DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING
MECHANICAL ENGINEERING PROGRAM, BSC.

Course Syllabus

1. **Course number and name**
   ME 538 Gas Dynamics

2. **Credits and contact hours**
   (3+0) 3 credit hours, 3 contact hours

3. **Course type**
   Face to face Learning Course (3+0)

4. **Instructor's or course coordinator's name**
   Eng. Dia' A. Afaneh

5. **Textbook information**
   M.A.Saad, COMPRESSIBLE FLUID FLOW, 2nd Ed.,Prentice-Hall..
   ISBN: 978-0131613737

   a. **Other supplemental materials**
      - Gas Dynamics, M.H.Aksel and O.C.Eralp, , Prentice-Hall, 1993.
      - Fundamentals Of Compressible Fluid Dynamics, P. Balachandran PHI Learning Pvt. Ltd., Technology & Engineering, 2006
      - Gas Dynamics, E. Rathakrishnan, PHI Learning Pvt. Ltd., Aug 1, 2004
      - Frank M. White, Fluid Mechanics in SI units, 8th edition. 2016: McGraw-Hill.
      - Instructor's Notes

6. **Specific course information**
   a. **Catalog description**
   Fundamentals of compressible fluid flow (gas dynamics) in relation to effects of area change (nozzles and diffusers), friction and heat interaction (Fanno and Rayleigh lines and isothermal flow), combustion waves (deflagration, explosion and detonation waves), normal and oblique shock waves and their effects on flow properties (extended diffusers and supersonic airfoils). Applications to flow through pipelines, subsonic, sonic and supersonic flights, turbomachinery and combustion.

   b. **Prerequisites or co-requisites**
   Prerequisite: ME 341 Fluid mechanics

c. The course is:
Required in Mechanical Engineering Department.

7. Specific goals for the course

a. Course outcomes:

After completion of the course, students are expected to be able to:

1. Students shall gain clear knowledge about some of the basic mechanisms, thermodynamic analysis and fluid mechanics properties of gases; demonstrate a clear understanding of the use of the properties.
2. Students shall demonstrate the ability to assess the flow characteristics in nozzles and determine geometric configurations of variable area flow passages.
3. Students shall demonstrate the ability to determine flow properties across sanding shock waves in variable area ducts.
4. Students shall be able to perform design analysis of flow systems involving with friction and heat transfer in constant area ducts.
5. Students shall demonstrate ability to construct two-dimensional waves in internal and external diffusers.
6. Students shall demonstrate a basic understanding of the expansion waves in sharp edges of two-dimensional airfoils.

b. The following student outcomes are addressed by the course:

8. Learning Outcomes and their Alignment with Program Educational Objective (PEO's), Methods of Delivery, and Assessment Methods:

Learning Outcomes	Program PEOs	Method of Delivery	Assessment Method
Course Outcomes			
Students shall gain clear knowledge about some of the basic mechanisms, thermodynamic analysis and fluid mechanics properties of gases; demonstrate a clear understanding of the use of the properties.	-	Lectures (Example and Problems)	Question in exam

Students shall demonstrate the ability to assess the flow characteristics in nozzles and determine geometric configurations of variable area flow passages.	-	Lectures (Example and Problems)	Question in exam
Students shall demonstrate the ability to determine flow properties across sanding shock waves in variable area ducts.		Lectures (Example and Problems)	Question in exam
Students shall be able to perform design analysis of flow systems involving with friction and heat transfer in constant area ducts.	-	Lectures (Example and Problems)	Question in exam
Students shall demonstrate ability to construct two-dimensional waves in internal and external diffusers.			
Students shall demonstrate a basic understanding of the expansion waves in sharp edges of two-dimensional airfoils.	-	Lectures (Example and Problems)	Question in exam
Student Outcomes			

9. Weekly Teaching Plan

Week No.	Lecture	Topic	Method of Delivery
1	Sun (9-10)	Introduction to Flow and Thermodynamic Properties	Lecture
	Tue (9-10)	Introduction to Flow and Thermodynamic Properties	Lecture
	Thu (9-10)	Introduction to Flow and Thermodynamic Properties	Lecture
2	Sun (9-10)	Equations of flow and isontropic flow in variable and constant area ducts	Lecture
	Tue (9-10)	Equations of flow and isontropic flow in variable and constant area ducts	Lecture

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	Thu (9-10)	Equations of flow and isontropic flow in variable and constant area ducts	Lecture
3	Sun (9-10)	Subsonic and supersonic flow into convergence and divergent nozzles.	Lecture
	Tue (9-10)	Subsonic and supersonic flow into convergence and divergent nozzles.	Lecture
	Thu (9-10)	Subsonic and supersonic flow into convergence and divergent nozzles.	Lecture
4	Sun (9-10)	Supersonic and subsonic diffusers, and Efficiencies analysis	Lecture
	Tue (9-10)	Supersonic and subsonic diffusers, and Efficiencies analysis	Lecture
	Thu (9-10)	Supersonic and subsonic diffusers, and Efficiencies analysis	Lecture
5	Sun (9-10)	Thermodynamic and Flow analysis of normal shock waves,	Lecture
	Tue (9-10)	Thermodynamic and Flow analysis of normal shock waves,	Lecture
	Thu (9-10)	First Exam	Exam
6	Sun (9-10)	Shock waves in convergent and convergent-divergent nozzles	Lecture
	Tue (9-10)	Shock waves in convergent and convergent-divergent nozzles	Lecture
	Thu (9-10)	Shock waves in convergent and convergent-divergent nozzles	Lecture
7	Sun (9-10)	Shock waves in diffusers,	Lecture
	Tue (9-10)	Shock waves in diffusers,	Lecture
	Thu (9-10)	Shock waves in diffusers,	Lecture
8	Sun (9-10)	Flow with heat interaction: Analysis of Rayleigh Line Flows	Lecture
	Tue (9-10)	Flow with heat interaction: Analysis of Rayleigh Line Flows	Lecture
	Thu (9-10)	Flow with heat interaction: Analysis of Rayleigh Line Flows	Lecture
9	Sun (9-10)	Supersonic and subsonic flows with heat interaction in constant and variable area ducts	Lecture
	Tue (9-10)	Supersonic and subsonic flows with heat interaction in constant and variable area ducts	Lecture

	Thu (9-10)	Supersonic and subsonic flows with heat interaction in constant and variable area ducts	Lecture
10	Sun (9-10)	Two dimensional waves: Analysis of Oblique Shock waves	Lecture
	Tue (9-10)	Two dimensional waves: Analysis of Oblique Shock waves	Lecture
	Thu (9-10)	Two dimensional waves: Analysis of Oblique Shock waves	Lecture
11	Sun (9-10)	Flow passes over two dimensional wedges	Lecture
	Tue (9-10)	Flow passes over two dimensional wedges	Lecture
	Thu (9-10)	Second Exam	Exam
12	Sun (9-10)	Prandtl Meyer Flow over corners	Lecture
	Tue (9-10)	Prandtl Meyer Flow over corners	Lecture
	Thu (9-10)	Prandtl Meyer Flow over corners	Lecture
13	Sun (9-10)	Introduction to Linearized flow	Lecture
	Tue (9-10)	Introduction to Linearized flow	Lecture
	Thu (9-10)	Introduction to Linearized flow	Lecture
14	Sun (9-10)	Flow passes over undulated surface	Lecture
	Tue (9-10)	Flow passes over undulated surface	Lecture
	Thu (9-10)	Flow passes over undulated surface	Lecture
15	Sun (9-10)	Introduction to hyperbolic flows	Lecture
	Tue (9-10)	Introduction to hyperbolic flows	Lecture
	Thu (9-10)	Introduction to hyperbolic flows	Lecture

10. Grade Distribution:

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Assessment	Grade	Date
- First Exam	20%	Fifth Week
- Second Exam	20%	10th Week
- Assignments	10%	
- Final Examination	50%	16th Week

* Make-up exams will be offered for valid reasons. It may be different from regular exams in content and format.