
Q.2	a.	Derive the Navier-stokes equation in Cartesian co-ordinate using Newton's Second Law.	15	L2	CO1
	b.	Discuss the fundamental flows used in Superposition.	05	L1	CO1
Module – 2					
Q.3	a.	Explain the Hardy Cross method used in pipe network analysis. Illustrate the steps involved with an example.	10	L2	CO1
	b.	Explain the zero-equation model for fully developed turbulent flows.	10	L2	CO2
OR					
Q.4	a.	Water flows through a 10 mm diameter and 250 m long smooth pipe at an average velocity of 0.1 m/s. The density and the viscosity of water are 997 kg/m ³ and 855×10 ⁻⁶ NS/m ² , respectively. Assuming fully developed flow, the pressure drop (in pa) in the pipe is _____.	8	L3	CO2
	b.	Derive the velocity profile for laminar plane Poiseuille flow between two parallel plates and discuss its significance in fluid mechanics.	8	L2	CO2

	c.	Water is flowing through a horizontal pipe of constant diameter and the flow is Laminar. If the diameter of the pipe is increased by 50% keeping the volume flow rate constant, then the pressure drop in the pipe due to friction will decrease by _____.	4	L3	CO2
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Module – 3

Q.5	a.	In Hele-Shaw flow, the Navier-Stokes equation simplifies to the Stokes equation by neglecting inertial terms due to the low Reynolds number condition. Derive the governing equation for Hele-Shaw flow and show that the final result leads to Laplace equation of pressure $\nabla^2 P = 0$.	10	L2	CO3
	b.	Discuss Oseen's approximation for low Reynolds number flow past a sphere. How does it improve upon Stokes' solution?	10	L2	CO3

OR

Q.6	a.	A flat plate 15 cm wide and 45 cm long placed longitudinally in a stream of oil of specific gravity 0.925 and kinematic viscosity 0.9 stoke, flowing with a free stream velocity of 6 m/s. Determine (i) The thickness of boundary layer at trailing edge. (ii) The shear stress at the trailing edge. (iii) The friction drag on both side of the plate.	10	L3	CO3
	b.	Derive the equation for momentum thickness θ in terms of the boundary layer equations for a laminar boundary layer, considering both parabolic and cubic velocity profile. Show the step-by-step derivation and discuss the significance of momentum thickness in boundary layer theory.	10	L2	CO3

Module – 4

Q.7	a.	Define the following terms; write down their formulas and units where applicable. (i) Crocco number (ii) Stagnation pressure. (iii) Adiabatic Energy transformation.	10	L1	CO4
	b.	The pressure, temperature and Mach number at the entry of a flow passage are 2.45 bar, 26.5 °C and 1.4 respectively. If the exit Mach number is 2.5. Determine for adiabatic flow of a perfect gas ($\gamma = 1.3$, $R = 0.469$ KJ/kg-K) : (i) Stagnation temperature. (ii) Temperature and velocity of gas at exit and (iii) The flow rate per square meter of the inlet cross-section.	10	L3	CO4

OR

Q.8	a.	Explain briefly what is meant by impulse function. Derive $\frac{F}{F^*} = \frac{1 + \gamma M^2}{M} \left\{ 2(1 + \gamma) \left[1 + \frac{\gamma - 1}{2} M^2 \right] \right\}^{-1}$	10	L2	CO4
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	b. Air is discharged from a reservoir at $P_0 = 6.91$ bar and $t_0 = 325^\circ\text{C}$ through a nozzle to an exit pressure of 0.98 bar, if the flow rate is 3600 kg/hr, determine for isentropic flow : (i) Throat area, pressure and velocity (ii) Exit area, Mach number and (iii) Maximum velocity	10	L3	CO
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Module – 5

Q.9	a. Derive the following relations for flow through a normal shock : $M_y^2 = \frac{\left[\frac{2}{(\gamma-1)} \right] + M_x^2}{\left[\frac{2\gamma}{(\gamma-1)} \right] M_x^2 - 1}$	6	L2	CO
	b. Explain how strong compression and expansion waves are formed in a compressible fluid.	6	L1	CO
	c. The state of gas ($\gamma = 1.3$, $R = 0.469$ KJ/kg.K) upstream of a normal shock wave is given by the following data : $M_x = 2.5$, $P_x = 2$ bar, $T_x = 275$ K Calculate the Mach number, pressure, temperature and velocity of the gas downstream of the shock.	8	L3	CO

OR

Q.10	a. Describe two practical situations where oblique shock waves are produced. How are strong and weak shocks generated and how do they affect the flow.	10	L2	CO
	b. Air approaches a symmetrical wedge ($\delta = 15^\circ$) at a Mach number of 2. Determine for the strong and weak waves, (i) Weak angle (ii) Pressure ratio (iii) Density ratio (iv) Temperature ratio	10	L3	CO

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MMTP214D

Second Semester M.Tech Degree Examination, June/July 2025 Non-Conventional Energy Sources

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Differentiate between renewable and non-renewable energy sources with examples.	6	L2	CO1
	b.	Briefly explain the need for non-conventional energy sources.	4	L2	CO1
	c.	With a neat sketch explain pyrometer.	10	L2	CO1
OR					
Q.2	a.	With schematic representation, explain mechanism of absorption, scattering beam and diffused radiation received at Earth's surface.	10	L2	CO1
	b.	With a neat sketch explain pyrhelimeter. Describe spectral distribution of extra-terrestrial radiation.	10	L2	CO1
Module – 2					
Q.3	a.	With a neat sketch explain solar distillation system.	10	L2	CO2
	b.	With a neat sketch explain solar pond.	10	L2	CO2
OR					
Q.4	a.	With a neat sketch explain solar pond define : i) Declination angle ii) Hour angle iii) Zenith angle iv) Surface azimuth angle	8	L1	CO2
	b.	With a neat sketch explain solar flat plate collector.	8	L2	CO2
	c.	Write a note on Solar Cell.	4	L2	CO2
Module – 3					
Q.5	a.	With a neat sketch explain main Components of Horizontal axis wind turbine.	10	L2	CO3
	b.	List the advantages, disadvantages and applications of wind energy.	10	L1	CO3
OR					
Q.6	a.	Discuss the causes and properties of wind. What are the major problems associated with wind machines.	10	L2	CO3
	b.	Classify wind machines and briefly explain vertical axis wind turbine with sketch.	10	L2	CO3
Module – 4					
Q.7	a.	What are the fundamental characteristics of Tidal Power Plant?	6	L2	CO4
	b.	List the advantages and limitations of Tidal Power Plant.	4	L1	CO4
	c.	With a neat sketch explain single basin Tidal Power Plant. Briefly explain harnessing tidal energy.	10	L2	CO4

OR

Q.8	a.	Explain working principle of Ocean Thermal Energy Conversion [OTEC] with sketch.	10	L2	CO4
	b.	What are the problems associated with OTEC plant. List the advantages and disadvantages of OTEC plant.	10	L2	CO4

Module -5

Q.9	a.	Explain the process of photosynthesis.	4	L2	CO5
	b.	Briefly explain problems involved with biogas production.	6	L2	CO5
	c.	List the advantages and disadvantages of biomass energy list the applications of bio-gas.	10	L2	CO5

OR

Q.10	a.	Describe construction and working principle of geothermal energy with schematic diagram.	10	L2	CO5
	b.	List and explain problems associated with geothermal system operation.	10	L2	CO5

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22MTP22

Second Semester M.Tech Degree Examination, June/July 2025 Advanced Heat Transfer

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Derive the general heat conduction equation in cylindrical coordinates.	10	L2	CO1
	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 temperature are 25°C and $\pm 3^\circ\text{C}$ respectively. If the inside and outside heat transfer coefficients are 30 and 11 W/m ² °C respectively, and the thermal conductivities of brick, foam and wood are 0.99, 0.22 and 0.17 W/m°C respectively, determine : i) The rate of heat removal by refrigeration if the total watt area is 85 m ² ii) The temperature of the inside surface of the brick.	10	L2	CO1
OR					
Q.2	a.	Calculate the amount of energy required to solder together two very long pieces of bare copper wire 1.5 mm in diameter with solder that melts at 190°C. The wires are positioned vertically in air at 20°C. Assume that the heat transfer coefficient on the wire surface is 20 W/m ² °C and thermal conductivity of wire alloy is 330 W/m°C.	10	L3	CO1
	b.	The initial uniform temperature of a large mass of material ($\alpha = 0.42 \text{ m}^2/\text{h}$) is 120°C. The surface is suddenly exposed to and held permanently at 6°C, calculate the time required for the temperature gradient at the surface to reach 400°C/m.	10	L3	CO1
Module – 2					
Q.3	a.	Define the following terms : i) Boundary layer thickness ii) Displacement thickness iii) Momentum thickness iv) Energy thickness.	8	L2	CO2
	b.	Air at atmospheric pressure and 200°C flows over a plate with a velocity of 5 m/s. The plate is 15 mm wide and is maintained at temperature of 120°C. Calculate the thicknesses of hydrodynamic and thermal boundary layers and the local heat transfer coefficient at a distance of 0.5 m from the leading edge. Assume that flow is on one side of the plate. $\rho = 0.815 \text{ kg/m}^3$, $\mu = 24.5 \times 10^{-6} \text{ Ns/m}^2$, $P_r = 0.7$, $K = 0.0364 \text{ W/m K}$.	12	L3	CO2

OR

Q.4	a.	Derive the interrelationship between heat and momentum transfer for turbulent flow (Colburn analogy).	10	L2	CO2
	b.	Air at 20°C and 1.013 bar flows over a flat plate at 40 m/s. The plate is 1 m long and is maintained at 60°C. Assuming unit depth. Calculate the heat transfer from the plate. Use the following correlation. $N_{uL} = (P_r)^{0.33} [0.037(R_{eL})^{0.8} - 850]$.	10	L3	CO2

Module – 3

Q.5	a.	Define the following : i) Grashoff number ii) Nusselt number iii) Prandtl number iv) Reynold number v) Stanton number.	10	L3	CO3
	b.	A vertical cylinder 1.5m high and 180mm in diameter is maintained at 100°C in an atmosphere environment of 20°C. Calculate heat loss by free convection from surface of cylinder. Assume properties of air at mean temperature as, $\rho = 1.06 \text{ Kg/m}^3$, $\gamma = 18.97 \times 10^{-6} \text{ m}^2/\text{s}$, $C_p = 1.004 \text{ kJ/Kg}^\circ\text{C}$ and $K = 0.1042 \text{ kJ/mh}^\circ\text{C}$.	10	L3	CO3

OR

Q.6	a.	Explain the empirical correlation for free convection : i) Concentric cylinder spaces ii) Concentric spheres spaces.	10	L2	CO3
	b.	Assuming that a man can be represented by a cylinder 350 mm in diameter and 1.65 m high with a surface temperature of 28°C. Calculate the heat he would lose while standing in a 30 km/h wind at 12°C.	10	L3	CO3

Module – 4

Q.7	a.	Define the following : i) Kirchhoff's law ii) Planck's law iii) Stefan – Boltzmann law iv) Wien's displacement law v) Lambert's law.	10	L2	CO4
	b.	Two large parallel plates with $\epsilon = 0.5$ each are maintained at different temperatures and are exchanging heat only by radiation. Two equally large radiation shields with surface emissivity 0.05 are introduced in parallel to the plates. Find the percentage reduction in net radiative heat transfer.	10	L3	CO4

OR

Q.8	a.	With a neat sketch explain the regimes of boiling.	10	L2	CO4
	b.	The order surface of a cylindrical drum 350 mm diameter is exposed to saturated steam at 2.0 bar for condensation. If the surface temperature of the drum is maintained at 80°C. Calculate the following : i) The length of the drum ii) The thickness of the condensate layer to condense 70 kg/h of steam.	10	L3	CO4

Module – 5

Q.9	a.	How are heat exchangers classified? What do you mean by fouling in heat exchangers?	10	L2	CO5
	b.	An oil cooler for a lubrication system has to cool 1000 kg/h of oil ($C_p = 2.09 \text{ kJ/kg}^\circ\text{C}$) from 80°C to 40°C by using a cooling water flow of 1000 kg/h at 30°C. Give your choice for a parallel flow or counter flow heat exchanger, with reasons. Calculate the surface area of the heat exchanger, if the overall heat transfer coefficient is $24 \text{ W/m}^2\text{C}$. Take C_p of water = $4.18 \text{ kJ/kg}^\circ\text{C}$.	10	L3	CO5

OR

Q.10	a.	Derive the LMTD for counter flow heat exchanger. State the assumptions.	10	L2	CO5
	b.	The following data is given for counter flow heat exchanger : $\dot{m}_h = 1 \text{ kg/s}$ $\dot{m}_c = 0.25 \text{ kg/s}$ $C_{ph} = 1.045 \text{ kJ/kg}^\circ\text{C}$ $C_{pl} = 4.18 \text{ kJ/kg}^\circ\text{C}$ $t_{h1} = 1000^\circ\text{C}$ $t_{l2} = 850^\circ\text{C}$ $U = 88.5 \text{ W/m}^2\text{C}$, $A = 10 \text{ m}^2$ calculate t_{n2} and t_{l1} .	10	L3	CO5

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22UTP/MTP13

First Semester M.Tech Degree Examination, June/July 2025

Advanced Fluid Mechanics

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Derive the 3.0 continuity equation in Cartesian co-ordinate form.	10	L3	CO1
	b.	Explain the following : i) Stream line ii) Path line iii) Streak line.	10	L2	CO1
OR					
Q.2	a.	Prove the existence of flow field with possible irrotational flow through the stream function and velocity potential for a flow given as : $\psi = 2xy, \phi = (x^2 - y^2)$.	10	L3	CO1
	b.	Derive the Navier-Stokes equation in cylindrical co-ordinate.	10	L3	CO1
Module – 2					
Q.3	a.	Describe evolution of various viscous flow at different Reynold's number.	8	L2	CO2
	b.	What is Wake Frequency?	4	L2	CO2
	c.	Derive the discharge equation for a laminar flow between two parallel fixed plates.	8	L3	CO2
OR					
Q.4	a.	Describe the Hardy-cross method for determining the flow in pipe network system.	10	L3	CO2
	b.	The population of a town is 4 lakhs. The town gets water from a reservoir through a pipe 20 km long. The per capita requirement of water is 150 liters/day and half of the total demand of the town is to be supplied in 8 hours. The flow is by gravity with a level difference of 18 m between the reservoir level and exit of the pipe if $f = 0.025$ for the pipe, find suitable diameter of the pipe.	10	L3	CO2
Module – 3					
Q.5	a.	Elucidate hydrodynamic Theory of lubrication.	8	L2	CO3
	b.	A plate of 600 mm length and 400 mm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity $\gamma = 10^{-4} \text{m}^2/\text{s}$. The fluid is moving with a velocity of 6 m/s. Describe : i) Boundary layer thickness ii) Shear stresses at the end of the plate iii) Drag force on one side of the plate.	12	L3	CO3
OR					
Q.6	a.	Using Vonkarman momentum integral equation. Explain the turbulent boundary layer over a flat plate. Also derive the expression for shear stress and boundary layer thickness.	12	L3	CO3
	b.	For the velocity profile for laminar boundary flow $\frac{U}{U_0} = \sin\left(\frac{\pi}{2} \frac{y}{\delta}\right)$ obtain an expression for boundary layer thickness.	8	L3	CO3

Module – 4

Q.7	a.	Derive the following energy equation from Bernoulli principle. $\left(\frac{\gamma}{\gamma-1}\right)\frac{P_0}{\rho_0}\left(\frac{P}{P_0}\right)^{\frac{\gamma-1}{\gamma}} + \frac{1}{2}C^2 = \left(\frac{\gamma}{\gamma-1}\right)\frac{P_0}{\rho_0}$	10	L3	CO4
	b.	Air $\left[C_p = 1.05 \frac{\text{KJ}}{\text{kgK}}, \gamma = 1.38 \right]$ at $P_1 = 3 \times 10^5 \text{N/m}^2$ and $T_1 = 500 \text{K}$, Flows with a velocity of 200 m/s in a 30 cm diameter duct. Calculate : i) Mass flow rate ii) Stagnation temperature iii) Mach number iv) Stagnation pressure (Assuming flow is incompressible)	10	L3	CO4

OR

Q.8	a.	Discuss the effect of Mach number variation in : i) Expression in Nozzle ii) Compression in Diffuser.	10	L2	CO4
	b.	Air is discharged from a reservoir at $P_0 = 6.91 \text{ bar}$ and $T_0 = 325^\circ\text{C}$ through a nozzle at an exit pressure of 0.98 bar. If the flow rate is 3600 kg/hr. Determine for isentropic flow : i) Throat area, pressure and velocity ii) Exit area, Mach number iii) Maximum velocity.	10	L3	CO4

Module – 5

Q.9	a.	Derive the following relation through normal shock wave : $M_y^2 = \frac{\left(\frac{2}{\gamma-1}\right) + M_x^2}{\left(\frac{2\gamma}{\gamma-1}\right)M_x^2 - 1}$	10	L3	CO5
	b.	The following data refers to supersonic wind tunnel : Nozzle throat area = 200 cm ² , Test cross section = 337.5 cm ² Working fluid air ($\gamma = 1.4$, $C_p = 0.287 \text{ KJ/kgK}$). Determine the test section Mach number and the diffuser throat area if a normal shock is located in the test section.	10	L3	CO5

OR

Q.10	a.	Derive Rankine – Hugoniot equation.	10	L3	CO5
	b.	A gas ($\gamma = 1.3$) at $P_1 = 345 \text{ m bar}$, $T_1 = 350 \text{ K}$ and $M_1 = 1.5$ is to be isentropically expanded to 138 m bar. Determine : i) The deflection angle ii) Final Mach number iii) The temperature of the gas.	10	L3	CO5

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MMTP202

Second Semester M.Tech. Degree Examination, June/July 2025 Steams and Gas Turbine

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Explain the following: i) Supersonic nozzle ii) Subsonic nozzle iii) Supersonic diffuser iv) Subsonic diffuser	10	L1	CO1
	b.	A convergent divergent nozzle receives steam at 7 bar and 200°C and into a space of 3 bar neglecting the inlet velocity. Calculate the exit area required for a mass flow of 0.1 kg/sec. When the flow is in equilibrium through all and super super saturated with $Pv^{1.3} = c$.	10	L2	CO1
OR					
Q.2	a.	Show by analytical method that for isentropic flow of steam through a convergent-divergent nozzle, the throat velocity is the local acoustic velocity.	10	L1	CO1
	b.	Air enters a diffuser at 5 bar and 450 K with a velocity of 250 m/s. The area ratio of the diffuser is 3. If the diffuser efficiency is 70%. Calculate the static pressure recover coefficient, total pressure loss coefficient and static pressure at the exit of diffuser.	10	L2	CO1
Module – 2					
Q.3	a.	Compare steam engine with steam turbine. Explain each parameter.	10	L2	CO2
	b.	Find expression for the force, work done diagram efficiency, gross stage efficiency and axial thrust for an impulse turbine.	10	L2	CO2
OR					
Q.4	a.	Define the following terms with respect to single stage impulse turbine: i) Force on blade ii) Work done iii) Blade efficiency iv) Stage efficiency v) Nozzle velocity co-efficient.	10	L3	CO2
	b.	In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 80 cm and the speed of rotation is 3000 rpm. The steam issues from the nozzles with a velocity of 300 m/s and the nozzle angle is 20°.C The rotor blades are equiangular and due to friction in the blade channels the relative velocity of steam at outlet from the blades is 0.86 times the relative velocity of the steam entering the blades. What is the power developed in the blades when the axial thrust on the blades is 140 N?	10	L3	CO2

Module – 3

Q.5	a.	Define stage efficiency. Explain the design procedure for single stage impulse turbine.	10	L2	CO3
	b.	The discs in the high pressure cylinder of a two cylinder of a two cylinder steam turbine of 50,000 kW output are of 90 cm mean diameter the speed being 1500 rpm. Estimate the disc friction power in the first stage, given that the steam conditions are as follows: steam pressure = 28 bar, steam superheat = 180°C, steam specific volume = 0.1106 m ³ /kg.	10	L4	CO3

OR

Q.6	a.	List out the energy losses and explain with figure regulating valve losses.	10	L1	CO3
	b.	The first stage wheel running at 1500 rpm of a 20,000 kW turbine is a single row wheel having a mean diameter 2.1 m. The condition of steam in the first stage is as follows – pressure = 17.5 bar, super heat = 110°C specific volume = 0.1503 m ³ /kg. The blades are 3.2 cm long and the active nozzles cover 40% of total circumference at full load. Calculate: i) Power absorbed by disc friction. ii) Power absorbed by blade windage and disc friction.	10	L3	CO3

Module – 4

Q.7	a.	Give comparison between centrifugal and axial flow compressor.	10	L2	CO4
	b.	In an experiment with two dimensional cascade of blades the total pressure measured downstream. Where the flow is uniform was found to be less than the inlet total pressure by 0.0065 bar. The pitch chord ratio of the blades was 0.7 and the inlet and outlet fluid angles were measured as 50.3° and 25.3° respectively from the axial direction. The outlet velocity was measured as 150 m/s. Calculate co-efficient of drag. Take density of air as 1.22 kg/m ³ .	10	L2	CO4

OR

Q.8	a.	Explain the factor affecting the stage pressure ratio in an axial flow compressor.	10	L2	CO4
	b.	In an eighteen stage axial flow compressor, the overall compressor pressure ratio achieved is 15:1 with an overall isentropic efficiency of 90%. The temperature and pressure at inlet is 20°C and 1 bar. The work is divided equally between the stages. The mean blade velocity is 175 m/s and 50% reaction design is used. The axial velocity through the compressor is continued and equal to 100 m/s. Calculate the power required and blade angles for mass flow rate of 300 kg/s.	10	L4	CO4

Module – 5

Q.9	a.	With a neat sketch, explain the working principle of Ramjet engine.	10	L2	CO5
	b.	Draw flow diagram and T-S diagram for following gas turbine cycles: i) Inter cooling ii) Regeneration.	10	L2	CO5

OR

Q.10	a.	With a neat sketch, explain turbo fan engine and turbo prop engine.	10	L2	CO5
	b.	What are the desirable requirement of a liquid propellant for rockets? Compare the advantages of solid and liquid propellants.	10	L2	CO5

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MMTP203

Second Semester M.Tech. Degree Examination, June/July 2025 Advanced Thermodynamics and Combustion

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	State the first law of thermodynamics applied to a cyclic process.	3	L1	CO1
	b.	With a neat diagram, explain Joule's experiment.	7	L2	CO1
	c.	State and prove Clausius inequality.	10	L3	CO1
OR					
Q.2	a.	Explain the concept of Exergy.	4	L1	CO1
	b.	Prove that entropy of universe is increasing.	6	L2	CO1
	c.	Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW. Determine the net power output and the thermal efficiency for the engine.	10	L3	CO1
Module – 2					
Q.3	a.	Write the Calusius-Clapeyron equation and explain the terms involved.	4	L1	CO2
	b.	What are the conclusions drawn from Mayer relation?	6	L2	CO2
	c.	Derive an equation by using Maxwell relation to determine the change of internal energy.	10	L3	CO2
OR					
Q.4	a.	Write ideal gas equation of state and explain the terms involved.	4	L1	CO2
	b.	Explain Amagat's law of additive volumes.	6	L2	CO2
	c.	A gas mixture contains 1 kg CO ₂ and 1.5 kg of N ₂ . The pressure and temperature of mixture are 3.5 bar and 27°C. Determine (i) Mass fraction of each component (ii) Mole fraction of each component.	10	L3	CO2
Module – 3					
Q.5	a.	What are the causes of incomplete combustion?	5	L1	CO3
	b.	What is enthalpy of formation? How does it differ from enthalpy of combustion?	5	L2	CO3

	c.	Determine the enthalpy of combustion of liquid octane (C_8H_{18}) at $25^\circ C$ and 1 atm, using the data : The enthalpy of formation at $25^\circ C$ and 1 atm is $-3,93,520$ kJ/mol for CO_2 , $-2,85,830$ kJ/mol for $H_2O (l)$ and $-2,49,950$ kJ/mol for $C_8H_{18} (l)$.	10	L3	CO3
OR					
Q.6	a.	What is the air fuel ratio? How it is related to the fuel air ratio.	5	L1	CO3
	b.	Write reversible work relation and explain how Gibbs function of formation g_f° of a compound represent?	5	L2	CO3
	c.	Derive an energy balance relation for a reacting closed system undergoing a Quasi-equilibrium constant expansion or compression process.	10	L3	CO3
Module - 4					
Q.7	a.	Explain Gibbs free energy.	5	L1	CO4
	b.	Write three different K_p relations for reacting ideal gas mixtures.	6	L2	CO4
	c.	Derive Van-Hofts equation.	9	L3	CO4
OR					
Q.8	a.	Differentiate between elementary and global reactions.	4	L1	CO4
	b.	Mention the factors influencing the laminar flame speed in premixed combustion.	6	L2	CO4
	c.	State and derive Fick's law of Diffusion.	10	L3	CO4
Module - 5					
Q.9	a.	Explain Bunsen Burner method of Flame speed measurement.	10	L1 L2	CO5
	b.	Explain the effect of physical variables on flame speed.	10	L2 L3	CO5
OR					
Q.10	a.	Explain the structure of Turbulent premixed flames.	10	L1 L2	CO5
	b.	Define spray combustion and explain the parameters affecting its behaviour.	10	L2 L3	CO5

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CBCS SCHEME

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Question Paper Version : A

Second Semester M. Tech. Degree Examination, June/July 2025 Python Programming for Beginners

Time: 1 hr

Max. Marks: 50

INSTRUCTIONS TO THE CANDIDATES

1. Answer all the **fifty** questions, each question carries one mark.
2. Use only **Black ball point pen** for writing / darkening the circles.
3. **For each question, after selecting your answer, darken the appropriate circle corresponding to the same question number on the OMR sheet.**
4. Darkening two circles for the same question makes the answer invalid.
5. **Damaging/overwriting, using whiteners** on the **OMR** sheets are strictly prohibited.

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1. Which key word is used to define a function in Python?
a) func b) define c) def d) function
 2. What does len ("programming") return
a) Error b) 10 c) 11 d) 9
 3. What is the result of 11%3
a) 2 b) 0 c) 3 d) 11
 4. What will the following code print
X = 4
If X < 5
 print ("Small")
else:
 print ("Big")
a) Big b) Small c) 4 d) Error
 5. Which loop is used to iterate a known number of times
a) for b) while c) if else d) repeat
 6. What is the output of 'range (5)'
a) 0 to 3 b) 0 to 4 c) 1 to 4 d) 0 to 5
 7. What keyword is used to stop a loop?
a) stop b) break c) exit d) end
 8. Which key word skips the current iteration of a loop?
a) break b) pass c) skip d) continue

9. Which function takes input from the user in python?
a) print() b) type() c) get() d) input()
10. What is the output of print (3 + 6)
a) 18 b) 3 + 6 c) 9 d) 36
11. Which is more memory efficient?
a) Lists b) Tuples c) Sets d) Dictionaries
12. Which indexing method is valid for both lists and tuples?
a) Dot notation b) Negative indexing c) Slicing with () d) Using string keys
13. Which data structure automatically removes duplicates?
a) List b) Dictionary c) Set d) Tuple
14. Which data structure uses hashing internally?
a) List b) Tuple c) Dictionary d) String
15. Which operation is not supported by sets?
a) Union b) Indexing c) Intersection d) Difference
16. List comprehensions are most similar to which structure.
a) While loop b) Function c) For loop d) Class
17. Lists are suitable for which of the following
a) Constant data b) Large sets of unique values
c) Storing fixed values d) Dynamically changing data
18. Which keyword is used for decision making in python?
a) while b) for c) if d) switch
19. What happens if you try to modify a tuple?
a) It updates silently b) It changes the type
c) It throws an error d) It creates a new tuple
20. Which of the following is true about sets?
a) Sets are ordered b) It allows duplicate values
c) Allows only numeric types d) Sets stores only unique items
21. What will be the output of following code :
def add (a, b) :
 return a + b
print (add (9, 8))
a) 98 b) 17 c) 89 d) None
22. Which of these is correct lambda function to add 10 to a number?
a) lamda X : X + 10 b) lamda X : 10 +
c) lamda (X) : + 10 d) def lamda (X) : X + 10
23. How do you import entire math module?
a) include math b) require math
c) import math d) load math

24. Which keyword is used to import specific function from a module?
a) only b) fetch c) from d) get
25. What does the following code output from `math import Pi`
`print (round (Pi, 2))`
a) 3 b) 3.14 c) 3.1459 d) 2
26. What is the extension of python module?
a) •txt b) •py c) •exe d) •mod
27. Which of the following can lamda function not contain
a) Expressions b) Single operations
c) Multiple expressions d) Arithmetic operations
28. What is a module in python?
a) Variable b) Class
c) File containing python code d) Data type
29. What will `math.sqrt (25)` return?
a) 5 b) 256 c) 7 d) None
30. What is the output of the following code
try :
 print ("Try")
except :
 print ("Except")
else
 print ("Else")
a) Try b) TryElse c) Except d) Else
31. What keyword is used to return a value from a function?
a) output b) result c) return d) give
32. If a function does not have a return statement, what will it return by default?
a) 0 b) undefined c) None d) Error
33. What happens if a function is called with fewer arguments than declared?
a) An error is raised b) It returns 0
c) It uses default values d) It ignores missing parameters
34. Functions that do not return any value are called :
a) Static b) Null c) Void d) None-type
35. What function is used to close an open file?
a) shutdown() b) exit() c) end() d) close()
36. Which method reads one line at a time from file?
a) readline() b) read() c) readlines() d) readlineall()
37. Which statement is used to manually raise an exception
a) throw b) except c) raise d) error

38. Which exception is raised when a variable is not defined?
a) SyntaxError b) NameError c) TypeError d) ValueError
39. The benefit of using with open() in Python is
a) Speeds up execution b) Avoids writing file modes
c) Automatically closes the file d) None of these
40. Using with open() eliminate the need for
a) File creation b) Close() function c) Error handling d) File permission
41. NumPy stands for
a) Number Python b) Numeric Python
c) Numerical programming d) Numeric program
42. The function used to create NumPy array is
a) List() b) array() c) arr() d) new()
43. The result of np.array ([1, 3, 2]) + 2 is
a) [1, 3, 2, 2] b) [3, 5, 4] c) [2, 6, 4] d) [2, 3, 2]
44. The function which performs matrix multiplication is
a) np.multiply() b) np.matmul() c) np.dot() d) np.prod()
45. The purpose of Matplotlib is
a) Create 3D models b) Plot graphs and visualize data
c) Solve equations d) Manage files
46. The function which creates a line plot is
a) plt.bar() b) plt.line() c) plt.plot() d) plt.graph()
47. The output of plt.xlabel ("Time") is
a) Plots time series b) Adds label to X-axis
c) Draws horizontal axis d) Adds a legend
48. What does plt.grid (True) do?
a) Disable axis b) Adds background image
c) Displays grid on the plot d) Creates subplots
49. What kinds of data can be visualized using Matplotlib in mechanical systems?
a) Temperature change b) Loads Vs. deflection
c) Vibration signals d) All of these
50. Which function calculates eigen values
a) np.eig() b) np.solve() c) np.eigen d) np.value()

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Second Semester M.Tech. Degree Examination, June/July 2025

Design of Heat Transfer Equipments

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1			M	L	C
Q.1	a.	Define Heat exchanger, classify heat exchangers in detail.	10	L1	CO1
	b.	In counter flow double pipe heat exchanger, water is heated from 25°C to 65°C by an oil with a specific heat of 1.45 kJ/Kg K and mass flow rate of 0.9 Kg/sec, the oil is cooled from 250°C to 160°C, If the overall heat transfer coefficient is 420 W/m ² °C. calculate : i) The rate of heat transfer ii) Mass flow rate of water iii) The surface area of heat exchanger	10	L3	CO1
OR					
Q.2	a.	Derive an expression for LMTD for a counter flow heat exchangers.	10	L3	CO1
	b.	It is required to design a shell and tube heat exchanger for heating 2.4 Kg/sec of water from 20°C to 90 °C by hot engine oil (C _p = 2.4 kJ/Kg K) flowing through the shell of the heat exchanger. The oil makes a single pass entering at 145 °C and leaving at 90 °C with an average heat transfer coefficient of 380 W/m ² K, the water flows through '12' thin walled tubes of 25 mm diameter with each tube making 8-passes through the shell the heat transfer coefficient on the water side is 2900 W/m ² K. calculate the length of the tube required for the heat exchanger to accomplish the required water heating.	10	L4	CO1
Module – 2					
Q.3		It is desired to heat 9820 lb/hr of cold benzene from 80 to 120°F using hot toluene which is cooled from 160 to 100 °F, the specific gravities at 68 °F are 0.88 and 0.87 respectively. The other properties will be found in the data hand book. A fouling factor of 0.001 should be provided for each stream and allowable pressure drop on each stream is 10 Psi. A number of 20 ft hair pins of 2 inches by 1 ¹ / ₄ inches IPS pipes available. Calculate overall coefficient U _c and U _d .	20	L3,4	CO2

OR				
Q.4	<p>A 43800 lb/hr of a 42 ° API kerosene leaves the bottom of a distilling column at 390 °F and will be cooled to 200 °F by 149000 lb/hr 34 ° API Midcontinent crude coming from storage at 100 °F and heated to 170 °F. A 10 Psi pressure drops is permissible on both streams, and in accordance with table 12, a combined dist factor of 0.003 should be provided.</p> <p>Available for this service is a $21\frac{1}{4}$ inch. ID exchanger having 1581 inch, OD, 13 BWG tubes 16'0" long and laid out on $1\frac{1}{4}$ inches. Square pitch the bundle is arranged for 4 passes and buffers are spaced 5 inches apart. Will the exchanger be suitable ie what is the dirt factor?</p>	20	L3,4	CO2
Module – 3				
Q.5	<p>Design of horizontal 1-2 condenser is required for the condensation of 60,000 lb/hr of pure n-propanol (propyl alcohol) coming from the top of distilling column operating at 15 Psig, at which pressure it boils at 244°F. Water at 85 °F will be used as the cooling medium. A dirt factor of 0.003 is required with allowable pressure drops of 2.0 Psi for the vapour and 10.0 Psi for the water. Because of the location of the condenser, assume that 8'0" tube are used. Tubes are to be $\frac{3}{4}$ inch, OD, 16 BWG on $\frac{15}{16}$ in (inch), Triangular pitch.</p>	20	L3	CO3
OR				
Q.6	<p>Design a butane DC super heater condenser 27958 lb/hr of isobutene with small amount of n-butane issues from a gas reactor at 200 °F and 85 Psig. The gas becomes saturated at 130 °F and its completely condensed at 125 °F cooling is by well water from 65 to 100 °F. A minimum combined dirt factor of 0.003 is required along with allowable pressure drops of 2.0 Psi for the butane and 10.0 Psi for the water. Available for the service is a $23\frac{1}{4}$ inches. ID horizontal 1-2 gas exchangers with $352\frac{3}{4}$ inches OD, 16 BWG tubes 16'0" long laid out on 1-inch triangular pitch for four (4) passes. The baffles are spaced 12 inches apart.</p>	20	L4	CO3
Module – 4				
Q.7	<p>a. With a neat sketch, explain the following :</p> <p>i) Forced circulation vaporizer</p> <p>ii) Natural circulation vaporizer</p>	10	L1,2	CO4
	<p>b. Classify vaporizing exchanger.</p>	10	L2	CO4

OR				
Q.8		<p>A 45500 lb/hr of bottoms of 65° API gravity and small boiling range at 400°F enters a Kettle reboiler from which 28,100 lb/hr of vapor is formed at an operating pressure of 200 Psig. Heat is supplied by 28 ° API gas oil in the range from 575 to 475 °F and 120 Psig, operating pressure. A pressure drop of 10 Psi is permissible. Available for the service is a 25 inch ID kettle reboiler containing six pass $15\frac{1}{4}$ inches circular bundle.</p> <p>The bundle contains 68.1 inch OD, 14 BWG tubes 12'0" long on $1\frac{1}{4}$ inch square pitch. The bundle is baffled only by quarter circular support plates.</p> <p>i) Will reboilers is satisfactory? ii) What are the dirt factor and pressure drops?</p>	20	L1,2 CO5
Module – 5				
Q.9		<p>Explain the influence of following process and conditions upon design of cooling tower with H-T diagram.</p> <p>i) Number of Diffusion unit ii) Changing the L/G ratio iii) Elevation iv) Close approach v) Dehumidification</p>	20	L1,2 CO5
OR				
Q.10	a.	<p>A 50,000 lb/hr of the gas (dew point is 120 °F) is to be cooled from an initial temperature of 500° to 200 °F. How many diffusion units of any type of tower are required?</p>	20	L4 CO5

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MEC102

First Semester M.Tech. Degree Examination, June/July 2025 Advanced Embedded Systems

Time: 3 hrs.

Max. Marks: 100

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

Module - 1			M	L	C
Q.1	a.	What is an Embedded System. Explain briefly the different classification of Embedded System based on generation and performance.	10	L2	CO1
	b.	Differentiate between – i) SRAM and DRAM ii) Von Neumann and Harvard Architecture	10	L2	CO1
OR					
Q.2	a.	Explain the product life cycle core of an Embedded System development.	10	L2	CO1
	b.	Explain six operational quality attributes of an Embedded System.	10	L2	CO1
Module - 2					
Q.3	a.	Describe Embedded System firmware design using assembly language programming. Mention the advantages and drawbacks of this method.	10	L2	CO2
	b.	Explain on clip debugging.	10	L2	CO3
OR					
Q.4	a.	Differentiate between monitor program based firmware debugging and in-circuit emulator based target debugging.	10	L2	CO2
	b.	Explain the major drawbacks of out-of-circuit programming.	10	L2	CO2
Module - 3					
Q.5	a.	With a neat diagram explain operating modes of cortex M3.	10	L2	CO3
	b.	Briefly discuss the features of Nested Vectored Interrupt Controller (NVIC).	10	L2	CO3
OR					
Q.6	a.	Describe the functions of special registers in ARM cortex M3.	10	L2	CO3
	b.	Explain two stack model in the cortex M3.	10	L2	CO3
Module - 4					
Q.7	a.	Explain the following instructions with an example – i) LSRW ii) RORW iii) STRB iv) ASR v) BFC	10	L2	CO4
	b.	Describe SSAT and USAT instructions with necessary diagrams.	10	L2	CO4
OR					
Q.8	a.	Explain memory access attributes of ARM cortex M3.	10	L2	CO4
	b.	Explain the 3-stage pipeline in ARM cortex M3.	10	L2	CO4
Module - 5					
Q.9	a.	With a neat diagram explain stored program concept.	10	L2	CO5
	b.	Briefly explain constant or immediate operands.	10	L2	CO5
OR					
Q.10	a.	Briefly explain various addressing modes of RISC-V.	10	L2	CO5
	b.	Explain the following – i) Assembler ii) Compiler iii) linker iv) Loader	10	L2	CO5

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MEC114B

First Semester M.Tech. Degree Examination, June/July 2025 Advanced Computer Networking

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Illustrate the working of CSMA/CA with a diagram.	7	L2	CO1
	b.	Explain Bluetooth protocol stack architecture describing its layers and function in wireless communication.	7	L2	CO1
	c.	Explain the format of query message in RFID.	6	L2	CO1
OR					
Q.2	a.	Explain 802.16 architecture and protocol stack used across air interface.	7	L2	CO2
	b.	Illustrate the working on leaky bucket and token bucket algorithm with a diagram and describing their role in traffic shaping.	8	L2	CO2
	c.	List comparison between Datagram Network and Virtual-Circuit Network.	5	L1	CO2
Module – 2					
Q.3	a.	What is the essence of domain name system? Explain DNS name space and domain resource records.	7	L2	CO1
	b.	Illustrate the architecture of the email system with a diagram.	7	L2	CO1
	c.	Explain RFC 5322 header fields related to message transport.	6	L2	CO1
OR					
Q.4	a.	Explain how mail transfer is done using Simple Mail Transfer Protocol (SMTP).	7	L2	CO2
	b.	How does Hypertext Transfer Protocol (HTTP) connections work?	7	L2	CO2
	c.	Illustrate IPV6 header structure, explaining its fields and their role in internet.	6	L2	CO2
Module – 3					
Q.5	a.	Illustrate spanning tree protocol. Build an example to calculate shortest path in a network.	7	L3	CO2
	b.	Demonstrate forces in networking. How forces handle packet forwarding and processing in a network.	7	L2	CO2
1 of 2					

MEC114B					
	c.	Explain packet processing function of a SDN device in i) Virtual Switch ii) Physical Switch	6	L2	CO2
OR					
Q.6	a.	What are the main design principles associated with implementing 4D centralized network? Explain general architecture of 4D.	6	L2	CO3
	b.	What is OpenFlow Protocol? List the basic operation of OpenFlow Protocol.	6	L1	CO3
	c.	Illustrate the device level and policy level at which API can be provided for SDN application.	8	L2	CO3
Module – 4					
Q.7	a.	Explain the basic function of OpenFlow V.I.O. switch and its relationship to a controller.	10	L2	CO4
	b.	Explain the major features of OpenFlow 1.4 addition.	10	L2	CO4
OR					
Q.8	a.	List the basic components of initial OpenFlow implementation.	10	L1	CO4
	b.	Explain the major features of OpenFlow 1.5 addition.	10	L2	CO4
Module – 5					
Q.9	a.	Compare between SDN and NFV. Illustrate a scenario where SDN and NFV collaborate.	10	L2	CO4
	b.	Summarize open source SDN switch implementation.	10	L2	CO4
OR					
Q.10	a.	Illustrate open source SDN applications.	10	L2	CO4
	b.	What is OpenStack Open Source? What is the role of mention in OpenStack?	10	L1	CO4

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MLIE201

Second Semester M.Tech. Degree Examination, June/July 2025 Advanced Control Systems


Time: 3 hrs.

Max. Marks: 100

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

		Module - 1	M	L	C
Q.1	a.	Determine inverse z-transform of i) $F(z) = \frac{4z^2 - 2z}{z^3 - 5z^2 + 8z - 4}$ ii) $F(z) = \frac{3z^2 + 2z + 1}{z^2 + 3z + 2}$	10	L3	CO1
	b.	Solve the difference equations by using z-transform method. i) $x(k+2) - 3x(k+1) + 2x(k) = 4^k$; $x(0) = 0, x(1) = 1$ ii) $x(k+2) + (a+b)x(k+1) + abx(k) = 0$ where a and b are constants [consider $a = b$]	10	L3	CO1
OR					
Q.2	a.	Explain in brief the properties of the z-transform.	10	L2	CO1
	b.	Determine the stability of system, whose characteristics equations are as follows: $z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$, using Jury's stability test.	5	L3	CO1
	c.	Consider the sampled-data system of Fig Q2(c). Determine its stability using the bilinear transformation.	5	L3	CO1
		<p style="text-align: center;">Fig Q2(c)</p>			
Module - 2					
Q.3	a.	Obtain state transition matrix $\phi(t)$ of the following and obtain inverse of it $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$	10	L3	CO2
	b.	Obtain state model of system whose transfer function is given as $\frac{y(s)}{u(s)} = \frac{10}{s^3 + 4s^2 + 2s + 1}$ Also given the block diagram representation of the state model.	10	L3	CO2

OR					
Q.4	a.	Obtain the canonical form of the following system : $\ddot{y} + 6\dot{y} + 11y + 6y = \ddot{u} + 8\dot{u} + 17\dot{u} + 8u$	10	L3	CO2
	b.	Reduce given state model into its canonical form by diagonalising matrix A. $\dot{x}(t) = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t); y(t) = [0 \ 0 \ 1] x(t)$	10	L3	CO2
Module – 3					
Q.5	a.	A single input system is described by the following state equation. Design a state feedback controller which will give closed loop poles at $-2, -1 \pm j1$ $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} u$	10	L3	CO3
	b.	Consider a linear system described by equation $\dot{x} = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & 1 \\ 0 & 2 & 0 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} u = Ax + Bu; y = [0 \ 0 \ 1] x.$ Design a full-order state observer, so that eigen values of observer matrix are at $-4, -3 \pm j1$	10	L3	CO3
OR					
Q.6	a.	Consider the regular system given by $\dot{x} = Ax + Bu$ $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & -1 \\ -1 & -5 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ The system uses state feedback $u = -Kx$. Determine state feedback given matrix K for described loop poles at $s = -2 \pm j4, s = -10$.	10	L3	CO3
	b.	Evaluate controllability and observability for the following state model in continuous time system $A = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 0 \\ 1 & 2 \\ 2 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 1 & 1 & 2 \\ 3 & 1 & 5 \end{bmatrix}$	10	L3	CO3
Module – 4					
Q.7	a.	Explain Dead-beat controller.	10	L2	CO4
	b.	With a neat block diagram, explain (MRAC) model reference adaptive control.	10	L2	CO4

OR					
Q.8	a.	Explain state regular problem from continuous systems and discrete time system using state variable approach.	10	L2	CO4
	b.	Consider second-order system of Fig Q8(b), where in it is desired to find optimum and which minimizes integral square error is $J = \int_0^{\infty} e^2(t) \cdot dt$ for initial conditions $c(0) = 1^\circ$, $c^*(0) = 0$.	10	L3	CO4
 <p style="text-align: center;">Fig Q8(b)</p>					
Module - 5					
Q.9	a.	Derive the expression for the describing function of dead zone non-linearity with input-output waveforms.	10	L2	CO5
	b.	Derive the expression for the describing function of saturation non-linearity. Also draw input output waveforms.	10	L2	CO5
OR					
Q.10	a.	Define non-linear systems. Explain the classification of non-linearity with examples.	10	L2	CO5
	b.	Discuss the stability analysis of non-linear control system using describing function with necessary sketches.	10	L2	CO5

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MLIE202

Second Semester M.Tech. Degree Examination, June/July 2025 Automotive Electronics

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	List the use of Electronics in the automobile.	10	L1	CO1
	b.	Explain basic braking system and ABS in automobile with neat figure.	10	L2	CO1
OR					
Q.2	a.	Explain basic suspension and electronically controlled suspension with neat diagrams.	10	L2	CO1
	b.	Explain basic steering and electronic steering system with neat diagrams.	10	L2	CO1
Module – 2					
Q.3	a.	With neat diagram, explain the role of Analog to Digital converter in automobiles with its working.	10	L2	CO2
	b.	Explain the microprocessor internal architecture with block diagram.	10	L2	CO2
OR					
Q.4	a.	Explain the working principle of Digital to Analog converter with neat diagram.	10	L3	CO2
	b.	With neat block diagram of typical automotive computer, explain microcomputer applications in automotive systems.	10	L2	CO2
Module – 3					
Q.5	a.	Briefly explain the concept of electronic engine control system with neat diagrams.	10	L3	CO3
	b.	Explain the Engine Performance Terms.	10	L2	CO3
OR					
Q.6	a.	With diagram explain mass airflow sensor?	10	L2	CO3
	b.	Explain the working of fuel injector actuator with neat diagram.	10	L2	CO3
Module – 4					
Q.7	a.	With neat diagrams, explain digital cruise control system.	10	L2	CO4
	b.	With neat diagram, explain occupant protection system.	10	L2	CO4
OR					
Q.8		Write a short note on : (i) On board and Off board diagnostics (ii) Expert Systems	20	L2	CO4
Module – 5					
Q.9	a.	Explain collision avoidance radar warning system in automobiles.	10	L2	CO5
	b.	Explain Low Tire Pressure Warning System with neat diagram.	10	L2	CO5
OR					
Q.10		Write a short note on : (i) Radio Navigation (ii) Signpost Navigation (iii) Dead Reckoning Navigation	20	L2	CO5

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MLIE215A

Second Semester M.Tech Degree Examination, June/July 2025 Smart Materials and Sensors

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Explain the physical properties of piezoelectric materials in detail.	10	L2	CO1
	b.	Describe shape memory materials in detail.	10	L3	CO1
OR					
Q.2	a.	Explain in detail, fiber optic sensors.	10	L3	CO1
	b.	Explain Magneto electric materials.	10	L3	CO1
Module – 2					
Q.3	a.	Explain smart transducers in detail.	10	L3	CO2
	b.	Discuss about smart Actuators.	10	L3	CO2
OR					
Q.4	a.	Explain the following : i) Accelerometer ii) Vibration dampers.	10	L3	CO2
	b.	Explain MEMS sensors in detail.	10	L3	CO2
Module – 3					
Q.5	a.	Explain feedback and feed forward control strategies.	10	L3	CO3
	b.	Write a note on derive and control techniques in Quasi – static and dynamic measurement.	10	L3	CO3
OR					
Q.6	a.	What is structural dynamics? Explain system identification in structural dynamics.	10	L3	CO3
	b.	Explain Passive, semi-active and active control.	10	L3	CO3
Module – 4					
Q.7	a.	Explain the design challenges and considerations in integrating smart materials and devices.	10	L4	CO4
	b.	With an example, explain manufacturing and fabrication challenges.	10	L4	CO4
OR					
Q.8	a.	Explain modeling and analysis issues in smart materials and its integration with devices.	10	L4	CO4
	b.	Explain the challenges in signal processing and control capabilities during integration of smart materials.	10	L4	CO4
Module – 5					
Q.9	a.	Explain the applications of computer and telecommunication products.	10	L3	CO5
	b.	Explain the applications, advantages and disadvantages of medical and dental tools and equipments.	10	L3	CO5
OR					
Q.10	a.	Discuss the applications of smart structures, automation and precision manufacturing equipment.	10	L3	CO5
	b.	Describe automation and precision manufacturing in : i) Sporting products ii) Consumer products.	10	L3	CO5

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MEC103

First Semester M.Tech Degree Examination, June/July 2025 Digital Circuits and Logic Design

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	What is threshold element? Explain with an example.	10	L2	CO1
	b.	Describe whether the function : $f(x_1, x_2, x_3, x_4) = \Sigma(0, 1, 3, 4, 5, 6, 7, 12, 13)$ is a threshold function? Find weight threshold vector.	10	L3	CO1
OR					
Q.2	a.	For the switching function : $f(x_1, x_2, x_3, x_4) = \Sigma(2, 3, 6, 7, 10, 12, 14, 15)$ find a minimal threshold realization.	10	L3	CO1
	b.	Explain capabilities of finite state machine.	10	L2	CO1
Module – 2					
Q.3	a.	Explain detection of multiple faults.	10	L2	CO2
	b.	Explain fault detection in combinational circuits.	10	L2	CO2
OR					
Q.4	a.	Explain failure-tolerant design.	10	L2	CO2
	b.	Explain Quadded logic.	10	L2	CO2
Module – 3					
Q.5	a.	Explain Boolean differences.	10	L2	CO3
	b.	Explain limitation of finite state machines.	10	L2	CO3
OR					
Q.6	a.	Explain state equivalence.	10	L2	CO3
	b.	Explain machine minimization.	10	L2	CO3
Module – 4					
Q.7	a.	Explain reduction of the functional dependency of state variable with example.	10	L2	CO4
	b.	Explain parallel decomposition with example.	10	L2	CO4
OR					
Q.8	a.	Explain reception of the output decency with example.	10	L2	CO4
	b.	Explain state assignment based on closed partitions.	10	L2	CO4
Module – 5					
Q.9	a.	Explain Homing experiments.	10	L2	CO5
	b.	Explain Testing Graph.	10	L2	CO5
OR					
Q.10	a.	Design definitely diagnosable machines.	10	L3	CO5
	b.	Explain successor tree.	10	L2	CO5

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MLIE215A

Second Semester M.Tech Degree Examination, June/July 2025 Smart Materials and Sensors

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Explain the physical properties of piezoelectric materials in detail.	10	L2	CO1
	b.	Describe shape memory materials in detail.	10	L3	CO1
OR					
Q.2	a.	Explain in detail, fiber optic sensors.	10	L3	CO1
	b.	Explain Magneto electric materials.	10	L3	CO1
Module – 2					
Q.3	a.	Explain smart transducers in detail.	10	L3	CO2
	b.	Discuss about smart Actuators.	10	L3	CO2
OR					
Q.4	a.	Explain the following : i) Accelerometer ii) Vibration dampers.	10	L3	CO2
	b.	Explain MEMS sensors in detail.	10	L3	CO2
Module – 3					
Q.5	a.	Explain feedback and feed forward control strategies.	10	L3	CO3
	b.	Write a note on derive and control techniques in Quasi – static and dynamic measurement.	10	L3	CO3
OR					
Q.6	a.	What is structural dynamics? Explain system identification in structural dynamics.	10	L3	CO3
	b.	Explain Passive, semi-active and active control.	10	L3	CO3
Module – 4					
Q.7	a.	Explain the design challenges and considerations in integrating smart materials and devices.	10	L4	CO4
	b.	With an example, explain manufacturing and fabrication challenges.	10	L4	CO4
OR					
Q.8	a.	Explain modeling and analysis issues in smart materials and its integration with devices.	10	L4	CO4
	b.	Explain the challenges in signal processing and control capabilities during integration of smart materials.	10	L4	CO4
Module – 5					
Q.9	a.	Explain the applications of computer and telecommunication products.	10	L3	CO5
	b.	Explain the applications, advantages and disadvantages of medical and dental tools and equipments.	10	L3	CO5
OR					
Q.10	a.	Discuss the applications of smart structures, automation and precision manufacturing equipment.	10	L3	CO5
	b.	Describe automation and precision manufacturing in : i) Sporting products ii) Consumer products.	10	L3	CO5

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22RMI16

First Semester M.Tech. Degree Examination, June/July 2025

Research Methodologies and IPR

Time: 3 hrs.

Max. Marks: 100

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

Module – 1			M	L	C
Q.1	a.	Define Research. Mention the objectives of research and explain about significance of research.	10	L2	CO1
	b.	Explain the techniques involved in defining a research problem.	10	L2	CO1
OR					
Q.2	a.	Explain steps involved in a research process with aid of a neat block diagram.	10	L2	CO1
	b.	Write short notes on: i) Problems encountered by researchers in India ii) Qualities of good research	10	L2	CO1
Module – 2					
Q.3	a.	What is Research Design? Explain the significance of a research design.	10	L2	CO2
	b.	In context of research design, explain the meaning of the following: i) Extraneous variable ii) Confound variable iii) Research hypothesis iv) Experimental and control groups v) Treatments	10	L2	CO2
OR					
Q.4	a.	Explain the steps involved in conducting literature review.	10	L2	CO2
	b.	Explain and illustrate the following research designs: i) Informal Experimental Designs ii) Completely Randomized Design.	10	L2	CO2
Module – 3					
Q.5	a.	Explain the important characteristics of case study method.	10	L2	CO3
	b.	Explain the stages of developing measurement tools.	10	L2	CO3
OR					
Q.6	a.	Distinguish between Experiments and Surveys.	10	L2	CO3
	b.	Discuss the four types of measurement scales in detail with relevant examples.	10	L2	CO3
1 of 2					

22RMI16					
Module – 4					
Q.7	a.	Explain the characteristics of hypothesis.	10	L2	CO4
	b.	Distinguish between: i) Type I and Type II errors ii) Null hypothesis and Alternate hypothesis iii) Two-tailed and one-tailed tests.	10	L2	CO4
OR					
Q.8	a.	Write short notes on: i) Critical value and decision value ii) Precautions in using chi-square less	10	L2	CO4
	b.	What is Chi-square test? Explain its significance in statistical analysis.	10	L2	CO4
Module – 5					
Q.9	a.	Explain different steps in writing a report.	10	L2	CO5
	b.	Explain the following types of reports: i) Popular Report ii) Technical Report	10	L2	CO5
OR					
Q.10	a.	What are Intellectual Property Rights? Explain various types of Intellectual Property Rights protected in India.	10	L2	CO5
	b.	Explain the procedure for filling patent application.	10	L2	CO5

Module – 5					
Q.9	a.	Explain standard power levels of conductive chargers.	10	L2	CO5
	b.	Explain characteristics of Battery.	10	L2	CO5
OR					
Q.10	a.	Explain different batteries and ultra capacitors.	10	L2	CO5
	b.	Explain Domestic Charging Infrastructure and Public Charging Infrastructure.	10	L2	CO5

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MLIE216B

Second Semester M.Tech. Degree Examination, June/July 2025 Internet of Things and Applications

Time: 3 hrs.

Max. Marks: 100

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

Module - 1			M	L	C
Q.1	a.	What is IoT Technology? Explain how digitization will help IoT.	10	L2	CO1
	b.	Discuss drivers behind new Architectures.	10	L2	CO1
OR					
Q.2	a.	Briefly explain the impact of IoT on the following : i) Connected Factory ii) Smart Connected Buildings.	10	L2	CO1
	b.	With neat diagram, explain IoT Reference Model.	10	L2	CO1
Module - 2					
Q.3	a.	What are the Core IoT Functional Stack? Explain in brief three layers of IoT stack.	10	L2	CO2
	b.	Explain about IoT Data Management and Computer Stack.	10	L2	CO2
OR					
Q.4	a.	Compare : i) Analytics versus Control Applications ii) Data versus Network Analytics	10	L2	CO2
	b.	Write a note on Gateways and Backhaul Sublayer. Also tabulate the Architectural considerations for WiMAX and Cellular Technology.	10	L2	CO2
Module - 3					
Q.5	a.	Explain the communication protocols for Wireless Sensor Network.	10	L2	CO3
	b.	Write a brief note on: i) LTE cat 0 ii) LTE - M	10	L2	CO3
OR					
Q.6	a.	Evaluate the protocols used for Constrained node Networks for use-case applicability.	10	L2	CO3
	b.	Explain in detail the features of NB - IoT.	10	L2	CO3
Module - 4					
Q.7	a.	How to implement IP in Data Center, Cloud Services and Operation Centers hosting IoT Applications using Adoption or Adaption for the IP	10	L2	CO4
	b.	Explain SCADA system and application layer protocols for IoT.	10	L2	CO4
OR					
Q.8	a.	Discuss the need for Optimization in an IoT, explain constrained node, constrained networks, IP versions.	10	L2	CO4
	b.	Explain about IoT data analytics overview and challenges.	10	L2	CO4
Module - 5					
Q.9	a.	Explain Grid Block Reference Model Architecture.	10	L2	CO5
	b.	Explain Smart City Security Architecture System.	10	L2	CO5
OR					
Q.10	a.	Explain Resilient Ethernet Protocol (REP).	10	L2	CO5
	b.	Explain Smart Street Lighting System using IoT.	10	L2	CO5

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MLIE216B

Second Semester M.Tech. Degree Examination, June/July 2025 Internet of Things and Applications

Time: 3 hrs.

Max. Marks: 100

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

Module - 1			M	L	C
Q.1	a.	What is IoT Technology? Explain how digitization will help IoT.	10	L2	CO1
	b.	Discuss drivers behind new Architectures.	10	L2	CO1
OR					
Q.2	a.	Briefly explain the impact of IoT on the following : i) Connected Factory ii) Smart Connected Buildings.	10	L2	CO1
	b.	With neat diagram, explain IoT Reference Model.	10	L2	CO1
Module - 2					
Q.3	a.	What are the Core IoT Functional Stack? Explain in brief three layers of IoT stack.	10	L2	CO2
	b.	Explain about IoT Data Management and Computer Stack.	10	L2	CO2
OR					
Q.4	a.	Compare : i) Analytics versus Control Applications ii) Data versus Network Analytics	10	L2	CO2
	b.	Write a note on Gateways and Backhaul Sublayer. Also tabulate the Architectural considerations for WiMAX and Cellular Technology.	10	L2	CO2
Module - 3					
Q.5	a.	Explain the communication protocols for Wireless Sensor Network.	10	L2	CO3
	b.	Write a brief note on: i) LTE cat 0 ii) LTE - M	10	L2	CO3
OR					
Q.6	a.	Evaluate the protocols used for Constrained node Networks for use-case applicability.	10	L2	CO3
	b.	Explain in detail the features of NB - IoT.	10	L2	CO3
Module - 4					
Q.7	a.	How to implement IP in Data Center, Cloud Services and Operation Centers hosting IoT Applications using Adoption or Adaption for the IP	10	L2	CO4
	b.	Explain SCADA system and application layer protocols for IoT.	10	L2	CO4
OR					
Q.8	a.	Discuss the need for Optimization in an IoT, explain constrained node, constrained networks, IP versions.	10	L2	CO4
	b.	Explain about IoT data analytics overview and challenges.	10	L2	CO4
Module - 5					
Q.9	a.	Explain Grid Block Reference Model Architecture.	10	L2	CO5
	b.	Explain Smart City Security Architecture System.	10	L2	CO5
OR					
Q.10	a.	Explain Resilient Ethernet Protocol (REP).	10	L2	CO5
	b.	Explain Smart Street Lighting System using IoT.	10	L2	CO5
