Q.6	i.	A vehicle with A/C system has a black sticker on the bonnet lock panel. What is your comment.	**2**
	ii.	Write a short note on refrigerant charging in a vehicle air conditioning system.	**8**
OR	iii.	Detail the simple inspection routine of a vehicle air conditioning system.	**8**

******

Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2019

AU3CO16 Automotive Refrigeration and Air Conditioning

Programme: B.Tech. Branch/Specialisation: AU

Duration: 3 Hrs. **Maximum Marks: 60**

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
(b) Use of steam table & psychrometric chart can be allowed.

Q.1	i.	The commonly used refrigerant in vehicle air conditioning system is R134a, which has replaced following refrigerant: (a) R11 (b) R12 (c) R22 (d) None of these	**1**
	ii.	The fluids used in the Electrolux refrigeration are: (a) Water and hydrogen (b) Ammonia and hydrogen (c) Ammonia, water and hydrogen (d) None of these	**1**
	iii.	A psychrometer is a device which is used for measuring: (a) DBT (b) WBT (c) DPT (d) Both (a) and (b)	**1**
	iv.	The vapour pressure during sensible heating: (a) Increases (b) Decreases (c) Can increase or decrease (d) Remains constant	**1**
	v.	In vehicle air conditioning exterior convection, conduction through body panels & interior convection contribute to: (a) Ambient load (b) Ventilation load (c) Engine load (d) None of these	**1**
	vi.	Room sensible heat factor (RSHF) is the ratio of room sensible heat and: (a) Room latent heat (b) Sum of room sensible heat and room latent heat (c) Total sensible heat (d) None of these.	**1**

vii. For rectangular ducts, the aspect ratio is equal to: **1**
(a) Sum of longer & shorter sides of the duct
(b) Difference of longer & shorter sides of the duct
(c) Product of longer & shorter sides of the duct
(d) Ratio of longer & shorter sides of the duct.

viii. A duct is said to be a low velocity duct if the velocity of air in the duct is upto: **1**
(a) 600 m/min (b) 800 m/min
(c) 1200 m/min (d) 1600 m/min

ix. Unusual noise in vehicle air conditioner compressor is due to: **1**
(a) Clutch bearing
(b) Suction pressure is less than desired
(c) Valve plate assembly
(d) All of these

x. What if a liquid refrigerant gets in your eyes or on your skin? **1**
(a) Wash the area with a lot of cool water and apply clean petroleum jelly
(b) Do not rub the area
(c) Go immediately to a physician
(d) All of these

Q.2 i. Define one tonne of refrigeration. **2**
ii. Derive the chemical formula of refrigerant R12. **3**
iii. Explain various components and working of commonly used automobile air conditioning system using appropriate diagram. **5**
OR iv. State the advantages of VAR system over VCR system. **5**

Q.3 i. What are various factors affecting comfort? **2**
ii. Define following terms with appropriate sketch: **8**
(a) Sensible cooling
(b) Sensible heating
(c) Cooling and dehumidification
(d) Heating and humidification.
OR iii. Saturated air at 19°C is passed through a drier so that its final relative humidity is 25%. The drier uses silica gel adsorbent. The air is then passed through a cooler until its final temperature is 19°C DBT **8**

without change in specific humidity. Determine the following:
(a) Temperature of air at the end of drying process;
(b) Heat rejected during the cooling process;
(c) Relative humidity at the end of cooling process;
(d) Dew point temperature at the end of the drying process;
(e) Moisture removed during the drying process.
Also draw the complete process on psychrometric chart.

Q.4 i. Explain the procedure to draw a GSHF line on psychrometric chart. **2**
ii. Write a short note on vehicle cooling heat load validation testing (wind tunnel testing). **3**
iii. What is the basis for estimating thermal loads in vehicle cabins? How to determine tonne of refrigeration required for a vehicle? **5**
OR iv. It is required to design an air conditioning system for a process for the following hot summer conditions: **5**
Outdoor condition: 32°C DBT and 65% RH
Required air inlet condition: 25°C DBT & 60% RH
Coil dew temperature: 13°C
The required condition is achieved by first cooling and dehumidifying and then by heating. Calculate the following:
(a) The cooling capacity of cooling coil & its by-pass factor;
(b) Heating capacity of the heating coil in kW and surface temperature of the heating coil if the by-pass factor is 0.3.

Q.5 i. Write a short note on air handling system in vehicle air conditioning system. **4**
ii. Explain air flow circuit of an automobile air conditioner. List out various features on a vehicle air conditioner control panel that distinguish it from home air conditioner. **6**
OR iii. In an air conditioning system, the size of the main air supply duct is 0.8 m *0.6 m in cross section and carries 5 m^3/s of standard air. The main duct branches into two ducts of cross-section 0.6 m * 0.5 m & 0.6 m * 0.4 m. If the mean velocity in the larger branch is 8 m/s, determine: **6**
(a) Mean velocity in the main duct & the smaller branch;
(b) Mean velocity pressure in each duct.

Marking Scheme

AU3CO16 Automotive Refrigeration and Air Conditioning

Q.1	i.	The commonly used refrigerant in vehicle air conditioning system is R134a, which has replaced following refrigerant: (b) R12	**1**
	ii.	The fluids used in the Electrolux refrigeration are: (c) Ammonia, water and hydrogen	**1**
	iii.	A psychrometer is a device which is used for measuring: (d) Both (a) and (b)	**1**
	iv.	The vapour pressure during sensible heating: (d) Remains constant	**1**
	v.	In vehicle air conditioning exterior convection, conduction through body panels & interior convection contribute to: (a) Ambient load	**1**
	vi.	Room sensible heat factor (RSHF) is the ratio of room sensible heat and: (b) Sum of room sensible heat and room latent heat	**1**
	vii.	For rectangular ducts, the aspect ratio is equal to: (d) Ratio of longer & shorter sides of the duct.	**1**
	viii.	A duct is said to be a low velocity duct if the velocity of air in the duct is upto: (a) 600 m/min	**1**
	ix.	Unusual noise in vehicle air conditioner compressor is due to: (d) All of these	**1**
	x.	What if a liquid refrigerant gets in your eyes or on your skin? (d) All of these	**1**

Q.2	i.	One tonne of refrigeration.		**2**
		Definition	1 mark	
		Unit	1 mark	
	ii.	Derive the chemical formula of refrigerant R12.		**3**
		Standard formulae	1.5 marks	
		Calculation and deriving final chemical formula	1.5 marks	
	iii.	Automobile air conditioning system		**5**
		Diagram and components	2 marks	
		Description	3 marks	
OR	iv.	Advantages of VAR system over VCR system.		**5**
		At least five differences 1 mark for each	(1 mark * 5)	

Q.3	i.	Factors affecting comfort		**2**
		1 mark for each	(1 mark * 2)	
	ii.	Define following terms with appropriate sketch:		**8**
		(1 mark for diagram and 1 mark for definition)	(2 marks * 4)	
OR	iii.	Determine the following:		**8**
		(a) Temperature of air at the end of drying process;	1 mark	
		(b) Heat rejected during the cooling process;	1 mark	
		(c) Relative humidity at the end of cooling process;	1 mark	
		(d) Dew point temperature at the end of the drying process;	1 mark	
		(e) Moisture removed during the drying process.	1 mark	
		Diagram of complete process on psychrometric chart.	3 marks	

Q.4	i.	Procedure to draw a GSHF line on psychrometric chart.		**2**
		Formula	1 mark	
		Explanation	1 mark	
	ii.	Vehicle cooling heat load validation testing.		**3**
	iii.	Basis for estimating thermal loads in vehicle cabins	4 marks	**5**
		Determine tonne of refrigeration required for a vehicle	1 mark	
OR	iv.	Calculate the following:		**5**
		Values from psychrometric	1 mark	
		Capacity of cooling coil = 42.04 TR	1 mark	
		By-pass factor(cooling coil)	1 mark	
		Capacity of heating coil	1 mark	
		Surface temperature (heating coil) = 28.2℃	1 mark	

Q.5	i.	Air handling system in vehicle air conditioning system.		**4**
		1 mark for each	(1 mark * 4)	
	ii.	Air flow circuit of an automobile air conditioner		**6**
		Diagram and explanation	4 marks	
		Features on a vehicle air conditioner control panel	2 marks	
OR	iii.	Determine:		**6**
		Given data and its representation	1 mark	
		Mean velocity in the main duct = 10.4 m/s	1 mark	
		Mean velocity in the smaller branch = 10.8 m/s	1 mark	
		Mean velocity pressure in each duct.= 6.62 mm of water	1 mark	
		Mean velocity pressure in medium sized duct = 3.92 mm of water	1 mark	

		Mean velocity in smaller duct = 7.14 mm of water	1 mark	
Q.6	i.	A vehicle with A/C system has a black sticker on the bonnet lock panel.		**2**
		Identification	1 mark	
		Comment	1 mark	
	ii.	Refrigerant charging in a vehicle air conditioning system.		**8**
		Basic procedure	2 marks	
		Vapour charging	3 marks	
		Liquid charging procedure	3 marks	
OR	iii.	Simple inspection routine of a vehicle air conditioning system		**8**
		1 mark for each step	(1 mark * 8)	

****