SHRI VENKATESHWARA UNIVERSITY

Syllabus

B.TECH

(Mechanical Engineering)

IV SEMESTER

(Four Years Degree Programme)

Batch 2019-23

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

SEMESTER- IV

Sl.No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	**SME- 401**	Applied Thermodynamics	3	1	0	20	10	30		70		100	4
2	**SME- 402**	Fluid Mechanics & Fluid Machines	3	1	0	20	10	30		70		100	4
3	**SME-403**	Strength of Materials	3	1	0	20	10	30		70		100	4
4	**SME-404**	Materials Engineering	3	0	0	20	10	30		70		100	3
5	**SME-405**	Instrumentation & Control	3	1	0	20	10	30		70		100	4
6	**SNM- 101**	Environmental Science	3	0	0	20	10	30		70			0
	Environmental Science - Noncredit Mandatory courses											**500**	**19**

Course Code	:	**SME-401**
Course Title	:	**Applied Thermodynamics**
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Objectives:

(1) To learn about of I law for reacting systems and heating value of fuels
(2) To learn about gas and vapor cycles and their first law and second law efficiencies
(3) To understand about the properties of dry and wet air and the principles of psychrometry
(4) To learn about gas dynamics of air flow and steam through nozzles
(5) To learn the about reciprocating compressors with and without intercooling
(6) To analyze the performance of steam turbines

Contents:.

Unit-I

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.**(8)**

Unit-II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration,exergy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle,effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.**(12)**

Unit-III

Properties of dry and wet air,use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. **(4)**

Basicsof compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables

Unit-IV

for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle,supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser. **(8)**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. **(5)**

Outcomes:

1. After completing this course, the students will get a good understanding ofvarious practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. They will be able to understand phenomena occurring in high speed compressible flows

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

Course Code	:	**SME-402**
Course Title	:	**Fluid Mechanics &Fluid Machines**
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Objectives:

- To learn about the application of mass and momentum conservation laws for fluid flows
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

Contents :

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.**(9)**

Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram. **(9)**

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis. **(6)**

Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle. **(8)**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines. **(8)**

Course Outcomes:

- Upon completion of this course, students will be able to mathematically analyze simple flow situations
- They will be able to evaluate the performance of pumps and turbines.

Course Code	:	**SME-403**
Course Title	:	**Strength of materials**
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Objectives:

- To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the elastic deformation occurring in various simple geometries for different types of loading

Contents:

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle. **(8)**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.**(8)**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. (**8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Course Outcomes:

• After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

• The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials,

Course Code	:	**SME-404**
Course Title	:	**Materials Engineering**
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Contents:

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. **(6)**

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength. **(6)**

Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT) **(8)**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.**(6)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening **(6)**

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys **(8)**

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Understand how to tailor material properties of ferrous and non-ferrousalloys
3. How to quantify mechanical integrity and failure in materials

Text Books:

1. W. D. Callister, 2006, " Materials Science and Engineering-An Introduction" , 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, " Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, " Engineering Materials and Metallurgy", Pearson, 2011.

Course Code	:	**SME-405**
Course Title	:	**Instrumentation and Control**
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Objectives:

1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

Contents:

Measurement systems and performance – accuracy, range, resolution, error sources; Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric; Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers;
System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

Practical group based project utilizing above concepts.

Course Outcomes:

Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007: New York,1999
Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Course Code	:	**SNM-101**
Course Title	:	**Environmental science**
Number of Credits	:	0 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so