ACHARYA INSTITUTE OF TECHNOLOGY Bangalore - 560090

CBCS Scheme

Third Semester B.E. Degree Examination, Dec.2016/Jan.2017 Engineering Thermodynamics Time: 3 hrs. Max. Marks: 80 Note: 1. Answer FIVE full questions, choosing one full question from each module. 2. Use of TD data handbook permitted. Module-1 1 a. Define the following terms, with respect to thermodynamics: System, Property, State, Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties: ii) Cyclic and non – cyclic processes. c. State and explain Zeroth law of thermodynamics. OR 2 a. Define Work and heat. Write three important similarities between them. (95 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. C. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in by Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. Module-2 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (94 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. 1 lo kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; p ₁ = 26 kg/m ³ ; V ₁ = 110 m/s and u ₁ = 910 kJ/kg, During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) C. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (06 Marks) OR 6 a. Define the following			apa achelle
Time: 3 hrs. Max. Marks: 80 Note: 1. Answer FIVE full questions, choosing one full question from each module. 2. Use of TD data handbook permitted. Module-1 1 a. Define the following terms, with respect to thermodynamics: System, Property, State, Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non - cyclic processes. c. State and explain Zeroth law of thermodynamics. (06 Marks) Define Work and heat. Write three important similarities between them. (05 Marks) Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) C. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in by' Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (08 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; p ₁ = 2.6 kg/m ³ ; V ₁ = 110 m/s and u ₁ = 910 kJ/kg, During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. C. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) OR a. Define the following terms with respect to IC engine: i)	USN		15AU33
Time: 3 hrs. Max. Marks: 80 Note: 1. Answer FIVE full questions, choosing one full question from each module. 2. Use of TD data handbook permitted. Module-1 1 a. Define the following terms, with respect to thermodynamics: System, Property, State, Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non - cyclic processes. c. State and explain Zeroth law of thermodynamics. (06 Marks) Define Work and heat. Write three important similarities between them. (05 Marks) Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) C. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in by' Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (08 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; p ₁ = 2.6 kg/m ³ ; V ₁ = 110 m/s and u ₁ = 910 kJ/kg, During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. C. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) OR a. Define the following terms with respect to IC engine: i)			Third Semester B.E. Degree Examination, Dec.2016/Jan.2017
Note: 1. Answer FIVE full questions, choosing one full question from each module. 2. Use of TD data handbook permitted. Module-1			
2. Use of TD data handbook permitted. Module-1 a. Define the following terms, with respect to thermodynamics: System, Property, State, Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non – cyclic processes. c. State and explain Zeroth law of thermodynamics. (04 Marks) Define Work and heat. Write three important similarities between them. (05 Marks) Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (06 Marks) Module-2 3. a. Write the help of P-V diagram. (06 Marks) Module-2 3. a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) Module-2 3. a. Write the statement of first law of thermodynamics for a system under going i) a cycle iii) a process. (05 Marks) Derive an expression for work done derive the work done when the pressure equation. 1. O kg of fluid per minute goes through a reversible steady flow process, the properties of fluid are: P ₁ = 1.5 bar; ρ ₁ = 26 kg/m³; V ₁ = 110 m/s and u ₁ = 910 kJ/kg and at the exit are: P ₂ = 5.5 bar, ρ ₂ = 5.5 kg/m³, V ₂ = 190 m/s and u ₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4. a. Write two statements of second law of thermodynamics. (04 Marks) Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (06 Marks) Module-3 5. a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. OR 6. a. Define the following terms with respect to IC engine: i) Brake power iii Indicated power iii) Mechanical efficiency of y Specific fuel consumption v) Thermal	Tim	ie:	3 hrs. Max. Marks: 80
 a. Define the following terms, with respect to thermodynamics: System, Property, State, Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non – cyclic processes. c. State and explain Zeroth law of thermodynamics. (04 Marks) OR 2 a. Define Work and heat. Write three important similarities between them. (05 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in the Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) b. Applying first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) c. A diesel engine has a compression ratio of 15 and h			Note: 1. Answer FIVE full questions, choosing one full question from each module. 2. Use of TD data handbook permitted.
 Process, Cycle, Quasi static process. b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non - cyclic processes. c. State and explain Zeroth law of thermodynamics. (04 Marks) (05 Marks) Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in m'. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR (06 Marks) b. Prove that entropy is a property of a system. C. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. C. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of			Module-1
 b. Differentiate: i) Intensive and Extensive properties ii) Cyclic and non – cyclic processes. (04 Marks) (06 Marks) OR 2 a. Define Work and heat. Write three important similarities between them. (05 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) C. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in m'. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) Module 2 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects SSkJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. Or Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. Or Module-3 6 a. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 	1	a.	D.,,
c. State and explain Zeroth law of thermodynamics. OR 2 a. Define Work and heat. Write three important similarities between them. (05 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in in 'V' Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) Module 2 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; ρ ₁ = 26 kg/m³; V ₁ = 110 m/s and u ₁ = 910 kJ/kg and at the exit are: P ₂ = 5.5 bar, ρ ₂ = 5.5 kg/m³, V ₂ = 190 m/s and u ₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. OR OR 6 a. Distinguish between: i) Theoretical air and Actual air iii) Higher heating value and Lower heating value. OR OR 6 a. Define the following terms with respect to IC engine: i) Brake power iii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal		b.	Dicc
2 a. Define Work and heat. Write three important similarities between them. (05 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in in'. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) Module 2 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; p ₁ = 26 kg/m³; V ₁ = 110 m/s and u ₁ = 910 kJ/kg and at the exit are: P ₂ = 5.5 bar, p ₂ = 5.5 kg/m³, V ₂ = 190 m/s and u ₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) OR 4 a. Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks)		C	processes. (04 Marks)
 a. Define Work and heat. Write three important similarities between them. (05 Marks) b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in in'. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; p₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, p₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) b. Prove that entropy is a property of a system. (04 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) 		C.	State and explain Zeroth law of thermodynamics. (06 Marks)
 b. Derive an expression for work done during quasi static process. Explain its significance with the help of P-V diagram. (05 Marks) c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in bar. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 	2	0	D-C W 1 1 11 / W'
the help of P-V diagram. c. The properties of a closed system change following the relation between pressure and volume as P-V = 3.0, where 'P' is in bar and 'V' is in in Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. (06 Marks) Module 2 3 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P1 = 1.5 bar; p1 = 26 kg/m³; V1 = 110 m/s and u1 = 910 kJ/kg and at the exit are: P2 = 5.5 bar, p2 = 5.5 kg/m³, V2 = 190 m/s and u2 = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. OA heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power iii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal	4	Derive an expression for work done during quasi static process. Explain its significance with	
as P-V = 3.0, where 'P' is in bar and 'V' is in m'. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. Module 2 3 a. Write the statement of first law of the modynamics for a system under going i) a cycle ii) a process. b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P ₁ = 1.5 bar; ρ ₁ = 26 kg/m³; V ₁ = 110 m/s and u ₁ = 910 kJ/kg and at the exit are: P ₂ = 5.5 bar, ρ ₂ = 5.5 kg/m³, V ₂ = 190 m/s and u ₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) C. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			the help of P-V diagram. (05 Marks)
Module-2 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. OR 4 a. Write two statements of second law of thermodynamics. C. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal		C.	The properties of a closed system change following the relation between pressure and volume as $P_{-}V = 3.0$, where $P_{-}V$ is in her and $P_{-}V$ is in her and $P_{-}V$.
 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 			
 a. Write the statement of first law of thermodynamics for a system under going i) a cycle ii) a process. (04 Marks) b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) OR 4 a. Write two statements of second law of thermodynamics. (06 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 			
 b. Applying first law of thermodynamics to steady flow process, derive steady flow energy equation. (05 Marks) c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 	3	a.	Write the statement of first law of thermodynamics for a system under going
 c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 		h	(OT MAINS)
 c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid are: P₁ = 1.5 bar; ρ₁ = 26 kg/m³; V₁ = 110 m/s and u₁ = 910 kJ/kg and at the exit are: P₂ = 5.5 bar, ρ₂ = 5.5 kg/m³, V₂ = 190 m/s and u₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. (07 Marks) OR 4 a. Write two statements of second law of thermodynamics. (04 Marks) b. Prove that entropy is a property of a system. (06 Marks) c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 		D.	
fluid are: P ₁ = 1.5 bar; ρ ₁ = 26 kg/m³; V ₁ = 110 m/s and u ₁ = 910 kJ/kg and at the exit are: P ₂ = 5.5 bar, ρ ₂ = 5.5 kg/m³, V ₂ = 190 m/s and u ₂ = 710 kJ/kg. During the process, the fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal		c.	10 kg of fluid per minute goes through a reversible steady flow process. The properties of
fluid rejects 55kJ/s and rises through 55m. Determine i) the change in enthalpy and ii) work done during the process. OR 4 a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			fluid are: $P_1 = 1.5$ bar; $\rho_1 = 26 \text{ kg/m}^3$; $V_1 = 110 \text{ m/s}$ and $u_1 = 910 \text{ kJ/kg}$ and at the exit
OR 4 a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. 6 b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. Copyright of the complex of the engine of			fluid rejects 55 kJ/s and rises through 55 m. Determine i) the change in enthalpy and
A a. Write two statements of second law of thermodynamics. b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			ii) work dans during the angues
b. Prove that entropy is a property of a system. c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			
c. A heat engine receives half of its heat supply at 1000K and half at 500K while rejecting heat to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal	-		D
to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine? (06 Marks) Module-3 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			
Module-3 5 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. 6 b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. 7 c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. 7 c. OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			to a sink at 300K, What is the minimum possible thermal efficiency of this heat engine?
 a. Distinguish between: i) Theoretical air and Actual air ii) Higher heating value and Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 			
Lower heating value. (04 Marks) b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal	5	0	District the second sec
 b. Derive an expression for thermal efficiency of Otto cycle in terms of compression ratio. (07 Marks) (07 Marks) (08 Marks) (05 Marks) (07 Marks) (08 Marks) (09 Marks)	5	a.	
 c. A diesel engine has a compression ratio of 15 and heat addition at constant pressure takes place at 6% of stroke. Find the air standard efficiency of the engine. (05 Marks) 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal 		b.	
place at 6% of stroke. Find the air standard efficiency of the engine. OR a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal		C	(07 Marks) A diesel engine has a compression ratio of 15 and heat addition at constant prosume talks
OR 6 a. Define the following terms with respect to IC engine: i) Brake power ii) Indicated power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			1 4 (0) C 4 1 D' 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
power iii) Mechanical efficiency iv) Specific fuel consumption v) Thermal			
cc ·	6	a.	THE STATE OF THE S
			control of the contro

15AU33

b. Explain Morse test method of determining indicated power and hence the frictional power of IC engine. (05 Marks)

c. A four cylinder, four stroke S.I engine has a compression ratio of 8 and bore of 100 mm, with stroke equal to the bore. The volumetric efficiency of each cylinder is equal to 75%. The engine operates at a speed of 4800 rpm with an air fuel ratio 15. Given that the calorific value of fuel as 42 MJ/kg, atmospheric air density = 1.12 kg/m³, Mean effective pressure = 10 bar and Mechanical efficiency of the engine = 80%, determine the indicated thermal efficiency and the brake power. (06 Marks)

Module-4

7 a. Explain steam jet refrigeration system with a neat sketch. Write its draw backs. (07 Marks)

b. Write the desirable properties of a good refrigerant. (04 Marks)

c. In a standard (dry compression) vapour compression refrigeration cycle, operating between an evaporator temperature of -10^{0} C and a condenser temperature of 40^{0} C, the enthalpy of the refrigerant, Freon -12, at the end of compression is 220 KJ/kg. Represent the cycle on T-S diagram and calculate: i) the COP of the cycle ii) the refrigerating capacity and the compressor power assuming a refrigerant flow rate of 1kg/min. You may use the extract of Freon -12 property table given below: (05 Marks)

t ⁰ C	P (MPa)	h _f (kJ/kg)	h _g (kJ/kg)
-10	0.2191	26.85	183.1
40	0.9607	74.53	203.1

OR

8 a. Distinguish between: i) Specific humidity and Relative humidity ii) Dry bulb and wet bulb temperature iii) Dry air and atmospheric air. (06 Marks)

b. With a neat sketch, describe the working of summer air – conditioning system for hot and dry weather. (05 Marks)

c. The dry and wet bulb temperatures of atmospheric air at 1 atm pressure are measured with a Bling psychrometer and determined to be 25°C and 15°C respectively. Determine using psychrometric chart i) Specific humidity ii) Relative humidity iii) Enthalpy of air.

(05 Marks)

Module-5

- a. Derive the condition for minimum work input to a two stage compressor with perfect inter cooling between stages.
 (05 Marks)
 - b. Explain the necessity of multi stage compression using P-V diagram. (05 Marks)
 - c. A single stage double acting air compressor is required to deliver 14m³ of air per minute measured at 1.013 bar and 15°C. The delivery pressure is 7 bar and the speed is 300 rpm. Take the clearance volume as 5% of swept volume with a compression and reexpansion index n = 1.3. Calculate the swept volume of the cylinder, the delivery temperature and the indicated power. (06 Marks)

OR

- 10 a. Explain Open and Closed cycle gas turbine cycles. (04 Marks)
 - b. Explain Turbo jet with the help of a neat sketch. Write its advantages and disadvantages.

 (06 Marks)
 - c. A gas turbine unit has a pressure ratio of 6:1 and maximum cycle temperature of 610° C. the isentropic efficiency of the compressor and turbine are 0.80 and 0.82 respectively. Calculate the power output in kilowatts when the air enters the compressor at 15° C at the rate of 16 kg/s. Take $C_p = 1.005$ kJ/kg.K and $\gamma = 1.4$ for the compression process and take $C_p = 1.11$ kJ/kg.K and $\gamma = 1.333$ for the expansion process. (06 Marks)