Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY



COURSE PLAN

Academic Year 2019-20

Program:	B E – Mechanical Engineering
Semester :	4
Course Code:	18ME42
Course Title:	Applied Thermodynamics
Credit / L-T-P:	4 / 3-2-0
Total Contact Hours:	50
Course Plan Author:	B.M.Krishne Gowda

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18ME42: Applied Thermodynamics

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	ME
Year / Semester :	2020/IV	Academic Year:	2019-20
Course Title:	Applied Thermodynamics	Course Code:	18ME42
Credit / L-T-P:	4/3-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50	SEE Marks:	60 Marks
CIA Marks:	40	Assignment	1 / Module
Course Plan Author:	B.M.Krishne Gowda	Sign	Dt:
Checked By:		Sign	Dt:

2. Course Content

Mod	Module Content	Teaching	Module	Blooms
ule		Hours	Concepts	Level
1	Gas Power Cycles: Air standard cycles; Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparis on of Otto and Diesel cycles. I.C.Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, Performance analysis of I.C Engines, heat balance, Morse test, IC Engine fuels, Ratings and Alternate Fuels.	10 Hours	Concepts Working principles. combustion Phenomenon	Level L3
2	Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Inter-cooling and reheating in gas turbine cycles. Jet propulsion: Introduction to the principles of jet propulsion. Turbojet, Ramjet, Turboprop and turbofan engines	10 Hours	Efficiency of gas turbines Principles of jet engines	L3
3	Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycleSimple Rankine cycle; description, T-sdiagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle. Characteristics of an Ideal working fluid in Vapour power cycles, Binary Vapour cycles.	10 Hours	Efficiency of steam power plants Reheat and regenerative	L4
4	Refrigeration Cycles:	10 Hours	COP	L3

COURSE PLAN - ACADEMY 2019-20		
Vapour compression refrigeration system; description, analysis,refrigerating effect. Capacity, power required, units ofrefrigeration, COP, Refrigerantsand their desirable properties, alternate Refrigerants. Any one case study on cold storage or industrial refrigerator. Air cycle refrigeration; reversed Carnot cycle, reversed Brayton cycle, Vapour absorption refrigeration system. Steam jet refrigeration. Pscychrometrics and Air-conditioning Systems: Properties of Atmospheric air, and Psychometric properties of Air, Psychometric Chart, Analyzing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams. Cooling towers.	f Cooling and heating loads	
5 Reciprocating Compressors: Operation of a single stage reciprocating compressors. Work input through p-v diagram and steady state steady flow analysis. Effect of Clearance and Volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor, saving in work, Optimum intermediate pressure, Inter-cooling, Minimum work for compr ession. Steam nozzles: Flow of steam through nozzles, Shape of nozzles, effect of friction, Critical pressure ratio, Supersaturated flow	10 Hours optimum intermediate pressure. Critical pressure ratio	L3

3. Course Material

#	Details	Available
1	Text books	
	1. Basic and Applied Thermodynamics" by P .K. Nag, Tata McGraw Hill, 2nd Edi. 2009	In Lib
	2.Fundamentals of Thermodynamics by G.J. Van Wylenand R.E. Sonntag, Wiley Eastern. Fourth edition 1993.	In Lib
2	Reference books	
	1.Thermodynamics for engineers, Kenneth A. Kroos and Merle C. Potter, Cengage Learning, 2016	In dept
	2.Principles of Engineering Thermodynamics, Michael J,Moran, Howard N. Shapiro, Wiley, 8 th Edition	In Lib
	3.An Introduction to Thermo Dynamics by Y.V.C.Rao, Wiley Eastern Ltd, 2003.	In Lib
	5.I.C Engines by Ganeshan.V. Tata McGraw Hill, 4rth Edi. 2012.	In Lib
	6.I.C.Engines by M.L.Mathur & Sharma. Dhanpat Rai&	
3	Others (Web, Video, Simulation, Notes etc.)	Not Available

4. Course Prerequisites

SNo	Course	Course Name	Module / Topic / Description		Remarks	Blooms
	Code					Level
1	15ME33	Basics of	1. Knowledge on basic laws and	3		L3

	COURSE PLAN - ACADEMY 2019-20					
thermodynamics thermodynamic process						
2	15ME34	Fluid mechanics	Working principles of turbines , and	4		L3
			compressors.			

Note: If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

B. OBE PARAMETERS

1. Course Outcomes

#	COs	Teach.	Concept	Instr	Assessment	Blooms'
17ME43.1	Apply thermodynamic concepts to	Hours 10Hrs	Working	Method Chalk	Method Assignment	Level L3
	analyze the performance of gas power cycles.		principles	and Board	and viva	
17ME43.2	Apply thermodynamic concepts to analyze the performance of vapour power cycles	10 Hrs	Efficiency of gas turbines.	Chalk and Board	Assignment and viva	L3
17ME43.3	Understand combustion of fuels and performance of I C engines.	10 Hrs	combustion Phenomenon	Chalk and Board	Assignment and Test	L2
17ME43.4	Understand the principles and applications of refrigeration systems	10 Hrs	Energy Dissipation	Chalk and Board	Assignment and Test	L3
17ME43.5	Apply Thermodynamic concepts to determine performance parameters of refrigeration and airconditioning systems.	5Hrs	Efficiency of steam power plants	Chalk and Board	Assignment and Test	L3
17ME43.6	Understand the working principle of Air compressors and Steam nozzles, applications, relevance of air and identify methods for performance improvement.	5Hrs	Reheat and regenerative	Chalk and Board	Assignment and Test	L3
		1				

Note: Identify a max of 2 Concepts per Module. Write 1 CO per concept.

2. Course Applications

SNo	Application Area	CO	Level
1	Applications In Internal combustion engines	CO1	L3
2	In research and development organizations (G.T.R.E) gas turbine engine.	CO2	L3
3	Application can be seen in heating devices, I.c engines, Rocket propulsion system.	CO3	L3

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4	Road vehicles , Air craft, Motorboats and small machines.	CO4	L3
5	In steam power plants for electricity generation	CO5	L3
6	Application in Nuclear power plants.	CO6	L3
7	Applications In Domestic , commercial and marine Refrigeration system.	CO7	L3
8	Application in heating, ventilating, and cooling	CO8	L3
9	In industry, including natural gas processing and delivery, chemical plants, and oil	CO9	L2
	refineries.		
10	In Steam turbine plants.	CO10	L3

Note: Write 1 or 2 applications per CO.

3. Articulation Matrix

(CO - PO MAPPING)

-	Course Outcomes	Course Outcomes Program Outcomes												
#	COs	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	Level
		1	2	3	4	5	6	7	8	9	10	11	12	
18ME43.1	Apply thermodynamic	\checkmark		\checkmark	-	-	-	-	-	-	-	-	-	L2
	concepts to analyze the													
	performance of gas power													
	cycles.													
18ME43.2	Apply thermodynamic	\checkmark	√	\checkmark	-	-	-	-	-	-	-	-	-	L2
	concepts to analyze the													
	performance of vapour power													
	cycles.													
4014540.0		1	,	,										
18ME43.3	Understand combustion of	V	V	V	-	-	-	-	-	-	-	-	-	L3
	ruels and performance of I C													
	engines.													
18ME437	Understand the principles and	2	2/	2	_	_	_	_	_		_	_	_	13
101012-43.4	onderstand the principles and	v		V		_								
	applications of refrigeration													
	systems													
18ME43A50	bly Thermodynamic concepts to	\checkmark			-	-	-	-	-	-	-	-	-	L3
r.	determine performance													
	narameters of refrigeration and													
	parameters of refigeration and													
	anconditioning systems													
18ME43.5	Understand the working	√	√	√	-	-	-	-	-	-	-	-	-	L3
	principle of Air compressors													
	and Steam nozzles,													
	applications, relevance of air													
	and identify methods for													
	performance improvement.													
Note: Menti	on the mapping strength as 1, 2, or	3												

4. Mapping Justification

Mapping		Justification				
			Level			
СО	PO		Level			
CO1	PO1	The knowledge of air standard cycles is required for the solution of problems.	L2			
CO1	PO2	Anlysing problems of actual I.C Engines using gas power cycles	L2			
CO2	PO1	The knowledge of principles of Gas turbines is required for the solution of problems.	L3			
CO2	PO2	Anlysing problems of Gas turbine for different process.	L3			
CO3	PO1	The knowledge of different prtocess is required for the solution of problems.	L2			
CO3	PO2	Anlysing the phenomena of combustion using bacis process	L2			
CO4	PO1	The knowledge of basic concepts is required for solution ptoblems	L3			
CO4	PO2	Anlysing problems of I.c engines efficiency using performance parameters	L3			
CO5	PO1	The knowledge of working principle of vapour cycles is needed for solution problems of steam power plants	L3			
CO5	PO2	Anlysing the efficiency of steam power plants using parameters	L3			
CO6	PO1	The knowledge of work done and efficiency of modified Rankine cycle required for the solution of problems.	L3			
CO6	PO2	Analysis of problems of steam power plants using modified Rankine cycle	L3			

Note: Write justification for each CO-PO mapping.

C. COURSE ASSESSMENT

1. Course Coverage

Mod	Title	Teaching	No. of question in Exam						CO	Levels
ule #		Hours	CIA-1	CIA-2	CIA-3	Asg	Extra	SEE		
							Asg			
1	Gas Power Cycles &	10	2	-	-	1	1	2	CO1,	L2, L3
	Gas turbine (Brayton)								CO2	
2	Combustion Thermodynamics &	10	2	-	-	1	1	2	CO3,	L2, L3
	I.C.Engines:								CO4	
3	Va pour Power Cycles	10	-	2	-	1	1	2	CO5,	L2, L3
									CO6	
4	Refrigeration Cycles &	10	-	2	2	1	1	2	CO7,	L3, L3
	Pscychrometrics and Air-conditioning								C08	
	Systems.									
5	Reciprocating Compressors &	10	-	-	2	1	1	2	CO9,	L3, L3
	Steam nozzles								CO10	
-	Total	50	4	4	4	5	5	10	-	-

Note: Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	30	CO1, CO2	L2, L4
		CO3, CO4	
CIA Exam – 2	30	CO5, CO6	L2, L3
		CO7, CO8	
CIA Exam – 3	30	CO9, CO10	L2, L3
Assignment - 1	10	CO1, CO2	L2, L3
		CO3, CO4	
Assignment - 2	10	CO5, CO6	L2, L3
		CO7, CO8	
Assignment - 3	10	CO9, CO10	L2, L3
Seminar - 1	-	-	-
Seminar - 2	-	-	-
Seminar - 3	-	-	-
	-	-	-
Other Activities - define -	-	-	-
Slip test			
Final CIA Marks	40	-	-

2. Continuous Internal Assessment (CIA)

Note : Blooms Level in last column shall match with A.2 above.

D1. TEACHING PLAN - 1

Module - 1

Title:	Gas Power Cycles & I.C.Engines:	Appr	10 Hrs
		Time:	
а	Course Outcomes	-	Blooms
			Level
1	Apply thermodynamic concepts to analyze the performance of gas power cycles.	CO1	L3
2	Student should able to apply thermodynamic concepts to analyze the performance of gas turbine and propulsion systems.	CO2	L3
b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
1	Air standard cycles; Carnot, p-v and T -s diagrams	C01	L2
2	Otto, Diesel p-v and T -s diagrams	C01	L3
3	Dual and Stirling cycles, p-v and T -s diagrams	C01	L3
4	Efficiencies and mean effective pressures	C01	L3
	Comparis on of Otto and Diesel cycles.		
5	problems	C01	L2
6	Gas turbine (Brayton)cycle	C02	L3
7	Regenerative gas turbine cycle	C02	L3
8	Inter-cooling and reheating in gas turbine cycles.	C02	L3
9	Jet propulsion: Introduction to the principles of jet propulsion	C02	L3
10	problems	C02	L3

со **Application Areas** Level С CO1 1 L2 Applications In Internal combustion engines. 2 In research and development organizations (G.T.R.E) gas turbine engine. CO2 L3 d **Review Questions** -_ CO1 L2 1 Define air standard cycles. 2 Draw p-v and T -s diagrams for Carnot, otto and diesel CO1 L2 3 Derive an expression of efficiency for carnot cycle CO1 L2 4 Derive an expression of efficiency for Otto cycle CO1 L2 5 Derive an expression of efficiency for Diesel cycle CO1 L2 6 Derive an expression for mean effective pressure for Diesel cycle CO1 L2 7 The stroke and cylinder diameters of a compression ignition engine are 250 CO1 L3 mm and 150 mm respectively. If the clearance volume is 0.0004 m3 and fuel injection takes place at constant pressure for 5 percent of the stroke determine the efficiency of the engine. Assume the engine working on the diesel cycle. 8 Derive an expression for optimum pressure ratio which gives maximum CO2 L3 specific work output in gas turbine considering machine efficiency. 9 Explain the working of a ramjet engine with the help of a sketch. What are its CO2 L3 advantages, disadvantages and applications? 10 In ideal diesel cycle running at 2000rpm, has a compression ratio of 20 and CO2 L3 uses air as theworking fluid. The state of air at the beginning of the compression process is 95kPa and20°C. If the maximum temperature in the cycle is not to exceed 2200K, Determine:i) Thermal efficiency; ii) Mean effective pressure; iii) Net work output per unit mass of air;iv) Specific air consumption in kg/s and Take density air = 1.225 kg/m3. A gas turbine plant works between the temperature limits of 300K and 1000K 11 CO2 L3 and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect intercooling in between. Calculate the net power of the plant, Cp = 1 kJ / kg.per kg of air circulation ; y = 1.4 for air. In a regenerative gas turbine cycle air enters the compressor at 1 bar, 15°C, CO2 L3 12 pressure ratio 6. The isentropic efficiencies of compressor and turbine are 0.8 and 0.85 respectively. The maximumtemperature in the cycle is 800°C. The regenerator efficiency is 0.78. Assume Cp = 1.1 KJ/kgK, y = 1.32 for the

Module – 2

Title:	Gas turbine (Brayton)& Jet proplusion	Appr	10 Hrs
		Time:	
а	Course Outcomes	-	Blooms
			Level
1	Understanding the components of energy transfer and find energy transfer	CO3	L2
	and dor using velocity triangles.		
2	Perform the preliminary design of turbo machines (pumps, rotary	CO4	L3
	compressors and turbines)		
b	Course Schedule	-	-
Class No	Module Content Covered	CO	Level
17	Combustion Thermodynamics	CO3	L2

combustion products find the cycle efficiency.

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	Theoretical (Stoichiometric) air for combustion of fuels.Excess air, mass balance,		
18	Exhaust gas analysis, A/F ratio.Energy balance for a chemical reaction,	CO3	L3
19	Enthalpy of formation, enthalpy and internal energy of combustion.	CO3	L2
20	Dissociation and equilibrium, emissions.	CO3	L2
21	problems	CO3	 L3
22	I.C.Engines: Classification of IC engines, Combustion of SI engine and CI engine	CO4	L3
23	Detonation and factors affecting detonation, Performance analysis of LC Engines IC Engine fuels	CO4	L3
24	Heat balance. Morse test	CO4	L3
25	Ratings and Alternate Fuels.	CO4	L3
26	problems	CO4	L3
C	Application Areas	CO	Level
1	In research and development organizations for predicting the parameters for analysis of actual turbines.	CO3	L2
2	In research and development organizations for predicting the parameters for analysis of actual fluid machines	CO4	L3
d	Review Questions	-	-
12	Explain	CO3	L2
	i) Enthalpy of formation. ii)Enthalpy of combustion.		
13	Explain ii) Stoichiometric air. iv) Excess air and	CO4	L3
14	Explain Adiabatic flame temperature.	CO3	L2
15	The products of combustion of an unknown hydro carbon Cx1-ly have the following composition as measured by an orsat apparatus: CO2 = 8.0%, CO = 0.9%, 02 = 8.8%,N2 = 82.3%.Determine: The composition of the fuel. ii) The air/fuel ratio and iii) The percent excess air used	CO4	L3
16	Explain the with neat sketch orsat orsat operatus.	CO3	
17	Explain briefly Morse test.	CO4	L3
18	Explain the heat balance sheet.	CO4	L2
19	The following data were obtained on MORSE test of 4-cylinder four stroke SI enginecoupled to a hydraulic dynamometer operating at constant speed of 1500rpm, brake load with second cylinder not firing = 206N, brake load with third cylinder not firing =192N, brake load with fourth cylinder not firing = 200N. Brake power in kW is calculated using the equation BP = WN/42,300, where 'W' is brake load in Newton, N-speed of the engine in RPM. Calculate: i) Brake power; ii) Indicated power; iii) Mechanical efficiency.	CO4	L3
20	4 cylinder gasoline engine operates on a 4 stroke cycle. The base of each cylinder is 70mm and the stroke is 90mm. Clearance volume per cylinder is 70CC. At a speed of 3500 rpm, the fuel consumption is 20 kg/hr and torque developed is 150N-m. Calorific value of fuel is 42000 kJ/kg. IP of the engine is 72 kW. Calculate BP, BMEP, brake thermal efficiency, relative efficiency and ISFC.	CO4	L4

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:		18ME42 Sem: IV I Marks: 30 Time: 75						75 minute	S	
Coui	rse:	APPLIED THERMODYNAMICS								
-	-	Note: Answ	ver any 2 ful	l questions.				Marks	CO	Level
1	а	Define air s	standard cycle	es.				2	CO1	L1
	b	Derive an	expression of	of efficiency f	for carnot cy	cle		4	CO1	L2
	С	Derive an e	expression o	f efficiency for	or Otto cycle			4	CO1	L3
	d	The stroke	and cylinder	diameters of	of a compres	sion ignition	engine are 2	250 5	CO1	L3
		mm and150	0 mm respec	tively. If the	clearance vo	olume is 0.00	04 m3 and f	uel		
		injection ta	akes place a	at constant	pressure for	or 5 percent	of the stro	oke		
		determine	the efficiency	of the eng	ine. Assume	the engine	working on t	the		
		diesel cycle	Э							
				-	OR					
2	а	Derive an specific wo	expression rk output in g	for optimum as turbine c	n pressure r onsidering m	atio which g achine efficie	jives maxim ency.	um 5	CO2	L3
	b	A gas turb	pine plant w	orks betwee	en the temp	erature limits	s of 300K a	ind 5	CO2	L3
		1000K and	a pressure c	of 1 bar and	16 bar. The o	compression	is carried out	tin		
		two stages	with perfect	intercooling	in between.	Calculate th	ne net power	of		
		the plant, C	p = 1 kJ / kg	.per kg of all	r circulation ;	y = 1.4 for a	Ir.		000	
	C	In a regen	erative gas tu	Irbine cycle	air enters the	e compressor	at 1 bar, 15	°C, 5	002	L3
		0.8 and 0.8	310 0. The IS	ly The max	imum temne	rature in the		°C		
		The regene	erator efficien	cv is 0.78 A	ssume Cn =		v = 1.32 for f	be		
		combustion	products fin	d the cvcle e	efficiency.	n n norngin,	y 1.02 101 1			
			<u> </u>							L2
3	а	Explain i) E	Inthalpy of fo	rmation.ii)Er	thalpy of co	nbustion		7	CO3	L3
		ii) Stoichior	netric air. iv)	Excess air a	and					
	d	The produ	icts of combi	ustion of an	unknown hy	dro carbon (Cx1-ly have t	the 8	CO3	L3
		following co	omposition as	s measured	by an orsat	apparatus: C	O2 = 8.0%, (00		
		= 0.9%, 02	<u>2</u> = 8.8%,N2	= 82.3%.De	etermine: The	e compositio	n of the fuel.	ii)		
		The air/fuel	I ratio and							
		iii) The per	cent excess a	air used						
		F	- C L - N A	- 1					004	1.0
4	a	Explain brie	ent balance	SI.					CO4	
	h		a data wara	e sneet.		t of 1 outlinds	ar four otroko	<u> </u>	CO1	12
	D		ing data were	draulic dynar	no meter on	erating at co	nstant sneed	SI O	004	
		1500rpm b	pied to a fiye	ith second c	vlinder not fi	ring = 206N	brake load w	/ith		
		third cylind	ler not firing	=192N hrs	ke load with	fourth cylin	der not firing	1 =		
		200N. Brak	e power in k	W is calcula	ted using the	equation RF	P = WN/42.3	, 00.		
		where 'W' i	s brake load	in Newton, N	N-speed of th	e engine in F	RPM. Calcula	ite:		

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i) Brake power; ii) Indicated power; iii) Mechanical efficiency.		

b. Assignment -1

Note: A distinct assignment to be assigned to each student.

model Assignment Questions										
Crs C	ode: 18M	E42 Sem: IV I Marks: 5 / 10 Time: 90) – 120 /	minutes	3					
Cours	se: APPL	IED THERMODYNAMICS								
Note:	Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.									
SNo	USN	Assignment Description	Marks	со	Level					
1		Define air standard cycles.	5	CO1	L2					
2		Draw p-v and T -s diagrams for Carnot, otto and diesel	5	CO2	L3					
3		Derive an expression of efficiency for carnot cycle		CO2	L4					
4		Derive an expression of efficiency for Otto cycle	5	CO1	L3					
5		Derive an expression of efficiency for Diesel cycle	5	CO1	L2					
6		Derive an expression for mean effective pressure for Diesel	5	CO2	L3					
		cvcle								
7		The stroke and cylinder diameters of a compression ignition		CO2	L3					
		engine are 250 mm and 150 mm respectively. If the clearance								
		volume is 0.0004 m3 and fuel injection takes place at constant								
		pressure for 5 percent of the stroke determine the efficiency of								
		the engine. Assume the engine working on the diesel cycle.								
8		Derive an expression for optimum pressure ratio which gives	5	CO1	L3					
		maximum specific work output in gas turbine considering								
		machine efficiency.								
9		Explain the working of a ramjet engine with the help of a sketch.	5	CO1	L2					
		What are its advantages, disadvantages and applications?								
10		In ideal diesel cycle running at 2000rpm, has a compression	5	CO2	L3					
		ratio of 20 and uses air as theworking fluid. The state of air at the								
		beginning of the compression process is 95kPa and20°C. If the								
		maximum temperature in the cycle is not to exceed 2200K,								
		Determine:i) Thermal efficiency; ii) Mean effective pressure; iii)								
		Net work output per unit mass of air;iv) Specific air consumption								
		in kg/s and Take density air = 1.225 kg/m3.								
11		A gas turbine plant works between the temperature limits of		CO2	L3					
		300K and 1000K and a pressure of 1 bar and 16 bar. The								
		compression is carried out in two stages with perfect intercooling								
		in between. Calculate the net power of the plant, Cp = 1 kJ /								
		kg.per kg of air circulation ; y = 1.4 for air.								
12		In a regenerative gas turbine cycle air enters the compressor at	5	CO3	L2					
		1 bar, 15°C, pressure ratio 6.The isentropic efficiencies of								
		compressor and turbine are 0.8 and 0.85 respectively. The								
		maximumtemperature in the cycle is 800°C. The regenerator								
		efficiency is 0.78. Assume Cp = 1.1 KJ/kgK, y = 1.32 for the								
		combustion products find the cycle efficiency.								
13		Define air standard cycles.	5	<u>CO1</u>	L3					
14		Draw p-v and 1 -s diagrams for Carnot, otto and diesel	5	CO2	L3					
15		Derive an expression of efficiency for carnot cycle		CO2	L3					
16		Derive an expression of efficiency for Otto cycle	5	CO1	L2					
17		Derive an expression of efficiency for Diesel cycle			L3					
18		Derive an expression for mean effective pressure for Diesel	5	CO1	L2					

	cvcle			
19	The stroke and cylinder diameters of a compression ignition engine are 250 mm and150 mm respectively. If the clearance volume is 0.0004 m3 and fuel injection takes place at constant pressure for 5 percent of the stroke determine the efficiency of the engine. Assume the engine working on the diesel cycle.	5	CO2	L3
20	Derive an expression for optimum pressure ratio which gives maximum specific work output in gas turbine considering machine efficiency.		CO2	L2
21	Explain the working of a ramjet engine with the help of a sketch. What are its advantages, disadvantages and applications?	5	CO1	L3
22	In ideal diesel cycle running at 2000rpm, has a compression ratio of 20 and uses air as theworking fluid. The state of air at the beginning of the compression process is 95kPa and20°C. If the maximum temperature in the cycle is not to exceed 2200K, Determine:i) Thermal efficiency; ii) Mean effective pressure; iii) Net work output per unit mass of air;iv) Specific air consumption in kg/s and Take density air = 1.225 kg/m3.	5	CO1	L2
23	A gas turbine plant works between the temperature limits of 300K and 1000K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect intercooling in between. Calculate the net power of the plant, Cp = 1 kJ / kg.per kg of air circulation ; $y = 1.4$ for air.	5	CO2	L3
24	In a regenerative gas turbine cycle air enters the compressor at 1 bar, 15°C, pressure ratio 6.The isentropic efficiencies of compressor and turbine are 0.8 and 0.85 respectively. The maximum temperature in the cycle is 800°C. The regenerator efficiency is 0.78. Assume Cp = 1.1 KJ/kgK, y = 1.32 for the combustion products find the cycle efficiency.		CO2	L3
25	Define air standard cycles.	5	CO1	L3
26	Draw p-v and T -s diagrams for Carnot, otto and diesel	5	CO1	L2
27	Derive an expression of efficiency for carnot cycle	5	CO2	L3
28	Derive an expression of efficiency for Otto cycle		CO2	L2
29	Derive an expression of efficiency for Diesel cycle	5	CO1	L3
30	Derive an expression for mean effective pressure for Diesel cycle	5	CO1	L2
31	The stroke and cylinder diameters of a compression ignition engine are 250 mm and150 mm respectively. If the clearance volume is 0.0004 m3 and fuel injection takes place at constant pressure for 5 percent of the stroke determine the efficiency of the engine. Assume the engine working on the diesel cycle.	5	CO2	L3
32	Derive an expression for optimum pressure ratio which gives maximum specific work output in gas turbine considering machine efficiency.		CO2	L4
33	Explain the working of a ramjet engine with the help of a sketch. What are its advantages, disadvantages and applications?	5	CO1	L3
34	In ideal diesel cycle running at 2000rpm, has a compression ratio of 20 and uses air as theworking fluid. The state of air at the beginning of the compression process is 95kPa and20°C. If the maximum temperature in the cycle is not to exceed 2200K, Determine:i) Thermal efficiency; ii) Mean effective pressure; iii)	5	CO1	L2

	COURSE PLAN - ACADEMY 2019-20			
	Net work output per unit mass of air;iv) Specific air consumption in kg/s and Take density air = 1 225 kg/m3			
35	A gas turbine plant works between the temperature limits of 300K and 1000K and a pressure of 1 bar and 16 bar. The compression is carried out in two stages with perfect intercooling in between. Calculate the net power of the plant, Cp = 1 kJ / kg.per kg of air circulation ; y = 1.4 for air.	5	CO2	L3
36	In a regenerative gas turbine cycle air enters the compressor at 1 bar, 15°C, pressure ratio 6.The isentropic efficiencies of compressor and turbine are 0.8 and 0.85 respectively. The maximumtemperature in the cycle is 800°C. The regenerator efficiency is 0.78. Assume Cp = 1.1 KJ/kgK, y = 1.32 for the combustion products find the cycle efficiency.		CO2	L3
37	Define air standard cycles.	5	CO1	L3
38	Draw p-v and T -s diagrams for Carnot, otto and diesel	5	CO1	L2
39	Derive an expression of efficiency for carnot cycle	5	CO2	L3
40	Derive an expression of efficiency for Otto cycle		CO2	

D2. TEACHING PLAN - 2

Module – 3

Title:	Vapour Power Cycles:	Appr	10 Hrs
		Time:	
а	Course Outcomes	-	Blooms Level
1	Evaluate the performance of steam turbine components.	CO5	L3
2	Student should Understand the working principle of practical regenerative	CO6	L3
	Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle.		
	, Binary Vapour cycles.		
b	Course Schedule		
Class No	Module Content Covered		Level
1	Vapour Power Cycles: Carnot vapour power cycle,	CO5	L3
2	Drawbacks as a reference cycleSimple Rankine cycle,T-sdiagram, analysis	CO5	L3
	for performance.		
3	Comparison of Carnot and Rankine cycles. Effects of pressure and	CO5	L3
	temperature on Rankine cycle performance.		
4	Actual vapour power cycles.	CO5	L3
5	problems	CO5	L3
6	open and closed feed water heaters.	CO6	L3
7	Ideal and practical regenerative Rankine cycles,	CO6	L3
8	Reheat Rankine cycle. Characteristics of an Ideal working fluid in Vapour	CO6	L3
0	Binary Vanour cycles	006	13
10	Drialy vapour cycles.	000	13
		000	LJ
c	Application Areas	со	Level
1	Power generation in steam power plant	CO5	L3

<u>^</u>	Bewer concertion in stoom never plant	000	1.0
2	Power generation in steam power plant	006	L3
d	Review Questions	-	-
1	Explain the Carnot vapour power cycle,	CO5	L3
2	Explain the Simple Rankine cycle, T-sdiagram, analysis for performance.	CO6	L3
	Explain the drawbacks also Effects of pressure and temperature on Rankine		
	cycle performance.		
3	Explain the Comparison of Carnot and Rankine cycles.	CO5	L3
4	Explain the Actual vapour power cycles.	CO6	L3
5	Explain the Ideal regenerative Rankine cycles,	CO5	L3
	Explain the practical regenerative Rankine cycles,		
6	What is Reheat Rankine cycle explain	CO6	L3
7	What is Binary Vapour cycles.	CO5	L3
8	What are the Characteristics of an Ideal working fluid in Vapour power	CO6	L3
	cycles,		
9	Sketch the flow diagram and the corresponding temperature-entropy	CO5	L3
	diagram of a reheat vapour cycle and derive an expression for the		
	reheat cycle efficiency. What are theadvantages gained by reheating		
	the steam between stages		
10	steam power plant incorporates an ideal reheat cycle to improve the	CO6	L3
	existing efficiency.Steam at 30 bar and 250 °C is supplied at high		
	pressure turbine inlet and expands till it is dry saturated at 3 bar. Now		
	the steam is taken to a reheater and its temperature is again increased		
	to 250°C by constant pressure reheating process. The reheated steam		
	expands in the low pressure turbine to a condenser pressure of 0.04		
	bar. Determine the cycle efficiency.		
11	40MW steam power plant working on Rankine cycle operates between		
	boiler pressure of 4MPa and condenser pressure of 10KPa. The steam		
	leaves the boiler and enters the turbine at 400°C. the isentropic efficiency		
	of the steam turbine is 85% determine: i) The cycle efficiency ii) The		
	quality of exhaust steam from turbine iii) Steam flow rate in kg/hr.		
	consider pump work.		

Module – 4

Title:	Refrigeration Cycles & Pscychrometrics and Air-conditioning Systems:	Appr	10 Hrs
		Time:	
а	Course Outcomes	-	Blooms
-		-	Level
1	Understand the principles and applications of refrigeration systems.	C07	L2
2	performance improvement of air-conditioning processes using the principles of psychrometry. Evaluate cooling and heating loads in an air-conditioning system.	CO8	L3
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Refrigeration Cycles:Vapour compression refrigeration system;	CO7	
2	analysis,refrigerating effect. Capacity, power required, units of refrigeration, COP	C07	

	COURSE PLAN - ACADEMY 2019-20		
3	Refrigerantsand their desirable properties, alternate Refrigerants. Any one case study on cold storage or industrial refrigerator. Air cycle refrigeration;	CO7	
4	Reversed Carnot cycle, reversed Brayton cycle, Vapour absorption refrigeration system. Steam jet refrigeration.	CO8	
5	Problems.	CO8	
6	Pscychrometrics and Air-conditioning Systems: Properties of Atmospheric air.	CO8	
7	Psychometric properties of Air, Psychometric Chart, Analyzing Air- conditioning Processes:	CO8	
8	Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling	CO8	
9	Adiabatic mixing of two moist air streams. Cooling towers.	CO8	
10	Problems.	CO8	
C	Application Areas	СО	Level
1	Applications In Domestic , commercial and marine Refrigeration system.	CO7	L3
2	Application in heating, ventilating, and cooling	CO8	L3
d	Review Questions	-	-
1	With Neat sketch Explain the Vapour compression refrigeration system;	CO7	L1
2	What is refrigerating effect. Capacity, power required, units of refrigeration, COP	C07	L3
3	What are their desirable properties Refrigerant explain,	CO8	L2
4	Draw the P-V and T-S diagram for reversed Brayton cycle,	CO7	L4
5	Derive COP for reversed Brayton cycle,		
6	With neat explain Steam jet refrigeration.	CO8	L2
7	A refrigeration system of 10.5 Tonnes capacity at a evaporator	CO8	L3
	in a food storage locker. The refrigerant Ammoniais sub cooled by		
	6°C before entering the expansion value. The vanour is 0.05 dry as it		
	leavesthe evanorator coil. The compression in the compressor is of		
	adiabatic type Using P-H chart find i) Condition of vanour at the		
	outlet of the compressor ii) Condition of vapour atentrance to		
	evaporator iii) COP iv) Power required in kW Neglecting valve		
	Throttling and clearance effect		
8	Define the following: i) DBT ii) Specific humidity iii) Relative humidity	CO8	L5
9	Show the following processes on Psychrometric chart.	CO8	L2
	i) Sensible heating and cooling		
	ii) Cooling and dehumidification		
	iii) Adiabatic mixing of two streams		
	iv) Heating and humidification.		
10	With a neat sketch, briefly describe a summer air conditioning system.	CO8	L3
11	Adiabatic mixing of two moist air streams. Cooling towers.	CO8	L3
12	It is required to design an air conditioning plant for a small office room for following winterconditions: Outdoor conditions: 14°C DBT	CO8	L3
	Amount of air circulation = $0.30 \text{ m}^3/\text{min/nerson}$ Seating capacity of		
	office = 60 . The required condition is achieved first by heating and		
	then by adiabatic humidifying. Determine the following:		
L			

i r ł	i)Heatcapacity of the coil in kW and the surface temperature required if the by-pass factor of coil is 0.4 ii) The capacity of the humidifier using psychrometric chart.	

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs		18ME42	Sem: IV	3	Marks:	30	Time:	75	minute	S	
Code	e:										
Cour	se:	APPLIED T	HERMODYN	IAMICS							
		Note: Answ	er any 2 full o	questions.					Marks	CO	Level
1	а	Explain the	practical reg	enerative Ra	ankine cycles	6			7	CO7	L2
	b	steam pow	er plant inc	corporates a	an ideal rel	neat cycle to	o improve	the	8	CO7	L3
		existing ef	ficiency.Ste	eam at 30	bar and 25	0 °C is su	pplied at hi	igh			
		pressure tu	rbine inlet a	and expand	s till it is di	y saturated	at 3 bar. N	ow			
		the steam i	s taken to a	reheater an	id its tempe	rature is aga	ain increase	d			
		to 250°C b	y constant p	pressure reh	leating proc	ess. The ref	neated steam	n			
		expands in	the low pre	ssure turbi	ne to a conc	lenser press	ure of 0.04				
		bar. Detern	nine the cyc	ele efficienc	с <u>у</u> .						
					OR .				7	007	10
2	a ⊾	What is Reheat Rankine cycle explain					/	007	L3		
	D	401vi w stea	an power p	ant workin	lg on Kanki denser press	ure of 10K	Do The ste	am	ð	007	L3
		leaves the h	oiler and en	ters the turk	hine at 400°	C the isentr	onic efficier	ann			
		of the stear	m turbine is	85% deter	mine: i) Th	e cvcle effi	ciency ii) 7	The			
		quality of	exhaust ste	am from tu	urbine iii) S	Steam flow	rate in kg/	hr.			
		consider pu	mp work.		,		U				
3	а	Derive COF	P for reverse	d Brayton c	ycle,				7	CO8	L3
	d	A refriger	ation syste	m of 10.5	Tonnes of	capacity at	a evapora	tor	8	CO8	L3
		temperatur	e of -12°C	and aconde	enser tempe	erature of 2	7°C is need	led			
		in a food	storage loci	ker. The re	efrigerant A	mmoniais s	sub cooled	by			
		6°C before	e entering th	e expansio	n valve. Th	e vapour is	0.95 dry a	s it			
		leavesthe e	evaporator	coil. The c	ompression	in the cor	npressor is	of			
		adiabatic t	ype. Using	P-H chart	find i) Co	ondition of	vapour at	the			
		outlet of	the compr	essor 11) (Condition (of vapour	atentrance	to			
		Throttling	III) COP	IV) Power	required	in KW Neg	glecting va	ive			
		Throuning		ce effect							
4	2	Show the f	allowing pr	ocesses on	Psychrome	tric chart			7	CO8	13
-	a	i) Sensible	heating and	l cooling	1 Sychionic	une enant.			'	000	
		ii) Cooling	and dehum	idification							
		iii) Adiaba	tic mixing of	of two strea	ms						
		iv) Heating	g and humid	ification.							
	b	With a nea	t sketch, bri	efly descril	be a summe	r air conditi	oning syste	m.	8	CO8	L3
		Explain Adi	abatic mixing	g of two mois	st air stream	s. Cooling to	wers.				

b. Assignment – 2

Note: A distinc	t assignment t	to be assigned	to each student.

			Model Assignment Questions			
Crs C	ode:	18ME42	Sem: IV 3 Marks: 5 / 10 Time: 9	0 – 120	minutes	;
Cours	se:	APPLIEI	D THERMODYNAMICS			
Note:	Each	student t	o answer 2-3 assignments. Each assignment carries equal mark.			
SNo	, I	USN	Assignment Description	Marks	СО	Level
1			Explain the Carnot vapour power cycle,	5	CO5	L3
2			Explain the Simple Rankine cycle,T-sdiagram, analysis for	5	CO5	L3
			performance.			
3			Explain the drawbacks also Effects of pressure and temperature	5	CO5	L3
	on Rankine cycle performance.					
4			Explain the Comparison of Carnot and Rankine cycles.	5	CO5	L3
5			Explain the Actual vapour power cycles.	5	CO6	L3
6			Explain the Ideal regenerative Rankine cycles,	5	CO6	L3
7			Explain the practical regenerative Rankine cycles,	5	CO5	L3
8			What is Reheat Rankine cycle explain	5	CO6	L3
9			What is Binary Vapour cycles.	5	CO5	L3
10			What are the Characteristics of an Ideal working fluid in Vapour power cycles.	5	CO6	L3
11			Sketch the flow diagram and the corresponding	5	C07	L3
			temperature-entropy diagram of a reheat vapour cycle and	ĺ		
			derive an expression for the reheat cycle efficiency. What			
			are theadvantages gained by reheating the steam betweer	L		
			stages			
12			steam power plant incorporates an ideal reheat cycle to	5	CO7	L3
			improve the existing efficiency. Steam at 30 bar and 250 °C	2		
			is supplied at high pressure turbine inlet and expands till it			
			is dry saturated at 3 bar. Now the steam is taken to a	L		
			reheater and its temperature is again increased			
			to 250°C by constant pressure reheating process. The			
			reheated steam expands in the low pressure turbine to a			
			condenser pressure of 0.04 bar. Determine the cycle			
			efficiency.			
13			40MW steam power plant working on Rankine cycle operates	5	CO8	L3
			between boiler pressure of 4MPa and condenser pressure of			
			10KPa. The steam leaves the boiler and enters the turbine at	-		
			400°C. the isentropic efficiency of the steam turbine is 85%			
			determine: 1) The cycle efficiency 11) The quality of exhaust	·		
			steam from turbine iii) Steam flow rate in kg/hr. consider			
			pump work.		007	1.0
14			with real sketch Explain the vapour compression remgeration	5	007	LJ
15			What is refrigerating effect. Capacity power required units of	5	00	12
			refrigeration COP		000	LL
16			What are their desirable properties Refrigerant explain	5	CO8	L5
17			Draw the P-V and T-S diagram for reversed Bravton cycle	5	CO8	 L2
18			Derive COP for reversed Brayton cvcle.		CO8	 L3
19			With neat explain Steam iet refrigeration.	5	CO8	L3
20			A refrigeration system of 10.5 Tonnes capacity at a	5	CO8	L3

	evaporator temperature of -12°C and acondenser			
	temperature of 27°C is needed in a food storage locker. The			
	refrigerant Ammoniais sub cooled by 6°C before entering			
	the expansion valve. The vapour is 0.95 dry as it leaves the			
	evaporator coil. The compression in the compressor is of			
	adiabatic type. Using P-H chart find i) Condition of vapour			
	at the outlet of the compressor ii) Condition of vapour			
	atentrance to evaporator iii) COP iv) Power required in kW			
	Neglecting valve Throttling and clearance effect			
21	Define the following: i) DBT ii) Specific humidity iii)	5	CO5	L3
	Relative humidity			
22	Show the following processes on Psychrometric chart.	5	CO6	L3
	i) Sensible heating and cooling			
	ii) Cooling and dehumidification			
	iii) Adiabatic mixing of two streams			
	iv) Heating and humidification			
23	With a neat sketch briefly describe a summer air	5	CO5	L3
	conditioning system	-		
24	Adiabatic mixing of two moist air streams. Cooling towers.	5	CO6	L3
25	It is required to design an air conditioning plant for a small	5	CO5	L3
	office room for following winterconditions: Outdoor			-
	conditions: 14°C DBT and 10°C WBT Required			
	conditions = 20° CDBT and 60° RH Amount of air			
	circulation = $0.30 \text{ m}^3/\text{min/nerson}$ Seating capacity of			
	office = 60 The required condition is achieved first by			
	heating and then by adiabatic humidifying Determine the			
	following: i)Heatcanacity of the coil in kW and the surface			
	temperature			
	required if the by page factor of apil is 0.4 ii) The conscitute			
	of the humidifier using nevel promotion chart			
26	What is Binary Vanaur avalas		C06	12
20	What is billiary vapour cycles.	F	C06	LO
21		5	005	LS
20	Stratch the flow diagram and the corresponding	5	C06	12
20	Sketch the flow diagram and the corresponding	5	000	LS
	derive on evenession for the releast evels officiency. What			
	derive an expression for the reneat cycle efficiency. What			
	are theadvantages gained by reneating the steam between			
	stages		005	
29	steam power plant incorporates an ideal reneat cycle to	5	005	L3
	improve the existing efficiency. Steam at 30 bar and 250 °C			
	is supplied at high pressure turbine inlet and expands till it			
	is dry saturated at 3 bar. Now the steam is taken to a			
	reheater and its temperature is again increased			
	to 250°C by constant pressure reheating process. The			
	reheated steam expands in the low pressure turbine to a			
	condenser pressure of 0.04 bar. Determine the cycle			
	efficiency.			
30	40MW steam power plant working on Rankine cycle operates	5	CO5	L3
	between boiler pressure of 4MPa and condenser pressure of			
	10KPa. The steam leaves the boiler and enters the turbine at			

	COURSE PLAN - ACADEMY 2019-20			
	400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work.			
31	With Neat sketch Explain the Vapour compression refrigeration system;	5	CO6	L3
32	Explain the Carnot vapour power cycle,	5	CO5	L3
33	Explain the Simple Rankine cycle,T-sdiagram, analysis for performance.		CO6	L3
34	Explain the drawbacks also Effects of pressure and temperature on Rankine cycle performance.	5	CO5	L3
35	Explain the Comparison of Carnot and Rankine cycles.		CO6	L3
36	Explain the Actual vapour power cycles.	5	CO5	L3
37	Explain the Ideal regenerative Rankine cycles,	5	CO6	L3
38	Define the following: i) DBT ii) Specific humidity iii) Relative humidity	5	CO5	L3
39	 Show the following processes on Psychrometric chart. i) Sensible heating and cooling ii) Cooling and dehumidification iii) Adiabatic mixing of two streams iv) Heating and humidification. 	5	CO6	L3
40	With a neat sketch, briefly describe a summer air conditioning system.	5	CO5	L3

D3. TEACHING PLAN - 3

Module – 5

Title:	Reciprocating Compressors & Steam nozzles	Appr	16 Hrs
		Time:	
а	Course Outcomes	-	Blooms
-		-	Level
1	Should able to find Volumetric efficiency, minimum work and Optimum	CO9	L3
	intermediate pressure for reciprocating compressor.		
2	Should able to understand Critical pressure ratio, Supersaturated flow for	CO10	L3
	flow of steam through nozzle.		
b	Course Schedule		
Class No	Module Content Covered	CO	Level
1	Reciprocating Compressors: Operation of a single stage reciprocating	CO9	L3
	compressors.		
2	Work input through p-v diagram and steady state steady flow analysis. Effect	CO9	L3
	of Clearance and Volumetric efficiency.		
3	Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor,	CO9	L3
	saving in work, Optimum intermediate pressure,		
4	Inter-cooling, Minimum work for compRession.	CO9	L3
5	Problems.	CO9	L3
6	Steam nozzles: Flow of steam through nozzles,	CO10	L3
7	Shape of nozzles, Supersaturated flow	CO10	L3

8	effect of friction	CO10	L3
9	Critical pressure ratio	CO10	
10	Problems.	CO10	
C	Application Areas	СО	Level
1	In industry, including natural gas processing and delivery, chemical plants, and oil refineries.	CO9	L3
2	In Steam turbine plants.	CO10	L3
d	Review Questions	-	-
1	Derive expression for workdone of a single stage reciprocating compressors.	CO9	L3
2	Derive an expression for volumetric efficiency of a single stage reciprocating air compressor in terms of clearance factor (K), pressure ratio (P2/P1) and index of compression (n).	CO9	L3
3	Explain the Adiabatic, Isothermal and Mechanical efficiencies.	CO9	L3
4	Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages.	CO9	L3
5	Derive expression for the intermediate pressure which gives minimum power in a two stage compressor with perfect inter cooling.	CO9	L3
6	What are the different methods to increase isothermal efficiency of air compressor		
7	What are the advantages of multi-stage compression?	CO9	L3
0	A two stage single-acting recipiocating compressor takes in all at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at 600 rpm. Neglectingclearance determine i) The intermediate pressure ii) The total volume of each cylinder iii) Power required to drive the compressor and iv) The rate of heat rejection in the intercooler take Cp = 1.005 kJ/kgK and R = 0.287 kJ/kgK .	09	L3
9	single cylinder, double acting air compressor is required to deliver 100m3/min of air at amean piston speed of 500m/min measured at lbar and 15°C. The air is delivered at 7 bar. Assume a clearance volume of swept volume per stroke. Find volumetric efficiency15speed, bore, stroke for the following two cases.i) If ambient and suction conditions are same ii) If ambient and suction conditions are different.Assume,Ambient pressure = 1.0bar,Ambient temperature = 15° C, Suction pressure = 0.98 bar. Suction temperature = 30° C L/D=1.25	CO9	L3
10	A single acting, two-stage air-compressor delivers air at 17 bar when the pressure andtemperature of air at the end of suction are 1 bar and 303 k. The interstage pressure is 4 barand there is perfect intercooling. If LP cylinder diameter is 23 cm and common stroke is15 cm and speed of the compressor is 350 rpm. Determine:i) Volumetric efficiency of LP stage compressor. ii) Heat transfer in the inert cooler in kJ/min and iii) Capacity of the motor required to drive the compressor if the mechanical efficiency is 85% . Assume the clearance volume of LP compressor = 5% of stroke volume. The compression and expansion in both cylinders follow the law PV' 25 = constant.	CO9	L3

10	Explain the Supersaturated flow	CO10	L3
11	What is the effect of friction	CO10	L3
12	Derive an expression for Critical pressure ratio	CO10	L3

E3. CIA EXAM – 3

a. Model Question Paper - 3

Crs		18ME42	Sem: IV	3	Marks:	Varks: 30 Time: 75 minutes		S			
Code	e:										
Cour	se:	APPLIED T	HERMODYN	IAMICS							
-	-	Note: Answ	er any 2 full	questions.					Marks	CO	Level
1	а	Derive an compressor	expression the with perfect	for minimum inter cooling	m work rec g between st	quired by a ages.	two stage	air	7	CO9	L3
	b	A two stag rate of 0.2 MPa and 1 The interm compression 600 rpm. N ii) The tota iii) The tota iii) Power rejection in kJ/kgK.	ge single-act m3/s. The 6°C. The a lediate press on index in Neglectingc I volume of required to n the interc	ting recipro intake pre ir is compr sure is ideal both stages learance de each cylin drive the ooler take	becating com ssure and t ressed to a and inter c s is 1.25 ar termine i) ' der compressor Cp = 1.00	pressor take emperature finalpressur ooling is pe id the comp The interme and iv) Th 5 kJ/kgK at	es in air at of air are of air are of 0.7 M rfect. The pressor runs ediate pressor runs ediate pressor and $R = 0.2$	the 0.1 Pa. at ure eat 287	8	CO9	L3
					000	1.2					
2		UR Derive on expression for volumetric officiency of a single store							7	<u> </u>	L3
	а	reciprocatin $(P2/P1)$ and	g air compre	ssor in terms	s of clearance).	e factor (K),	pressure rati	o.	7	09	L3
	b	single cyli 100m3/mir Ibar and 1 volume c efficiency1 ambient ar conditions temperatur = 30°C L/I	nder, double n of air at $.5^{\circ}$ C. The approximate for the sweet sweet between the second suction of are different to the e = 15° C, Sp=1.25	le acting at amean pist air is deliv ept volun ore, stroke conditions nt.Assume, suction pres	ir compress on speed of rered at 7 ne per st for the for are same in Ambient pr ssure = 0.98	sor is required of 500m/min bar. Assum troke. Find ollowing tw i) If ambier ressure = 1. 3 bar. Suction	red to delive n measured e a clearar d volumet vo cases.i) nt and suction obar,Ambion	ver at nce ric If ion ent ure	8	CO9	L3
					OR						
3	а	Derive expr	ession for wo	orkdone of a	single stage	reciprocating	g compresso	ors.	7	CO10	L3
	b	A single ac pressure and interstage p diameter is is 350 rpm. ii) Heat tran required to a 85%.Assum volume. Th PV' 25 = con	eting, two-sta dtemperature oressure is 4 23 cm and c Determine:i) nsfer in the i drive the com- ne the cleara- te compression nstant.	age air-comp of air at the barand there ommon stro Volumetric nert cooler in pressor if the ance volum on and expa	e end of suct e is perfect ke is15 cm a efficiency of n kJ/min an ne mechanica e of LP co ansion in bo	vers air at 17 ion are 1 bar intercooling. and speed of of LP stage co d iii) Capaci al efficiency = ompressor = th cylinders	7 bar when and 303 k. T If LP cylind the compress ompressor. ty of the mo is 5% of stro follow the 1	the The der sor otor oke aw	8	CO10	L3

	COURSE PLAN - ACADEMY 2019-20							
4	а	Explain the Supersaturated flow and What is the effect of friction	7	CO10	L3			
	b	Derive an expression for Critical pressure ratio	8	CO10	L3			

b. Assignment – 3

Note: A distinct assignment to be assigned to each student.

			Model	Assignment	Questions				
Crs Coc	de: 17ME43	8 Sem: IV	3	Marks:	5 / 10	Time:	90 – 120	minutes	;
Course:	: APPLIEI	D THERMOD	YNAMICS						
Note: Ea	ach student	to answer 2-3	assignments	s. Each assig	nment carr	ies equal marl	K .		
SNo	USN		Assig	nment Desci	ription		Marks	CO	Leve
1		Derive expre	ession for wo	orkdone of a	single sta	ge reciprocatir	ng 5	CO9	L3
		compressors	S.		ffi ai an arr	f a simela sta		000	1.0
2		Derive an ex	air compre	ssor in term	s of clears	on a single stag	se 5	C09	L3
		pressure ratio					-),		
		(P2/P1) and	index of com	pression (n).					
3	3 Explain the Adiabatic, Isothermal and Mechanical efficiencies.							CO9	L3
4		Derive an ex	pression for	minimum wo	ork require	d by a two stag	ge 5	CO9	L3
	air compressor with perfect inter cooling between stages.								
5		Derive ex	pression fo	or the inter	mediate p	pressure which	ch 5	CO10	L3
		gives mini	mum powe	r in a two	stage co	mpressor wi	th		
		perfect inte	r cooling.		•	• •	1 -		
6		What are	the differen	nt methods	to increa	ase isotherm	al 5	CO10	L3
		efficiency c	of air compre	essor	,	· 0		0040	
/		What are th	e advantage	s of multi-s	tage comp	pression?	5	CO10	L3
8		A two stage	e single-acti	ng reciproca	ting comp	bressor takes	in 5	CO10	L3
		air at the	rate of 0.	2 m3/s. II	ne intake	pressure an			
		comprosed	to a final nr	e U.I MPa	and to 7 MD_{2} The second sec	C. The all	1S to		
		pressure is	i w a maipi	er cooling i	/ IVIF a. 11 s perfect '	The			
		compressio	n index i	n hoth st	ages is	1.25 and the	ne		
		compressor	runs at	600 rpr	n Negle	ectingclearan	ce		
		determine i) The intern	nediate pres	sure ii) Th	ne total volun	ne		
		of each cyli	nder	1	,				
		iii) Power r	equired to d	rive the con	npressor a	nd iv) The ra	te		
		of heat reje	ction in the	intercooler	take Cp =	= 1.005 kJ/kg	K		
		and $R = 0.2$	87 kJ/kgK.						
9		single cylin	der, double	acting air c	ompresso	r is required	to 5	CO10	
		deliver 10	0m3/min_o	f air at a	mean pis	ston speed	of		
		500m/min	measured at	lbar and 1:	5°C. The	air is delivere	ed		
		at / bar. As	sume a clea	rance volur	ne of sw	ept volume p	er		
		stroke. Find	1 volumetric	efficiency	Sspeed, t	ore, stroke f	or		
		the following	ig two cases	s.1) II amble	nt and suc	tion condition	15		
		different A	II) II amu	ont pross	suction $($	Obar Ambia	re		
		temperature	$s = 15^{\circ}C$ S	uction press	u c = 0	8 bar Suctio	n		
		temperature	$h = 30^{\circ}C$	uction press	Jule = 0.9		,11		
		L/D=1.25							
10		A single act	ing, two-stag	e air-compre	essor delive	ers air at 17 b	ar 5	CO9	L3
		when the pre	essure andten	perature of a	air at the er	nd of suction a	re		

	COURSE PLAN - ACADEMY 2019-20			
	1 bar and 303 k. The interstage pressure is 4 barand there is perfect intercooling. If LP cylinder diameter is 23 cm and common stroke is15 cm and speed of the compressor is 350 rpm.			
	Determine.) Volumetric efficiency of LP stage compressor.			
	the motor required to drive the compressor if the mechanical			
	efficiency is			
	85% Assume the clearance volume of LP compressor = 5% of			
	stroke volume. The compression and expansion in both cylinders			
	follow the law $PV' 25 = constant.$			
11	Explain the Supersaturated flow	5	CO10	L3
12	What is the effect of friction	5	CO10	L3
13	Derive an expression for Critical pressure ratio	5	CO10	L3
14	Derive an expression for minimum work required by a two stage	5	CO9	L3
	air compressor with perfect inter cooling between stages.			
15	Derive expression for the intermediate pressure which	5	CO9	L3
	gives minimum power in a two stage compressor with			
	perfect inter cooling.			
16	What are the different methods to increase isothermal	5		L3
	efficiency of air compressor			
17	What are the advantages of multi-stage compression?	5	CO9	L3
18	A two stage single-acting reciprocating compressor takes in	5	CO9	L3
	air at the rate of 0.2 m3/s. The intake pressure and			
	temperature of air are 0.1 MPa and 16°C. The air is			
	compressed to a finalpressure of 0.7 MPa. The intermediate			
	pressure is ideal and inter cooling is perfect. The			
	compression index in both stages is 1.25 and the			
	compressor runs at 600 rpm. Neglectingclearance			
	determine i) The intermediate pressure ii) The total volume			
	of each cylinder			
	111) Power required to drive the compressor and iv) The rate			
	of heat rejection in the intercooler take $Cp = 1.005 \text{ kJ/kgK}$			
	and $R = 0.287 \text{ kJ/kgK}$.			
19	Derive expression for workdone of a single stage reciprocating	5	CO9	L3
	compressors.			
20	Derive an expression for Critical pressure ratio	5	CO10	L3
21	Explain the Supersaturated flow	5	CO10	L3
22	What is the effect of friction	5	CO10	L3
23	Derive an expression for Critical pressure ratio	5	CO10	L3
24	Derive an expression for minimum work required by a two stage	5	CO9	L3
25	Derive supression for the interreadists pressure which		<u> </u>	1.2
25	cives minimum norver in a two stage compressor with	5	COa	LS
	gives minimum power in a two stage compressor with			
26	What are the different methods to increase isothermal	F	<u> </u>	1.2
20	what are the different methods to increase isothermal	Э	CO9	L3
27	What are the advantages of multi-stars are supervised.	E		10
21	A two stage single acting resigned the second stage compression?	5 F	009	LJ
20	A two stage single-acting reciprocating compressor takes in air at the rate of $0.2 \text{ m}^2/2$. The intelled processor and	Э	09	
	temporature of oir are 0.1 MDs and 1600. The size is			
	temperature of air are 0.1 Mira and 10°C. The air is			

	COURSE PLAN - ACADEMY 2019-20			
	compressed to a finalpressure of 0.7 MPa. The intermediate			
	pressure is ideal and inter cooling is perfect. The			
	compression index in both stages is 1.25 and the			
	compressor runs at 600 rpm. Neglectingclearance			
	determine i) The intermediate pressure ii) The total volume			
	of each cylinder			
	iii) Power required to drive the compressor and iv) The rate			
	of heat rejection in the intercooler take $Cp = 1.005 \text{ kJ/kgK}$			
	and $R = 0.287 \text{ kJ/kgK}$.			
29	Derive an expression for minimum work required by a two stage	5	CO9	L3
	air compressor with perfect inter cooling between stages.			
30	Derive expression for the intermediate pressure which	5	CO9	L3
	gives minimum power in a two stage compressor with			
	perfect inter cooling.			
31	What are the different methods to increase isothermal	5		L3
	efficiency of air compressor			
32	What are the advantages of multi-stage compression?	5	CO9	L3
33	A two stage single-acting reciprocating compressor takes in	5	CO9	L3
	air at the rate of 0.2 m3/s. The intake pressure and			
	temperature of air are 0.1 MPa and 16°C. The air is			
	compressed to a finalpressure of 0.7 MPa. The intermediate			
	pressure is ideal and inter cooling is perfect. The			
	compression index in both stages is 1.25 and the			
	compressor runs at 600 rpm. Neglectingclearance			
	determine i) The intermediate pressure ii) The total volume			
	of each cylinder			
	iii) Power required to drive the compressor and iv) The rate			
	of heat rejection in the intercooler take $Cp = 1.005 \text{ kJ/kgK}$			
	and $R = 0.287 \text{ kJ/kgK}$.			
34	Explain the Supersaturated flow		CO10	L3
35	What is the effect of friction		CO10	L3
36	Derive an expression for Critical pressure ratio		CO10	L3
37	Explain the Supersaturated flow		CO10	L3
38	What is the effect of friction		CO10	L3
39	Derive an expression for Critical pressure ratio		CO10	L3
40	Derive expression for workdone of a single stage reciprocating		CO9	L3
	compressors.			

F. EXAM PREPARATION

1. University Model Question Paper

Cou	rse:	APPLIED THERMODYNAMICS Mor					Month /	/lonth / Year		JAN /2019	
Crs Code:		18ME42	Sem:IV		Marks:	100	Time:		180 minutes		
-	Note	Answer all FIVE		Marks	CO	Level					
1	а	Derive an expre	ession of effici	ency for Otto	cycle			8	CO1	L2	
	b	The stroke and	cylinder diam	eters of a cor	mpression ign	ition engine	are 250	12	CO1	L3	
		mm and150 mn	n respectively	If the cleara	nce volume is	0.0004 m3	and fuel				
		injection takes	injection takes place at constant pressure for 5 percent of the stroke								
		determine the efficiency of the engine. Assume the engine working on the									
		diesel cycle.									

		COURSE PLAN - ACADEMY 2019-20			
		OR			
	а	Derive an expression for optimum pressure ratio which gives maximum specific work output in gas turbine considering machine efficiency.	10	CO2	L3
	b	A gas turbine plant works between the temperature limits of 300K and 1000K	10	CO2	L3
		and a pressure of 1 bar and 16 bar. The compression is carried out in two			
		stages with perfect intercooling in between. Calculate the net power of the			
		stages with peneci intercooling in between. Calculate the net power of the plant $C_{\rm D} = 1.4 {\rm km}$ / kg parks of air eigenlation ${\rm km} = 1.4$ for air			
		plant, $Cp = 1 kJ / kg.per kg of all circulation , y = 1.4 for all.$			
2	а	Explain I) Enthalpy of formation.II)Enthalpy of combustion	8	CO3	L2
		ii) Stoichiometric air. iv) Excess air and			
	b	The products of combustion of an unknown hydro carbon Cx1-ly have the	12	CO3	L3
		following composition as measured by an orsat apparatus: CO2 = 8.0%, CO			
		= 0.9%, 02 = 8.8%, N2 = 82.3%. Determine: The composition of the fuel. ii)			
		The air/fuel ratio and			
		iii) The percent excess air used			
	а	Explain briefly Morse test.	8	CO4	
	u	Explain the heat balance sheet	Ŭ		
	h	The following data were obtained on MORSE test of 4 cylinder four stroke SI	12	CO4	12
	U	anging counted to a hydroutic dyname mater operating at constant anead of	12	004	
		engine coupled to a hydraulic dynamo meter operating at constant speed of			
		1500rpm, brake load with second cylinder not firing = 206N, brake load with			
		third cylinder not firing =192N, brake load with fourth cylinder not firing =			
		200N. Brake power in kW is calculated using the equation BP = WN/42,300,			
		where 'W' is brake load in Newton, N-speed of the engine in RPM. Calculate:			
		i) Brake power: ii) Indicated power: iii) Mechanical efficiency			
		i) brake power, ii) indicated power, iii) Mechanical enciency.			
3	а	Explain the practical regenerative Rankine cycles	8	CO5	L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency.	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency.	8 12	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain	8 12 8	CO5 CO5	L3 L3
3	a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between	8 12 8 8 12	CO5 CO5 CO5 CO5 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam	8 12 8 12	CO5 CO5 CO5	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency	8 12 8 12	CO5 CO5 CO5 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The	8 12 8 12	CO5 CO5 CO5 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency. Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr.	8 12 8 12	CO5 CO5 CO5 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency. Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work.	8 12 8 12	CO5 CO5 CO5	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work.	8 12 8 12	CO5 CO5 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work.	8 12 8 12 12 8	CO5 CO5 CO5 CO6 CO6 CO6	L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work.	8 12 8 12 12 8 8 12	CO5 CO5 CO5 CO6 CO6 CO6 CO6	L3 L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work. Derive COP for reversed Brayton cycle, A refrigeration system of 10.5 Tonnes capacity at a evaporator temperature of -12°C and acondenser temperature of 27°C is needed in	8 12 8 12 8 12 8 12	CO5 CO5 CO5 CO6 CO6 CO6 CO6	L3 L3 L3 L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work. Derive COP for reversed Brayton cycle, A refrigeration system of 10.5 Tonnes capacity at a evaporator temperature of -12°C and acondenser temperature of 27°C is needed in a food storage locker. The refrigerant Ammoniais sub cooled by 6°C	8 12 8 12 8 12 8 12	CO5 CO5 CO6 CO6 CO6 CO6	L3 L3 L3 L3 L3 L3
3	a b a b	Explain the practical regenerative Rankine cycles steam power plant incorporates an ideal reheat cycle to improve the existing efficiency.Steam at 30 bar and 250 °C is supplied at high pressure turbine inlet and expands till it is dry saturated at 3 bar. Now the steam is taken to a reheater and its temperature is again increased to 250°C by constant pressure reheating process. The reheated steam expands in the low pressure turbine to a condenser pressure of 0.04 bar. Determine the cycle efficiency. OR What is Reheat Rankine cycle explain 40MW steam power plant working on Rankine cycle operates between boiler pressure of 4MPa and condenser pressure of 10KPa. The steam leaves the boiler and enters the turbine at 400°C. the isentropic efficiency of the steam turbine is 85% determine: i) The cycle efficiency ii) The quality of exhaust steam from turbine iii) Steam flow rate in kg/hr. consider pump work. Derive COP for reversed Brayton cycle, A refrigeration system of 10.5 Tonnes capacity at a evaporator temperature of -12°C and acondenser temperature of 27°C is needed in a food storage locker. The refrigerant Ammoniais sub cooled by 6°C	8 12 8 12 8 12	CO5 CO5 CO6 CO6 CO6 CO7 CO7	L3 L3 L3 L3 L3 L3
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		COURSE PLAN - ACADEMY 2019-20			
		outlet of the compressor ii) Condition of vapour atentrance to			
		evaporator iii) COP iv) Power required in kW Neglecting valve			
		Throttling and clearance effect			
		OR			
	а	Show the following processes on Psychrometric chart.	8	CO8	L3
		i) Sensible heating and cooling			
		ii) Cooling and dehumidification			
		iii) Adiabatic mixing of two streams			
		iv) Heating and humidification.			
	b	The dry and wet bulb temperatures of atmospheric air at 1 atm pressure	12	CO8	L3
		are measured with a sling psychrometer and found to be 25°C and 15°C			
		respectively. Determine i) Specific humidity ii) Relative humidity iii)			
		Enthalpy of air. Use the table to find property values. Do not use			
		psychrometric chart			
		OR			
5	а	OR Derive an expression for minimum work required by a two stage air	8	CO9	L3
5	а	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages.	8	CO9	L3
5	a b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the	8	CO9 CO9	L3 L3
5	a b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1	8	CO9 CO9	L3 L3
5	a b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa.	8 12	CO9 CO9	L3 L3
5	a b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The	8	CO9 CO9	L3 L3
5	a b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at	8	CO9 CO9	L3 L3
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5	b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at 600 rpm. Neglectingclearance determine i) The intermediate pressure ii) The total volume of each cylinder iii) Power required to drive the compressor and iv) The rate of heat rejection in the intercooler take Cp = 1.005 kJ/kgK and R = 0.287	8	CO9 CO9	L3 L3
5	b	OR Derive an expression for minimum work required by a two stage air compressor with perfect inter cooling between stages. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1 MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at 600 rpm. Neglectingclearance determine i) The intermediate pressure ii) The total volume of each cylinder iii) Power required to drive the compressor and iv) The rate of heat rejection in the intercooler take Cp = 1.005 kJ/kgK and R = 0.287 kJ/kgK .	8	CO9 CO9	L3 L3
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2. SEE Important Questions

Cour	se:	APPLIED THE	RMODYNAN	1ICS			Month	/ Year	Jan/2019	
Crs (Code:	18ME42	Sem: IV	3	Marks:	100	Time:	Time:		nutes
	Note	Answer all FIVE	E full questic	ns.			·	-	-	
Mod	Qno.	Important Ques	stion					Marks	CO	Year
ule										
1	1	Derive an expr	e an expression for mep for otto cycle							2014
	2	An air-standar	air-standard diesel cycle has an compression ratio of 14. The pres							2014
		at the beginni	ng ofcomp	erature is	5					
		27°C. The ma	ximum tem	perature of the	hecycle is 2	500°C. Dete	rmine: i)			
		Temperature a	at all salie	ent points; if	i) Thermal	efficiency;i	ii) Mear	ı 🔤		
		effective press	ure.							
2	1	Define						8	CO3	2015
		1) Stoichiomet	ric air							
		ii) Enthalpy of	i) Enthalpy of formation							
		iii) Enthalpy o	f reaction							
		iv) Adiabatic f	lame tempe	rature						

	2	The following data were obtained on MORSE test of 4-cylinder four stroke SI enginecoupled to a hydraulic dynamometer operating at constant speed of 1500rpm, brake loadwith all four cylinders firing = 296N, brake load with first cylinder not firing = 201 N. brakeload with second cylinder not firing = 206N, brake load with third cylinder not firing =192N, brake load with fourth cylinder not firing = 200N. Brake power in kW is calculatedusing the equation BP = WN/42,300, where 'W' is brake load in Newton, N-speed of theengine in RPM. Calculate: i) Brake power; ii) Indicated power; iii) Mechanical efficiency	8	CO4	2014
3	1	With a superimposed T — S diagram, compare Carnot and Rankine vapour cycles operating between the same boiler and condenser temperatures	8	CO5	2015
	2	In a Rankine cycle, the steam inlet to turbine is saturated at a pressure of 35 bar and theexhaust pressure is 0.2bar. Calculate i) Turbine work ii) Pump work iii) Rankineefficiency iv) Condenser heat flow v) Dryness fraction at the end of expansion. Assume the mass flow rate of steam as 9.5kg/sec	12	CO6	2015
4	1	Derive an Expression for COP for refrigeration system working on Bell Colemann cycle.	8	C07	2014
	2	A refrigeration system of 10.5 Tonnes capacity at a evaporator temperature of -12°C and acondenser temperature of 27°C is needed in a food storage locker. The refrigerant Ammoniais sub cooled by 6°C before entering the expansion valve. The vapour is 0.95 dry as it leavesthe evaporator coil. The compression in the compressor is of adiabatic type. Using P-H chart find i) Condition of vapour at the outlet of the compressor ii) Condition of vapour atentrance to evaporator iii) COP iv) Power required in kW Neglecting valve Throttling and clearance effect	12	CO8	2016
5	2	A single acting, two-stage air-compressor delivers air at 17 bar when the pressure andtemperature of air at the end of suction are 1 bar and 303 k. The interstage pressure is 4 barand there is perfect intercooling. If LP cylinder diameter is 23 cm and common stroke is15 cm and speed of the compressor is 350 rpm. Determine:i) Volumetric efficiency of LP stage compressor. ii) Heat transfer in the inert cooler in kJ/min and iii) Capacity of the motor required to drive the compressor if the mechanical efficiency is 85% . Assume the clearance volume of LP compressor = 5% of stroke volume. The compression and expansion in both cylinders follow the law PV' $25 = \text{constant}$. A two stage single-acting reciprocating compressor takes in air at the rate of 0.2 m3/s. The intake pressure and temperature of air are 0.1	10	CO9 CO10	2012 2016
		MPa and 16°C. The air is compressed to a finalpressure of 0.7 MPa. The intermediate pressure is ideal and inter cooling is perfect. The compression index in both stages is 1.25 and the compressor runs at 600 rpm. Neglectingclearance determine i) The intermediate pressure ii) The total volume of each cylinder iii) Power required to drive the compressor and iv) The rate of heat rejection in the intercooler take Cp = 1.005 kJ/kgK and R = 0.287 kJ/kgK.			