Course Contents

1. Give details of the course, on the following lines:

   a. Course Code ESE-823

   b. Title Thermal Hydraulics

   c. Credit Hours 3

   d. Objectives

   The objective of the Thermal Hydraulics course is to provide an overview of the essential thermal processes related to fluid flow and heat transfer that take place in thermal power plants. The objectives of this course are;

   (1) To enlighten the essential concept of single phase flow

   (2) To describe the phenomenon of two phase flow

   (3) To discuss the single phase heat transfer

   (4) To provide knowledge of two phase heat transfer and study its application in thermal power plants

   (5) To designand analyze the heat exchanger for thermal power plants

   (6) To discuss the thermal loops and applications in thermal power plants

   e. Outcomes

   (1) The students will be familiarized with single and two phase flow

   (2) The course teaches the essentials of two-phase flow systems, including flow regime maps, void-quality, pressure drop, and critical flow

   (3) The students learn the heat transfer in single and two phase

   (4) The course develops the concept of boiling heat transfer, and its implications

   (5) The students will differentiate between different types of heat exchanger and will help them to design heat exchanger for CPP, commercial NPP and STP.

(6) The students will understand the phenomenon behind the production of steam which spin turbine and generate electricity in thermal power plants.

f. Contents with suggested contact hours

No.	Topics	Book	Contact Hours
(1)	**Single Phase Fluid Dynamics** (a) Introduction (b) Flow analysis techniques (c) Flow patterns (d) Differential relations for a fluid particle (e) Inviscid flow (f) Viscous flow (g) Laminar flow inside a channel (h) Turbulent flow inside a channel (i) Pressure loss coefficient at abrupt area changes (j) Dimensional Analysis	TK FM	6
(2)	**Single Phase Heat Transfer** (a) Fundamentals of Heat Transfer (b) Heat Conduction (c) Laminar Heat Transfer (d) Turbulent Heat Transfer (e) Fundamentals of Convection (f) External forced convection (g) Internal forced convection (h) Natural convection (i) Radiation heat transfer	TK YC	6
(3)	**Two Phase Fluid Dynamics**	TK	8

	(a) Introduction (b) Flow patterns and maps (c) Void quality slip relation (d) Two phase flow models (e) Pressure drop relations (f) Critical flow		
(4)	**Two Phase Heat Transfer** (a) Boiling heat transfer (b) Pool boiling (c) Film Boiling (d) Subcooled boiling (e) Saturated boiling (f) Critical Heat Flux (g) Condensation (h) Film Condensation (i) Dropwise condensation	TK YC	8
(5)	**Heat Exchangers** (a) Types of Heat Exchanger (b) Overall Heat Transfer Coefficient (c) Analysis of Heat Exchanger (d) Log mean Temperature difference Method (e) Effectively Design Shell-and-Tube Heat Exchanger		5
(6)	**Thermal Power Systems** (a) Solar thermal Power Plant (b) Nuclear Power Plant (c) Coal Power Plant	TK DB	12
Total			45

g. Details of lab work, workshops practice (if applicable).

No lab is required.

h. Recommended Reading (including Textbooks and Reference books).

S #	Title	Author(s)	Assigned Code	Remarks
(1)	Nuclear System I: Thermal Hydraulic Fundamentals	N.E. Todreas, and M.S.Kazimi	TK	Text Book
(2)	Boiling heat transfer and two-phase flow, 2nd Ed	L. S. Tong, and Y. S. Tong	TT	Reference
(3)	Heat Transfer: A Practical Approach	Yunus A. Cengel	YC	Text Book
(4)	Fluid Mechanics	Frank White	FM	Reference
(5)	Steam Plant Operation, 9th Edition	E. B. Woodruff, H. B. Lammers, and T. F. Lammers	WL	Reference
(6)	Solar Engineering of Thermal Process, 3rd Edition	J. A. Duffie, W. A. Beckman	DB	Reference
(7)	Nuclear Heat Transport, International, 1981	M. M. El-Waqil	EW	Reference